THE NEXUS BETWEEN EDUCATION AND ECONOMIC GROWTH: ANALYSING EMPIRICALLY A CASE OF MIDDLE-INCOME COUNTRIES

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Abstract. The purpose of this paper is to examine empirically the nexus between education accumulation and economic growth for a sample of middle-income countries through panel data regressions. The sample consists of 28 middle-income countries from various continents: North Africa and the Middle East (6 countries), sub-Saharan Africa (7 countries), Latin America and the Caribbean (8 countries), East Asia and the Pacific (3 countries), and Europe and Central Asia (4 countries). Education is measured by quantitative (average years of labour force study) and qualitative indicators (student scores on international assessments of educational achievements). To test the impact of education accumulation on GDP per capita growth, a static panel is used during the period of study from 1970 to 2014. A dynamic panel is also being developed to estimate the effect of the education stock on the growth rate of GDP per capita. The results confirm the positive and significant impact of the education quantity and quality on economic growth, both in level and variation. The stock of education and its increase positively affect the growth. Moreover, this paper's original findings suggest that the quality of education is more significant than its quantity.

Keywords: quality of education, quantity of education, economic growth, static and dynamic panel

JEL Classification: C23, I2, O4

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1. Introduction

The place of the human factor and its collective appropriation in production constitute the core of the contributions of endogenous growth models to the macro-economy. Technical progress is endogenous because it is explained by the agents' saving behaviour. It is, directly or indirectly, introduced by the concept of human capital. The employees' productivity is improved by the higher quality of the work factor. Either because the "intelligence" of men makes it possible to produce more efficient machines, or because in the production system itself, human capital acts directly on the quantity and quality of production.

The precursor models emphasized two modes of human capital accumulation: accumulation outside the production process - the individual distributes his time between training and production (Lucas, 1988), and accumulation inside the production process - the very fact of producing allows knowledge accumulation (Romer, 1986, 1990). Here we find the traditional distinction by Becker (1964) between two components of human capital, in-service training and learning. These endogenous growth models are in line with microeconomic analyses of the human factor.

However, reading these models, considering the analyses carried out in the economics of education, makes it possible to set their theoretical limits, which some recent models have exceeded. These limits relate to the assumptions applied to the mode of individual accumulation of human capital and to the supply of education. For example, in Lucas's model, there is no education offer (Lucas, 1988).

Since the work of Barro (1991) and Mankiw et al. (1992) led to identifying a positive and significant link between education and economic growth, research on the subject has multiplied without leading to a clear consensus on the nature of the education impact on growth or on its channels of transmission.

Many avenues were then explored to find this positive link between education and growth, among which the one initiated by Hanushek & Kimko (2000) proposes to consider the quality of education, not just its quantity. Both authors suggest measuring the quality of education by referring to international assessments of student achievement.

Radieva & Kolomiiets (2019) examine the availability of dependence of the human capital development on institutionalization of the society in the information economy, to figure relationship regression models of the dependence of the human capital development on the level of the country's institutional system development in the information economy. They find out that the highest relationship among the human capital index and the selected indicators of the country's institutional system development exists for the countries with a high-level human capital index and high-level gross national income per capita, government labour costs, and tax burden.

In line with their work, education quality databases have emerged in the case developed by Hanushek & Woessmann (2013), that of Barro & Lee (2013) and finally the database of Altinok et al. (2014).

The objective of this paper is to examine empirically the link between education and economic growth for a sample of 28 middle-income countries through panel data regressions . The sample consists of 28 middle-income countries from different continents: North Africa and the Middle East (6 countries), sub-Saharan Africa (7 countries), Latin America and the Caribbean (8 countries), East Asia and the Pacific (3 countries) and Europe and Central Asia (4 countries). To test the impact of education accumulation on GDP per capita growth, a static panel is applied through the period of study from 1970 to 2014. The empirical findings prove the positive and significant influence of the quantity and quality of education on economic growth, both in level and variation. The stock of education and its increase positively affect economic development. Moreover, the quality of education is more significant than its quantity.

The article is structured as follows: the second section presents the conceptual framework, while the third one is devoted to explaining the methodology used; the fourth section outlines the results, and finally, section 5 concludes the study.

2. Literature Review

Empirical literature on this subject can be categorized according to several parameters, the main of which being the proxy used to measure human capital, the perception of the role of education in the growth or nature of the econometric models selected.

2.1. Measure of Education: Quantity or Quality?

The plurality of proxies used by economists to measure education led Woessmann (2000) to draw up a list to identify them. Referring to indicators that measure the amount of education received by an individual can be distinguished from those that appreciate the quality of the education.

2.1.1. Quantitative Indicators of Education

There are several indicators listed, the most popular of which are the rate of enrolment per a cycle of education and the average number of years of schooling for the entire population or a certain age group.

2.1.1.1. The Enrolment Rate

Used in cross-sectional studies (Barro, 1991; Mankiw et al., 1992), the enrolment rate indicator has been subject to considerable criticism. Indeed, flow variables are inappropriate to account for the stock of human capital unless very restrictive assumptions about

stationary balance are accepted. And even then, it must be admitted that enrolment rates fluctuate little over all the years studied, which is far from the reality for most developing countries.

2.1.1.2. The Average Number of Years of Education for Population

Today, it is rather the total number of years of schooling for the adult population that economists take as a direct measure of the human capital stock. Many authors have constructed series of this measure (Nehru et al., 1995), but the most frequently used today are those by Barro and Lee (2013).

This indicator is not beyond criticism, including for ignoring the declining performance of education and for the possibility of a year of study to have the same effect on accumulating human capital for all countries.

2.1.2. Indicators of Education Quality

Among many indicators that can measure the quality of education, it is the scores obtained by students in international assessments that tend to be more significant in recent research.

2.1.2.1. The Hanushek and Kimko Quality Indicator

First of all, the quality index established by Hanushek and Kimko (2000) is based on the results of the TIMSS (Trends in International Mathematics and Science Study) surveys conducted by IAEEA (International Association for the Evaluation of Educational Achievement) which also conducts the PIRLS (Progress in International Reading Literacy Study) surveys. Both authors obtain a positive but insignificant coefficient for the quantitative indicator of education and a positive and very significant coefficient of the qualitative indicator of education.

2.1.2.2. Barro Quality Indicator

Barro (2001) builds different indicators depending on the area of competence (mathematics, science and reading). These results show a positive but insignificant coefficient for the indicator of education quantity corresponding to the average levels of secondary and higher education completion, while that of the education quality has a positive and highly significant coefficient.

The IAEEA's investigations suffer from two main limitations. First, these tests were mainly carried out in the developed countries. Second, the survey questionnaire is too dependent on the U.S. curricula, which undermines the reliability of the results obtained by the developing countries.

For this reason, the Organization for Economic Co-operation and Development decided to launch its own program to assess student achievements called PISA (Program for International Student Assessment) in 1997. Unlike the IAEEA surveys, this test evaluates students who are all 15 years old, regardless of their level of grade. It consists of assessing students' skills, independently of curricula, in three areas: reading comprehension, mathematical culture and scientific culture.

While the IAEEA and OECD surveys are the only ones today to have an international scope, there are still others practicing on scales including the CESAP (Country Educational Systems Analysis Program) survey organized by the French-speaking countries of sub-Saharan Africa or the SACMEQ, LLECE and MLA surveys coordinated by UNESCO (United Nations Educational, Scientific and Cultural Organization).

2.1.2.3. The Altinok et al. Quality Indicator

Realizing the diversity of student achievement surveys , and aiming at having indicators of the education quality for the largest number of countries, Altinok (2006) decided to set up a new database from six different international survey groups (IAEEA, PISA, SACMEQ, PASEC, LLECE and MLA). It consolidates them on common scales by exploiting the results of the countries that participated in several surveys simultaneously. It obtains qualitative indicators of human capital (QIHC) for three areas of competence (mathematics, science, reading).

This database, which includes 105 countries, is used to test the relationship between education and growth. It concludes that qualitative indicators of human capital help explain economic growth between 1960 and 2000 (Altinok, 2006).

2.2. Role of Education: Model of Accumulation or Stock?

Depending on the underlying approach to the relationship between human capital and growth, econometric models fall into two categories (Gurgand, 2000). The first group is those that equate human capital with physical capital. The second category considers that human capital indirectly affects growth through research and development activities.

2.2.1. Accumulation Patterns

The founding writings of the human capital theory indicate that spending on education contributes to improving the quality of the workforce and increasing its productivity. As a result, human capital is part of the production function , a factor that accumulates and increases overall productivity with constant technology (Barro, 1991; Mankiw et al., 1992).

The main limitation of these models is the assumption that the marginal product of education can remain indefinitely positive for the entire population. Pritchett (2001) goes so far as to question the very existence of this supposed impact of education. The author takes up the MRW specification using physical and human capital stock data. It builds a panel on

the average number of years of productive force studies over 5-year intervals for the 1960-1985 period for many countries. The result of his study shows that the impact of human capital growth on the growth rate is negative and insignificant.

2.2.2. Stock Models

The second approach is based on Nelson and Phelps (1966) analysis, which suggests that the ability of a given economy to adapt to technological change depends on its human capital endowment. For these two authors, human capital, therefore, indirectly affects growth through innovation and technological adaptation, which are the real drivers of productivity growth.

This approach is applied by many authors including Benhabib & Spiegel (1994), Hanushek & Woessmann (2008) and Vandenbussche et al. (2006), who estimated a panel of OECD countries from 1960 to 2000 to show that the interaction between higher education and technology positively affects growth for countries close enough to the United States.

2.2.3. Are These Two Approaches Incompatible?

In a critical review of the literature on the subject, Krueger & Lindahl (2001) reject the idea that the two approaches presented above are irreconcilable. They succeed in highlighting a significant role in the growth of both accumulation and initial level of human capital in a panel of 110 countries observed between 1960 and 1990.

Similarly, Aghion & Cohen (2004) confirm the impact on growth of both an increase in the number of years of study and the number of years of study itself. Both authors make numerous regressions on educational data from 90 countries for the period 1960 - 2000. Their results show a macroeconomic performance of 8% in education and an effect of the initial level of education on subsequent growth of 0.5% per year.

2.3. Econometric Models: Instant Cuts versus Panel Data

While early models use cross-sectional data, more recent studies use panel data. Indeed, the first approach risks attributing to human capital the effect on income of intrinsic characteristics (institutional, political...) of countries (Islam, 1995). For this author, there are many variables that are correlated with both income and education and whose exclusion in a cross-sectional regression can lead to overestimating the effect of education on growth.

It is for this reason that he proposes to test a model in panel data. The variable explained is the GDP per capita at the end of every five-year period in the course of 1960-1985, while the explanatory variables are the GDP of 1960, the investment rate and the population size. The regression carried out by using a fixed-effect model leads to a negative and significant impact of education on economic growth (Islam, 1995).

3. Methods

The objective of this paper is to examine empirically the link between education and economic growth for a sample of middle-income countries through regressions on panel data during the period of study from 1970 to 2014.

The sample consists of 28 middle-income countries from different continents. These countries spread over the following regions: North Africa and the Middle East (Algeria, Jordan, Tunisia, Egypt, Syria, Lebanon), Sub-Saharan Africa (Angola, Botswana, Cameroun, Mali, Burkina Faso, Sudan, Kenya), Latin America and the Caribbean (Brazil, Colombia, Cuba, Costa Rica, Dominica, Ecuador, Mexico, Jamaica), East Asia and the Pacific (Thailand, Philippines, Vietnam) and Europe and Central Asia (Albania, Azerbaijan, Kazakhstan, Serbia).

Our goal was to include all developing countries with the education quality indicator adopted by this study. The developed countries are excluded because the related literature review has taught us that the link between education and growth is likely to suffer from a possible threshold effect. In order to use linear modelling, it seemed more plausible to retain relatively homogeneous countries.

3.1. Data Sources of the Study

Table 1 summarizes the list of variables used in our study and their sources. Regarding the observation period, since educational variables vary little from year to year, we opted for five-year periods and extend the duration of the study as much as possible to increase the number of observations.

3.2. Descriptive Analysis of Study Variables

Although the countries in the sample belong to the same category of middle-income countries, they show heterogeneous economic and social data in terms of initial level, trajectory, or current level.

3.2.1. GDP per Capita and its Growth

The GDP per capita of the richest country in the sample in 1970 accounted for $7,189, which is 21 times more than that of the poorest country at that time, Lesotho. This heterogeneity of the initial conditions is also attested by the standard deviation, which reaches 70% of the sample average.

The same is true of GDP per capita in 2014, with a maximum value of 10 of the minimum value, while the standard deviation is 60% of the average.

Table 1. The List of Variables and Their Sources

No	Variables	Notations	Form	Sources
1	GDP per capita with purchasing power parity (PPP)	GDP	In $ US constants 2010	WDI
2	Investment rate	INV	As a percentage of the GDP	WDI
3	Degree of the economy's commercial openness	OP	Sum of the imports and % exports on GDP	WDI
4	Inflation rate	INF	Annual rate of PCI variation	WDI
5	Growth rate of the population	POP	As a percentage of country's total population	WDI
6	Quantitative variable of education: average number of school years adult people over 15 years old	S	In years	Barro & Lee (2015)
7	Qualitative variable of education: Qualitative Indicator of Human Capital	QIHC	Index	Altinok et al. (2014)
8	The amount of education adjusted for the quality of the education	SQIHC	Sit * QIHCi / QIHCUSA	Our calculations
9	Civil Liberties	CL	Score from 1 to 7	Freedom House (2016)

Note: World Development Indicators (WDI)
Source: own elaboration.

3.2.2. The Amount of Education

As early as 1970, there were significant differences among the countries in the sample in terms of the average length of study of the working-age population. Thus, the leading country, namely Cuba, had a value of 5.4 years or a multiple of 7.5 of that of the country most lagging, Morocco in that case (0.72).

These gaps will only be partially filled by schooling efforts. The average for the sample increased from 3.40 to 8.10 years. While the trend is general, there are still significant differences between countries.

3.2.3. The Quality of Education

The average sample is 419.2; the standard deviation is 73.65, a coefficient of variation of just 17%. The maximum value rises to 588.9; it concerns Cuba and corresponds to the period 2005-2009. The minimum value of 244.4 refers to the Ivory Coast and dates back to the same period.

3.2.4. The Amount of Education Corrected

To compensate for the lack of data on the quality of education, Altinok (2007) proposes to readjust the quantitative variable of education by measuring its quality.

Following his approach, we calculated this new variable $SQIHC_{it}$ according to the following equation:

$$SQIHC_{it} = S_{it} \times QIHC_i \, / \, QIHCUSA \tag{1}$$

Thus, all observations concerning the average number of years of schooling for a given country are multiplied by the same indicator of the education quality invariant over time, the last available in this case. To obtain comparable data, years of education in the United States are used as baseline data.

Adjusting the average number of years of education by its quality leads to a decrease in this indicator's value for all countries in the sample. This is due to the low scores obtained by students from the abovementioned countries in international assessment.

3.3. The Analysis of Correlations among Variables

The correlation among GDP per capita and educational variables is positive but it is less than 0.5 for the quantity or quality of education. It is still higher than the correlation among GDP per capita and control variables other than GDP per capita at the beginning of the period.

The correlation between quality and quantity of education is strong and positive. Countries with the most years of adult schooling have the highest scores in international student assessment.

3.4. Presentation of Models

The approach chosen consists of three steps: selection of the most appropriate model, its implementation and, finally, verification of the residues' normality.

3.4.1. Accumulation of Education and Economic Growth

The model to be estimated is:

$$\begin{aligned} LGDP_{i,t} = \alpha_i + \beta_1 LGDP_{i,t-1} + \beta_2 S_{i,t} + \beta_3 QIHC_{i,t} + \beta_4 INV_{i,t} + \beta_5 OP_{i,t} + \beta_6 INF_{i,t} \\ + \beta_7 POP_{i,t} + \beta_8 CL_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where i - refers to the country shown with i = 1, ..., 28;
T - represents the time period with t = 1, ..., 9;
α_i - the specific effect or individual effect;
β_i - with i = 1 to 8 are parameters to estimate;
$\varepsilon_{i,t}$ - indicates the error term.

From the equation (2) which includes the two educational variables simultaneously, we estimated other equations by breaking down the education variable.

After applying the Hausman test, we opted for a fixed-effect model. Individual effects are invariant over time but potentially correlated to regressors. For this reason, we used the robust errors option of Stata software that corrects heteroscedasticity errors.

To gain more assurance about the estimates' robustness, there was chosen the Jarque-Bera test, the results of which confirm that the residues of the model generated after the estimate follow a normal law.

3.4.2. Education Stock and Economic Growth

The model to be estimated is:

$$LGDPF_{i,t} = \alpha_i + \beta_1 LGDPF_{i,t-1} + \beta_2 SQIHC_{i,t} + \beta_3 INV_{i,t} + \beta_4 OP_{i,t} + \beta_5 INF_{i,t} \\ + \beta_6 POP_{i,t} + \beta_7 CL_{i,t} + \varepsilon_{i,t}$$

(3)

where α - represents the fixed effect or country-specific effect factor (individual specific effect);
β_k - with k = 1 to 7 is the parameters to be estimated in this model;
$\varepsilon_{i,t}$ - indicates the error term that takes into account uncured factors that have an impact on economic growth.

In the equation (3), we regress the natural logarithm of GDP per capita at the end of each five-year period (LPIBHF), with its delayed value, as well as other control variables. The formulation of the model in differences then means that the regression now shows how variations in the education indicator influence the rate of economic growth.

Diagnostic statistics is favourable. Self-correction tests of the raw differences in the residues of the equation (2) validate the model specification: the hypothesis of no self-correction of the second order of residues is not rejected. The zero Sargan and Hansen test hypothesis of asymptomatic non-correlation of instrumental variables with model residues is not rejected either. As a result, the instruments used are significant and valid.

Although GMM estimators are robust and do not necessarily require an identical or normal distribution of residues (Saban, 2003), we verified the normality of the residues through the Skewness/Kurtosis test.

4. Results and Discussion

The objective of this study is to assess empirically the linkage between education and economic growth for a sample of 28 middle-income countries through regressions on panel data during the period for study from 1970 to 2014. To analyse the impact of education on economic growth, we use two estimations based on the accumulation and stock approaches.

4.1. The Approach in Terms of Accumulation

Table 2 summarizes the Static Panel Estimates Results. Variability explained by the different versions of the model is very high both at the intra- and inter-individual level.

The significance and magnitude of the coefficients of the educational variables depend on the version chosen.

According to column 2, the amount of education alone is insignificant and influences GDP per capita negatively. This result, consistent with many published studies, confirms that this indicator cannot be considered a true measure of education.

However, the quality of education has a positive and significant effect on GDP per capita even when it is alone (column 3). This result is also consistent with the literature reviewed; it indicates that the quality indicator better reflects differences in human capital among the countries.

Column 1 shows that educational variables together are significant and their impacts on per capita income are positive. The quality of education is significant at the 1% threshold, while the quantity of education is at the 10% threshold. This significance is not affected by the introduction or withdrawal of the GDP log per capita at the beginning of the period.

In terms of the magnitude of the impact, the accumulation of quantity and the improvement in the quality of education have a tangible impact on GDP per capita. Indeed, the increase in the average study time per year increases GDP per capita by 8.4% while the improvement in the education quality index by 100 points increases GDP per capita by 12%.

For control variables, the GDP coefficients per capita at the beginning of the period and the civil liberties index are significant. The other variables lose their significance when GDP per capita is introduced at the beginning of the period.

The GDP per capita ratio at the beginning of the period is positive; this means that the level of GDP per capita at the end of the period remains largely dependent on that at the beginning of the period. This is quite normal for a five-year span.

Investment is also positive, indicating that the countries that invest more are those with the highest income level.

The commercial opening also shows a positive coefficient; it can be inferred that the countries in the sample tend to open more as their GDP per capita increases.

In terms of population growth, the negative coefficient indicates that the countries with the highest incomes have reached a more advanced stage of demographic transition.

The positive inflation ratio is difficult to comment on. The literature tells us that the relationship between GDP per capita and inflation is not linear. In fact, we found that this variable is too volatile for our sample.

Table 2. Static Panel Estimates Results

VARIABLES	Fixed Effects (1)	Fixed Effects (2)	Fixed Effect (3)
Log (GDP)	0.463***	0.770***	0.553***
	(0.138)	(0.0350)	(0.129)
S	0.0847*	-0.0144	-
	(0.0480)	(0.0138)	
INV	0.00222	0.00538*	-0.000466
	(0.00320)	(0.00301)	(0.00373)
OP	0.000266	0.000615	0.00113*
	(0.000806)	(0.000567)	(0.000634)
INF	0.00193	- 0.000138***	0.00155
	(0.00265)	(4.19e-05)	(0.00324)
POP	-0.00913	-0.0195	-0.00670
	(0.0146)	(0.0242)	(0.0152)
CL	-0.0851**	0.00372	-0.0797*
	(0.0370)	(0.00965)	(0.0418)
Constant	3.501***	1.863***	3.297***
	(1.021)	(0.327)	(1.030)
Indicators for periods	Yes	Yes	Yes
Indicators for countries	Not	Not	Not
Number of observations	51	205	51
Number of countries	28	28	28
R^2	0.951	0.869	0.939

Note: ***, ** and * significant coefficients are 1%, 5%, and 10% respectively.
Source: own elaboration.

Finally, the regression indicates a significant and negative effect of the civil liberties index. Restrictions of civil liberties decrease, as income increases, as the Freedom House index is initially ranked between 1 (more civil liberties) and 7 (less civil liberties).

Our model confirms, therefore, the existence of a link in terms of accumulation between education and growth. What is then the effect of the education level on the growth rate of GDP per capita?

4.2 The Stock Approach

Table 3 summarizes the Results of Dynamic Panel Estimates. The results show that the amount of corrected education (SQIHC) positively and significantly affects the value of GDP per capita observed at the end of each period. Indeed, this variable shows a positive and significant rate at the threshold of 5%.

Table 3. Results of Dynamic Panel Estimates

VARIABLES	GMM in system
Log (GDPF)	0.810***
	(27.96)
S_{QIHC}	0.0444**
	(2.68)
INV	0.00752***
	(8.52)
POP	0.0110
	(0.53)
OP	0.000727
	(0.81)
INF	-0.000970*
	(-1.84)
CL	-0.0225**
	(-2.39)
Constant	1.263***
	(8.74)
Number of observations	188
Number of countries	28
Sargan[Test 1]	0.415
Hansen Test[1]	0.450
AR (1)[1]	0.035
AR (2)[1]	0.311

Note: ***, ** and * significant coefficients are 1%, 5%, and 10% respectively. Typical errors given in parentheses are robust to heteroscedasticity. Estimates contain temporal muteness whose coefficients are not reported.
[1] Denotes the P-value values associated with the various tests and specifically indicates that the instruments used in GMM in the system are good.
Source: own elaboration.

Thus, the increase in a standardized school year (one point of SQIHC) leads to an annual increase of about 0.4 points in the rate of GDP growth per capita for the countries in the sample. This result corresponds to that found by Altinok (2006).

Regarding control variables, the delayed dependent variable and the investment rate are positive and significant at the 1% threshold, which is in line with our expectations and previous results.

The civil liberties indicator is negative and significant at the 5% threshold, which is a result that corroborates our expectations and conclusions of regression in static panel.

The inflation rate has a negative and significant coefficient at the 10% threshold. Lower inflation is more conducive to greater economic growth even if the value of the coefficient remains low.

The coefficient of trade opening is positive but statistically insignificant. The only result that does not conform to the predictions published in the literature is population growth. Indeed, the coefficient of this variable appears with a positive sign reflecting a positive impact of population growth on the pace of growth. However, it is not significant.

5. Conclusions

The purpose of this paper is to examine empirically the relationship between education and economic growth for a sample of 28 middle-income countries through panel data regressions during the period for study from 1970 to 2014.

Using the Altinok et al. (2014), we experiment with different econometric models of panel data to assess the relationship between quantitative and qualitative educational variables and economic growth for a sample of the developing countries.

We have highlighted a positive and significant impact of education on GDP per capita and its growth. The static panel estimate indicates that the increase in the average study time per year increases GDP per capita by 8.4%, while the improvement in the education quality index by 100 points increases GDP per capita by 12%. The results of the dynamic panel indicate that the increase in a standardized school year leads to an annual increase of about 0.4 points in the per capita GDP growth rate.

These results confirm the role of education as the main lever for accumulating human capital and, thus, as a spring for long-term growth. They indicate that developing countries have an interest in intensifying measures to fill the gaps in this area.

Having accumulated significant quantitative and qualitative delays, the sample countries do not have to make choices between these two dimensions of education. Moreover, since they are strongly correlated, any progress on one level can only be positive for another.

However, the low qualities of learning mitigate the extent of progress around generalization of learning and schooling. Appropriate programmes to improve the quality of education systems must be implemented.

Compared to other work of the same nature, this contribution has the distinction of applying a comparable level of development to a sample of countries and to cover a relatively long and recent observation period.

The originality of our paper is observed in two points;
    (1) the positive and significant impact of the quantity and quality of education on economic growth, both in level and variation;
    (2) the quality of education is more significant than the quantity.

These results encourage us to continue the investigation of this field of research, which opens too many issues that are still insufficiently explored. This is, for example, the search for the determinants of the education quality in the macro-economic and micro-economic dimension.

6. Acknowledgements

7. Formatting of funding sources

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