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SocioEconomic Challenges, Volume 6, Issue 2, 2022
ISSN (print) – 2520-6621, ISSN (online) – 2520-6214

Public Investment in Human Capital and Economic Growth in Algeria: An empirical study using ARDL approach

https://doi.org/10.21272/sec.6(2).57-66.2022

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Abstract

The main aim of this research paper is to examine empirically the link between public investment in human capital and economic growth in Algeria over the period 1990-2017. In fact, public authorities spend annually considerable funds to make both education and health available for all citizens as they are vital elements for a better life. This political action which is well understood from social perspective should have also some economic benefits especially in terms economic growth. Scholars strongly argued the crucial importance of investing in human capital to spur growth. In this context, the current paper tends to assess the impact of public spending devoted to human capital components on economic growth in Algeria. To do so, the study used annual time series data of government expenditures on these two sectors ranged from 1990 to 2017, and employs for estimation the autoregressive distributed lag (ARDL) approach. The main finding of this paper is that there is no cointegrating relationship between these two variables in the long run. This result is in line with many previous studies in Algeria as well as in other developing countries. This basically supports the idea that spending on education and health would not inevitably lead to growth. The lessons learnt from the experience of emerging economies denote that there are a series of preliminary conditions that should be set up to make the association between public investment in human capital and growth possible. Government spending alone cannot induce economic growth if corruption prevails and resources are inefficiently allocated. Also, it is the quality of health and education that matters. In Algeria, despite of the considerable funding of education and health sectors, the quality of service offered inside schools and hospitals is still poor. Thus, increasing numbers of doctors leave the country because they believe that work conditions are not suitable. Many Patients also prefer to join foreign hospitals because they believe that local medical service is somewhat unsatisfactory. Likewise, a great number of university students choose to join foreign universities to pursue their higher studies because they consider the quality of local universities is poor. Based on this evidence, policymakers are invited to take into consideration these conditions among others in order to strengthen the impact of public investment in human capital on economic growth in the future.

Keywords: education, health, economic growth, ARDL, human capital in Algeria.

JEL Classification: C22; I11, I21, O40.

Cite as: Ramli, M., Boutayeba, F., Nezai, A. (2022). Public Investment in Human Capital and Economic Growth in Algeria: An empirical study using ARDL approach. *SocioEconomic Challenges*, *6*(2), 57-66. https://doi.org/10.21272/sec.6(2).57-66.2022

Received: 22.03.2022 **Accepted:** 25.05.2022 **Published:** 30.06.2022

Introduction

In early 1960s, the theory of human capital emerged as a new revolution in economic thought thanks to the seminal contributions of some famous American economists like Schultz (David E, Canning, Kotschy, Prettner, & Schünemann, 2018; Schultz, 1960) , Becker (Becker, 1962), and Mushkin (Mushkin, 1962). The starting point of this theory is that spending on education and health is a form of investment in human capital. In light of this, pubic as well as private expenditures on education and health yield various economic and non-economic benefits. At the aggregate level, the evidence suggests that education and health status is closely related to national income. Theoretical literature provides a number of arguments that explain the causal relationship between human capital and economic growth. Lucas (Lucas Jr, 1988) states that public investment in education and health contributes to improving the quality of the workforce and therefore to increasing productivity. Romer considers the accumulation of human capital as a prerequisite for the promotion of innovation, a vital engine of technological progress (Romer, 1986). In addition, Benhabib and Spiegel (Benhabib & Spiegel, 1994) indicate a certain level of human capital necessary to facilitate the diffusion and transfer of technology between countries.

On the other hand, economic growth constitutes the main source of public funding of education and health sectors. Hence, the link between human capital and economic growth is bidirectional. In accordance with this evidence, policy-makers worldwide advocate increased expenditures on both education and health, especially in developing countries where human development is far away from that in developed countries.

In Algeria, tremendous funds have been devoted to education and health sectors since independence. Public expenditures have been evolving over time to overcome social needs as a result of accelerated demographic growth, and to fulfil the economic requirements of the national economy. With respect to education, the overall public spending rose from 2.3 to 9.2 billion dollars between 2000 and 2018. Likewise, public health expenditures per capita increased from 278$ (PPP) in 2000 to 975$ in 2017. Meanwhile, GDP per capita increased from 1765$ in 2000 to 4278$ in 2018.

In light of this, the main objective of this research paper is to assess empirically the link between public investment on human capital and economic growth in Algeria over the period 1990-2017.

The paper is organised as follows: the second section presents an overview of the nexus between human capital and economic growth. The third section offers some empirical studies. The fourth section introduces data and methodology, while the fifth section presents and discusses the empirical findings. Finally, the sixth section concludes.

Literature Review

Human capital is accumulated by investing mainly in people's education and health. Economists as well as policy-makers believe that human capital accumulation impacts positively economic growth. As far as education is concerned, a large body of literature argues that investing in education boosts economic growth. According to Stevens and Weale (Stevens & Weale, 2004), there are two reasons for expecting to find some link between education and growth. First, since 1800, living standards have raised so much because of education. Second, many econometric studies suggest that individuals' earnings depend on their level of education, evidence that is true for countries. In light of this fact, theoretical growth literature emphasizes at least three channels by which education may affect growth (Hanushek & Woessmann, 2010): first, education can enhance competencies of the labour force, which raises labour productivity - as in augmented neoclassical growth theories (Mankiw, Romer, & Weil, 1992). Second, education can boost the innovative capacity of the economy, and the new knowledge on new technologies strengthens growth. cf. Lucas (Lucas Jr, 1988) and Romer (Romer, 1990). Third, education can facilitate the diffusion and transmission of knowledge which promotes growth, cf. Nelson and Phelps (Nelson & Phelps, 1966).

SocioEconomic Challenges, Volume 6, Issue 2, 2022
ISSN (print) – 2520-6621, ISSN (online) – 2520-6214

Despite these strong theoretical arguments, there are still mixed and conflicting empirical findings. Thus, the causal effect of education on growth is neither mechanical nor inevitable. Many studies did not find a link between education and growth in many countries, and some of them; rather, found a negative relationship between them. In fact, there are a series of reasons behind these findings. The first one consists in focusing on education quantitative measures (such as years of schooling) rather than qualitative ones. Aghion and Howitt (Aghion & Howitt, 2008), for instance, find that a one-standard-deviation increase in science test results would enhance the growth rate by 1% per year. In contrast, a one-standard-deviation rise in school attainment would increase the growth rate by only 0.2% per year. In addition to the education measurement problem, there is a variety of econometric approaches used in the literature. Also, the data considered are different in their nature and size. Furthermore, countries are heterogeneous in their economic structure and institutions.

With regard to health, Churchill et al. (Churchill, Yew, & Ugur, 2015) show that the effect of health on growth has not received much attention in the literature compared to the effect of education on growth. Although the data reveal clearly the positive association between health status and economic development stage, the causal effect of health on growth is subject to controversy in the literature. In his seminal paper entitled "health as an investment'' published in 1962, Mushkin argues that health affects positively growth in the United States. But it is until the 1990s where scholars began investigating deeply the nexus between health and growth at the cross-section level. Most of them found a positive effect of health measures on growth [see (R. J. Barro, 1991), (R. Barro, 2013), (Bloom, Canning, & Sevilla, 2004), and (Weil, 2014) for a review].

On contrary, other studies rejected such an effect, though some of them found a negative effect of health on growth in many countries as in Acemoglu and Johnson (Acemoglu & Johnson, 2007). In terms of assessing the impact of health on growth, David E et al. (David E et al., 2018) provide two main approaches: The first consists in microeconomic estimates of health effects to calibrate its size at the aggregate level, and the second is to estimate the aggregate link directly using macroeconomic data. For the studies that argued a positive effect of health on growth, there are various mechanisms that explain such an effect. By and large, literature highlights four mechanisms. First, health affects directly growth by increasing labour productivity. Second, health impacts indirectly growth by accumulating human capital since health can improve school attendance and cognitive skills. Third, health contributes to accumulating physical capital by rising saving (the incentives to save for retirement). Four, health leads to fertility reductions. Beyond these theoretical statements, there are many difficulties surrounding the assessment of the relationship between health and growth. David E et al. (David E et al., 2018) state three problems: the nexus between these two variables is unclear due to bidirectional causality between them, the link between health and growth varies given the health measures considered (age, gender, and socioeconomic status), and finally, health interventions differ widely between developed and less-developed countries.

Empirical Evidence

As far as academic research is concerned, a myriad of empirical studies have examined the effect of public spending on education and health on economic growth. For instance, Eggoh et al. (Eggoh, Houeninvo, & Sossou, 2015) explored the link between human capital components and economic growth for a sample of 49 African countries over the period (1996-2010). Using traditional cross-section and dynamic panel techniques, the authors find that government expenditures on education and health negatively influence economic growth; however, human capital stock indicators have a slight positive impact. They find also education and health expenditures are complementary.

Maitra and Mukhopadhyay (Maitra & Mukhopadhyay, 2012) investigated the impact of public investment in education and health on the economic growth of 12 countries in Asia and the Pacific over the time period (1980-2010). They used cointegration and VECM techniques. The findings were mixed; in six countries (Bangladesh, Kiribati, Malaysia, Maldives, Philippines, and South Korea) there are cointegrating relations while in the other six countries, there are no cointegrating relations (Fiji, Nepal, Singapore, Sri Lanka, Tonga and Vanuatu).

In a meta-analysis study, Churchill et al. (Churchill et al., 2015) used a sample of 306 estimates drawn from 31 primary studies and conducted an empirical synthesis of the relationship between government spending on education or health and growth. They found government education expenditures affect growth negatively.

However, when they used government expenditures on both education and health as a combined measure, they found a positive growth effect. The study revealed also the factors that explain the heterogeneity in the literature. They are mainly econometric specifications, publication characteristics, and data characteristics.

Regarding the empirical evidence on the impact of public spending on education and health on economic growth in Algeria, most studies focused separately on one of the human capital components (either education or health expenditures). The studies that combine both education and health include, in addition to public spending on education or health, other measures such as years of schooling or rates of enrolment for education, and life expectancy or infant mortality rate for health. Mokhtari (Mokhtari, 2009) investigated the main sources of economic growth in Algeria over the period (1970-2002). Using Granger causality, he revealed the absence of causality between public spending on education and economic growth in both directions. In contrast, Ahmed and Bengana (Ahmed & Bengana, 2016) examined the relationship between government expenditures on education and growth during 1964-2013. They used Granger causality and cointegration techniques. They found a long-run equilibrium between the two variables, in addition to the existence of bidirectional causality between them.

On the other hand, Messaili and Tlilane (MESSAILI & TLILANE, 2018) assessed the contribution of health to economic growth in Algeria over the period (1974-2013). Among the proxy variables used for health, they included public spending on health. By using the ARDL approach, they found this one affects positively and significantly economic growth. Likewise, Boussalem et al. (Boussalem, Boussalem, & Taiba, 2014) investigated the causality and cointegration relationships between government spending on health and economic growth during (1974-2014). The study revealed a long–run equilibrium between these two variables; however, it showed that causality runs only from economic growth to government spending on health.

Data and Methodology

The methodology of this research paper is driven by the need to investigate the effect of public investment in human capital on economic growth in Algeria. This section displays the size of the data sample, definition of variables, in addition to the specifications of the study model. This paper is also based on annual time series data ranged from 1990 to 2017. The data are obtained from the World Bank database and ministry of finance. The model used in this paper is based on the study of Bokhari (Bokhari, 2017) as follows:

$$Y = f(H, K, E) \tag{1}$$

After introducing logarithm in both sides, the model becomes in the following form:

$$\log Y = \alpha_0 + \alpha_1 \log H + \alpha_2 \log K + \alpha_3 \log E + \mu_i \tag{2}$$

Where: Y: is real GDP per capita; H: is expenditures on health; K: is physical capital measured by the Gross Fixed Capital Formation; E: is expenditures on education; μ_i: is random disturbance term; $\alpha_0, \alpha_1, \alpha_2, \alpha_3$: are the respective parameters.

Thus, the model used for estimation is given as follows:

$$\log GDP = \alpha_0 + \alpha_1 \log H + \alpha_2 \log K + \alpha_3 \log E + \mu_i \tag{3}$$

All variables are measured in real terms, and they are all of them expressed in logarithm.

Results and discussion

Table (1) shows the results of unit root estimation by using both ADF and PP tests.

Table 1. The Results of Unit-Root Estimation

Variables	Augmented Dickey-Fuller test statistic			Philips Perron test statistic		
	Intercept & trend	Intercept	None	Intercept & trend	Intercept	None
log *GDP*	-3.434654 (0.0677) ***	- -	- -	-3.244546 (0.0972) ***	- -	- -

SocioEconomic Challenges, Volume 6, Issue 2, 2022
ISSN (print) – 2520-6621, ISSN (online) – 2520-6214

Table 1 (cont.). The Results of Unit-Root Estimation

Variables	Augmented Dickey-Fuller test statistic			Philips Perron test statistic		
	Intercept & trend	Intercept	None	Intercept & trend	Intercept	None
D(log *GDP*)	-3.535422 (0.0563)	-3.721133 (0.0098)*.**.***	- -	-3.498629 (0.0605)	-3.696229 (0.0104)*.**.***	- -
log *H*	-3.423889 (0.0691) ***	- -	- -	-3.423889 (0.0691) ***	- -	- -
D(log *H*)	-9.013764 (0.0000)	- -	-8.032099 (0.0000)*.**.***	-9.013764 (0.0000)	- -	-7.481609 (0.0000)*.**.***
log *K*	-2.797564 (0.2104)	- -	- -	-5.796629 (0.0003)*.**.***	- -	- -
D(log *K*)	-5.952730 (0.0003)	- -	-2.792516 (0.0072)*.**.***	- -	- -	- -
log *E*	-2.274073 (0.4329)	- -	0.950339 (0.9044)	-2.333838 (0.4031)	- -	- -
D(log *E*)	-5.199853 (0.0015)	- -	-5.058759 (0.0000)*.**.***	-5.199853 (0.0015)	- -	-5.029942 (0.0000)*.**.***

Note: *, **, *** represent significance at 1%, 5% and 10% respectively.
Source: Authors' Computation.

By employing *ADF* and *PP* unit root tests, all variables are non-stationary at level I(0), but they are stationary after taking the first difference I(1) except the (log *K*) variable which is stationary at level when using *PP* unit root test. Moreover, some variables have a difference stationary (DS) specification while others have a trend-stationary specification. Based on the stationary results obtained, the autoregressive distributed lag (ARDL) approach can be used to estimate the link between human capital and economic growth in Algeria. This approach -popularized by Pesaran and Shin (Pesaran & Shin, 1999), Pesaran et al. (Pesaran, Shin, & Smith, 2001)- is used to investigate the relationship between the variables under study. "Table 2" displays the estimation of the model (3) by using ARDL approach. In this model, the dependent variable is *real GDP per capita* while the dynamic regressors are: the real GDP per capita with one lag, expenditures on health, physical capital measured by the Gross Fixed Capital Formation without lag, and expenditures on education with four lags.

Table 2. ARDL Model Estimation Results

Variables	Coefficient	Std. Error	t-Statistic	Prob
log *GDP* (-1)	0.743852	0.222433	3.344162	0.0048
log *H*	0.043224	0.030504	1.417025	0.1783
log *K*	0.131286	0.238343	0.550829	0.5904
log *E*	-0.007490	0.035798	-0.209234	0.8373
log *E* (-1)	-0.051474	0.035179	-1.463192	0.1655
log *E* (-2)	0.000977	0.039714	0.024603	0.9807
log *E* (-3)	-0.009479	0.032178	-0.294594	0.7726
log *E* (-4)	-0.063843	0.024616	-2.593562	0.0212
C	5.290718	4.992031	1.059833	0.3072
@TREND	0.005274	0.009680	0.544850	0.5944

R-squared	0.998559	Mean dependent var	25.64137
Adjusted R-squared	0.997632	S.D. dependent var	0.253843
S.E. of regression	0.012352	Akaike info criterion	-5.655592
Sum squared resid	0.002136	Schwarz criterion	-5.164736
Log likelihood	77.86710	Hannan-Quinn criter	-5.525367
F-statistic	1077.664	Durbin-Watson stat	2.087458
Prob(F-statistic)	0.000000		

Source: Authors' Computation.

The results in "Table 2" came after having determined the appropriate lag structure that allowed this estimated model to be free of econometric problems, which were determined according to Akaike Criterion Information: ARDL (1.0.0.4) as "Figure 1"shows.

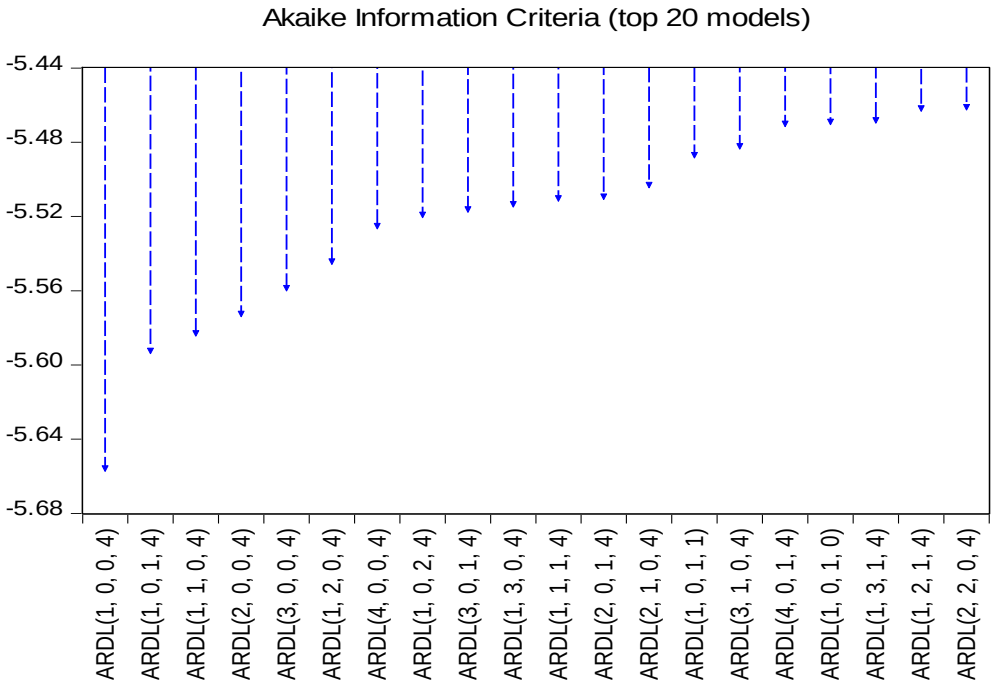
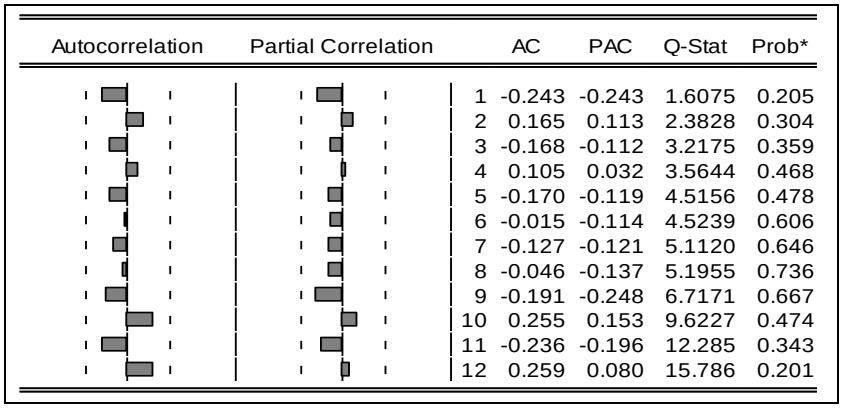


Figure 1. Lag Length Selection

Source: Authors' Computation.

"Figure 2" indicates no autocorrelation of residuals in the model. Besides, "Figure 3" denotes that the residuals are normally distributed since the probability is higher than 5%.



	AC	PAC	Q-Stat	Prob*
1	-0.243	-0.243	1.6075	0.205
2	0.165	0.113	2.3828	0.304
3	-0.168	-0.112	3.2175	0.359
4	0.105	0.032	3.5644	0.468
5	-0.170	-0.119	4.5156	0.478
6	-0.015	-0.114	4.5239	0.606
7	-0.127	-0.121	5.1120	0.646
8	-0.046	-0.137	5.1955	0.736
9	-0.191	-0.248	6.7171	0.667
10	0.255	0.153	9.6227	0.474
11	-0.236	-0.196	12.285	0.343
12	0.259	0.080	15.786	0.201

Figure 2. Correlogram of Residuals

Source: Authors' Computation.

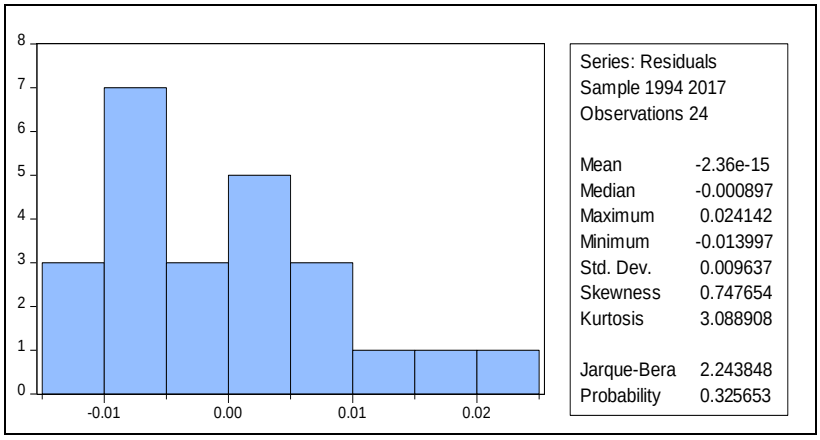


Figure 3. Normality Test for Residuals

Source: Authors' Computation.

On the other hand, we use also another test that detects the risk of second-degree autocorrelation. This test is Breusch–Godfrey serial correlation *LM*. The results in "Table 3" reveal that the probability associated with Fisher's statistic (F-statistic) equals 0.8817 and the probability of Chi-Square equals 0.7795. Both of them are more than 5% ; therefore, one can conclude that there is no autocorrelation of residuals.

Table 3. Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.127188	Prob. F(2,12)	0.8817
Obs*R-squared	0.498190	Prob. Chi-Square (2)	0.7795

Source: Authors' Computation.

In addition, there is no problem with error variances, which means that they are constant over time. Based on "Table 4", and according to the ARCH heteroskedasticity test, the probability value of Fisher's statistic (Prob. F(1,21)) equals 0.2525. Furthermore, the probability value of Chi-square observations (Prob. Chi-Square (1)) equals 0.2330. These two results are higher than the critical probability value of 5%. Thus, the model is not suffering from heteroskedasticity problem.

Table 4. ARCH Heteroskedasticity Test

Heteroskedasticity Test: ARCH			
F-statistic	1.384531	Prob. F(1,21)	0.2525
Obs*R-squared	1.422599	Prob. Chi-Square (1)	0.2330

Source: Authors' Computation.

Based on "Table 2", the long run form and bounds test have been used to find out the equilibrium relationship. Their results are shown in "Table 5". In fact, the relationship is completely unknown at 10% because it falls within the area of suspicion (between lower and upper bounds). Its statistical value F-statistic (4.121209) obtained from the results of bounds test of the public investment in human capital and economic growth in Algeria falls between the upper I(1) and lower I(0**)** critical value bound. Consequently, the null hypothesis cannot be rejected, so there is no cointegrating relationship between public investment in human capital and economic growth in Algeria in the long run.

As for the rest of the significance levels 1% and 5%, respectively, there is no equilibrium relationship between these variables, because the F-statistic value (4.121209) is evidently below I(0) critical value bound. Hance, the alternative hypothesis is rejected and the null hypothesis is accepted, which indicates no equilibrating relationship between the variables of this study. Also, these results are also confirmed by using t-statistic.

Table 5. Results of Bounds Test Approach to Cointegration

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Finite Sample: n=35	
F-statistic	4.121209	10%	3.8	4.888
Actual Sample Size	3	5%	4.568	5.795
		1%	6.38	7.73
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-1.151575	10%	-3.13	-3.84
		5%	-3.41	-4.16
		1%	-3.96	-4.73

Source: Authors' Computation.

Among the sensitive technical econometric issues is that the estimated parameters by using ARDL methodology must be constant over the study period. In such a case, there is no structural imbalance over time, and there is only one estimated equation for this study. Based on the "Figure 4", the cumulative sum (CUSUM) and cumulative sum squares (CUSUMSQ) of the recursive residuals tests show clearly that the parameters of the estimated model appear constant. The results confirm the stability of coefficients since the (CUSUM) and (CUSUMSQ) statistics do not exceed 5% critical bounds of parameter stability.

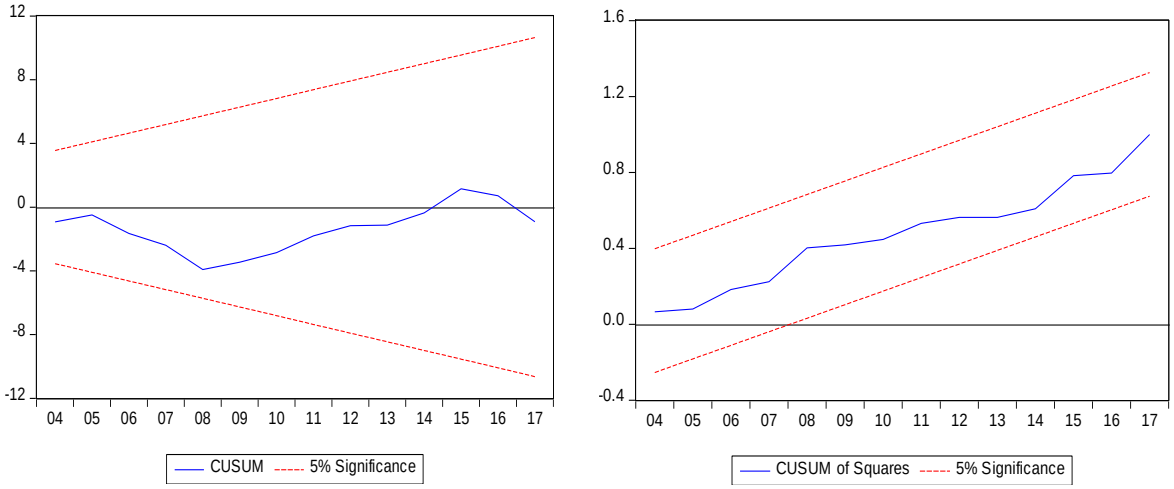


Figure 4. Plot of CUSUM and CUSUMSQ of Recursive Residuals

Source: Authors' Computation.

The absence of any co-integrating relationship between public investment in human capital and economic growth in Algeria based on the outcomes of the autoregressive distributed lag (ARDL) approach supports the idea that spending on education and health would not inevitably lead to growth in developing countries. In fact, there are a series of conditions that should be set up to make the association between public investment in human capital and growth possible. Government spending cannot induce growth if corruption prevails and resources are inefficiently allocated. Also, it is the quality of health and education that matters. In Algeria, despite of the considerable funding of education and health sectors, the quality of service offered inside schools and hospitals is still poor. Therefore, increasing numbers of doctors leave the country because they believe that work conditions are not suitable. Many Patients also prefer to join foreign hospitals because they believe that local medical service is not satisfactory. Likewise, a great number of university students choose to join foreign universities to pursue their higher studies because they consider the quality of local universities is poor.

Back to literature review, it seems that both education and health do not contribute to enhance productivity which is considered as the key factor for economic growth. Empirically speaking, it could be find different results if a

qualitative measure of education or health is used. Aghion and Howitt (Aghion & Howitt, 2008) in their paper denote the sizable effect of qualitative measures compared to quantitative ones. Besides, David E et al. (David E. et al., 2018) state some explanations why there are difficulties surrounding the assessment of the nexus between health and growth. The measures used in the study influence the findings, and health interventions differ from developed and developing countries. These explanations are valid for the case of our study.

Conclusion

This paper aimed to investigate empirically the relationship between public investment in human capital (education and health) and economic growth in Algeria. During the last decades, Algerian authorities devoted increasing funds to finance education and health sectors in order to meet social and economic requirements. In fact, it has been a big challenge for policy-makers to keep up with the accelerated demographic growth and economic development.

Theoretically speaking, scholars argue that, for developing countries, investing in human capital is prerequisite to spur economic growth and cutch up developed countries. However, a large body of empirical literature concludes contradictory findings. In Algeria, for instance, many studies found a positive association between public investment in human capital and growth while other studies did not find any association.

In this paper, and by using an ARDL approach, we concluded that public investment in human capital and growth are not cointegrated in the long run in Algeria. This finding suggests that government spending on education and health does not contribute to spurring growth. The missing link between them consists in a number of conditions that should be set up. Combating corruption, enhancing the quality of education and health establishments, allocating efficiently public resources are among top priorities in order to make public investment in human capital a key driver for economic growth in Algeria in the future.

Contributions: Conceptualisation: Azzeddine Nezai; methodology: Azzeddine Nezai; Mohamed Ramli; project administration: Azzeddine Nezai; Software: Azzeddine Nezai; Investigation: Azzeddine Nezai, Mohamed Ramli, Faiçal Boutayeba;data curation:Azzeddine Nezai, Mohamed Ramli; formal analysis:Azzeddine Nezai; validation: Azzeddine Nezai, Mohamed Ramli, Faiçal Boutayeba; visualization: Azzeddine Nezai, Mohamed Ramli; writing-original draft preparation: Azzeddine Nezai; Faiçal Boutayeba; writing - review & editing: Azzeddine Nezai, Faiçal Boutayeba, Mohamed Ramli; Proofreading: Azzeddine Nezai, Faiçal Boutayeba; template formatting and references: Azzeddine Nezai.

Funding: This research received no external funding.

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