THE RELATIONSHIP BETWEEN EDUCATION LEVELS AND ECONOMIC GROWTH IN ALGERIA: AN ARDL APPROACH

العلاقة بين مراحل التعليم والنمو الاقتصادي في الجزائر: منهجية الانحدار الذاتي لفترات الإبطاء الموزعة

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Abstract:

Based on annual data collected between 1987 and 2011, this study investigates the short-and long-run co-integration relationships between various education levels and economic growth in Algeria using an Autoregressive Distributed Lag (ARDL) model. The empirical results show clearly that both primary and secondary education levels influence positively and significantly economic growth in the long run; whereas in the short run, only secondary education has such influence. Therefore, it is strongly recommended to devote much more public funds to these two education levels in the hope of raise enrolment and enhance education quality in the future.

Keywords: Education levels; Human capital; Economic growth, ARDL; Algeria.
JEL Classification Codes: C22; I25; O47.

ملخص:

تهدف الورقة البحثية إلى دراسة العلاقة التوازنية قصيرة وطويلة الأجل ما بين مراحل التعليم والنمو الاقتصادي في الجزائر خلال الفترة 1987-2011، وذلك باستخدام منهجية الانحدار الذاتي للفجوات الزمنية الموزعة (ARDL). تشير النتائج المتوصل إليها إلى أن كلاً من التعليم الابتدائي والثانوي لهما تأثير موجب ومعنوي على النمو في المدى الطويل، بينما يؤثر التعليم الثانوي لوحده على النمو في المدى القصير. على هذا الأساس، توصي الدراسة بأهمية تخصيص موارد أكبر لهاتين المرحلتين التعليميتين قصد الرفع من معدلات القيد وتحسين جودة التعليم بهما مستقبلاً.

كلمات مفتاحية: مراحل التعليم، رأس المال البشري، النمو الاقتصادي، منهجية الانحدار الذاتي لفترات الإبطاء الموزعة، الجزائر.
تصنيفاتJEL : C22 ، I25 ، O47.

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1-INTRODUCTION:

Education is seen as the vital engine of economic growth in developed and emerging countries alike. Since the seminal contributions of Schultz (1960), Denison (1962) and Becker (1964), a myriad of empirical studies has corroborated the crucial impact of investment in education on economic growth in both developed and emerging countries. However, defining which education level has the great effect on growth in less-developed countries has not been paid much attention by scholars. The implications of the findings of such investigation are undoubtedly beneficial for policy makers. This can enable them to effectively design educational policy on one hand, and efficiently allocate resources among education sectors on the other.

This paper tends to investigate empirically the short- and long-run relationships between different education levels and economic growth in Algeria during the period of 1987-2011. As a proxy variable for education, gross enrolment rate (GER) is used. Unfortunately, the annual data for this measure are available only until 2011. The study applies ARDL bounds test developed by Pesaran, Shin, & Smith (2001) after having ensured that all time series are of order one.

The findings of this paper confirm the positive and significant impact of primary and secondary education on economic growth in the long run. But in the short run, only secondary education matters for growth. In contrast, tertiary education has not any impact on growth both in the short and the long run.

In addition to introduction, this paper is divided into five more sections. The following section presents the empirical literature on growth effects of education levels. Section three offers an insight on the Algerian educational system. Section four highlights data and methodology. Section five is devoted to results and discussions. Finally, section six is concluded with a summary.

2- EMPIRICAL LITERATURE:

The investigation of the nexus between education levels and economic growth has been the subject of tremendous studies over the last few decades. Some of them tackled the issue from cross-country perspective, whereas other studies focused on individual countries. In all cases, the ultimate objective is to determine the level of education that has the crucial effect on growth.

Petrakis and Stamatakis (2002) examined the effects of various levels of education on economic growth in three groups of countries. They reveal that the role of both primary and secondary education seems to be more important in less-developed countries. In OECD countries, on the other hand, it is tertiary education which affects growth. For Malaysia, for instance, Singh et al. (2018) employed autoregressive distributed lag (ARDL) model to analyse the short- and long-run effects of education levels globally and by gender. The study finds that primary education has a significant positive contribution to growth in the long run followed by tertiary education; while, in the short run, it is found that only tertiary education matters for growth. As far as gender is concerned, they find male education has higher effect on growth in the long run, but in the short run, female education has such effect. In Indonesia, by using the same methodology, Mandy and Widodo (2018) state that tertiary education has a significant positive impact on growth while primary education is insignificant both in short and long run. Furthermore, secondary education is found significantly but negatively affects

growth in the long run. For a study in Guatemala, Loeing (2005) used an error-correction methodology. The results show that primary education is most important for productivity growth, followed by secondary education. By and large, education explains more than 50% of output growth. Pegkas (2014) applied the same methodology for the case of Greece. He finds both secondary and tertiary education has had a statistically positive effect on growth, whereas primary education had not impacted growth. In Nepal, Nowak and Dahal (2016) apply both OLS and Johansen Cointegration models, where they find that all education levels matter for growth.

Other studies used Granger causality to test and determine the causal effects of education levels on economic growth. For instance, Sharmistha and Grabowski (2003), for the cause of India, reveal that primary education has a strong causal impact on growth, with more limited evidence on such an impact for secondary education. Gumus and Kayhan (2012) employed Toda-Yamamoto causality test to examine the causal relationship between GDP per capita and various levels of education in Turkey. The study shows that there is a statistically significant relationship between GDP per capita and primary education bi-directionally, an unidirectional relationship running from GDP per capita to secondary education, and no-causality was found between GDP per capita and tertiary education.

In Algeria, numerous studies examined the relationship between education and economic growth using different methodologies and various education proxies. However, only few papers have focused on levels of education and growth. Oukaci et al. (2015), for instance, by applying a VAR model, find primary and tertiary education impact positively economic growth during the period 1970-2009. Becheriar (2014) used an ARDL model to distinguish between shot-run and long-run effect of all levels of education on growth over the period 1971-2011. His study reveals that both secondary and tertiary education is statistically significant in the short run, but in the long run, only tertiary education contributes to growth.

3- THE ALGERIAN EDUCATIONAL SYSTEM: AN OVERVIEW:

The Education System in Algeria comprises three distinct subsystems namely: the national education system, higher education system, and vocational education and training system. The structural organisation of these three subsystems is based on a set of basic principles:

- ✓ The principal of educational system unity,
- ✓ The principal of coherence among the three components of educational system,
- ✓ The principal of consistency among them.

Among the important reforms of the educational system curried out in Algeria are those which have been implemented in the national education system. This latter is the basis on which the higher education and vocational training systems stand. Over the last few decades, the national education system witnessed several reforms. The latest one consists in the structural reform launched in 2004 where the national education system has been restructured as follows: Primary education which lasts nine years. It comprises five years in elementary school which was six years before, and four years in low secondary school which was three years before. High secondary education lasts three years and ends with passing baccalaureate exam.

In addition to the reforms of the national education system, the higher education also has been important reforms. The recent rearm carried out in 2004 was radical the new structure of this educational stages is LMD (Licence, Master, and Doctorate). This system aims to make the content of knowledge consistent and identical at the national level. Thus, the students' movement will be easier among various national universities. Also, the teaching methods have been changed where the student becomes the focus of the educational process. Moreover, new technologies are used in teaching to keep up with recent trends worldwide. In addition to that, evaluation methods have been changed.

Based on national statistics office (ONS, 2020), the educational system witnessed an increasing trend in terms the number of pupils and students enrolled at the various educational levels. In 1971, the total number of pupils enrolled at primary education was 1887148 and in 2018 it increased to 4429994. During the same period, the number of pupils enrolled at secondary education increased from 186261 to 4075023. In tertiary education, the number of students increased from 19734 to 1600676 over this time of period. In fact, this evolution refers mainly to demographic growth and the educational policy that tends to generalise and democratize education in Algeria since it independence.

4- DATA AND METHODOLOGY:

4-1- DATA:

Due to data limitation regarding gross enrolment rate at the three different levels of education, this study covers only the period 1987-2011. As shown in table (1), all variables were sourced from Word Bank database except labour variable. Only gross domestic product per capita (GDP) is given in monetary value. The independent variables are all of them given in percentage. Therefore, only the dependent variable (real GDP per capita) has been transformed into natural logarithmic. Table (1) displays the variables used in this study with their sources.

Table (1): Sources of variables

Variable	Symbol	Source
Gross domestic product per capita ($ US constant, 2010)	GDP	World Bank
Gross fixed capital formation as % of GDP	GFCF	World Bank
Active population as % of total population	LAB	National Office of Statistics (Algeria)
Gross enrolment rate in primary education (%)	PRIM	World Bank
Gross enrolment rate in secondary education (%)	SEC	World Bank
Gross enrolment rate in tertiary education (%)	TER	World Bank

4-2- METHODOLOGY:

In investigating the relationship between education and economic growth, the following model can be specified:

$$\text{Ln}GDP_t = \alpha_0 + \alpha_1 GFCF_t + \alpha_2 LAB_t + \alpha_3 EDU_t + \mu_t \qquad (1)$$

where GDP is a measure of economic growth, GFCF is a proxy variable of physical capital, LAB is labour and EDU is a measure of education. μ is a white noise term.

This study applies the ARDL approach introduced by Pesaran et al. (2001). This technique has various advantages. Firstly, the ARDL does not impose conditions that all variables must be integrated of the same order. Instead, this approach can be used whether the

variables are integrated of order I (0), I (1) or both of them. Secondly, the ARDL is suitable even the sample size is small. Thirdly, this technique enables to test both short-run and long-run relationships among variables.

The analysis of the relationship between variables of this study occurs through the estimation of three distinct ARDL models. The first model - described in equation (2) - uses gross enrolment rate (GER) at primary education as a proxy variable of education, while models (2) and (3) use the same measure but for secondary and tertiary education as described in equations (3) and (4) respectively. After the estimation of the models (2), (3) and (4), bounds test is applied based on F-statistic. The null hypothesis H (0) of no long-run relationship is tested against the alternative hypothesis I (1). The critical bounds have been tabulated by Pesaran et al. (2001). If the F-statistic is less than the lower critical bound I (0), then there is no co-integration, but if it is more than the upper critical bound I (1), so there exists co-integration. The decision about co-integration will be inclusive if F-statistic lays between I (0) and I (1). The optimal order of lags is selected by Schwartz Bayesian Criterion (SBC) as recommended by Pesaran et al. (2001).

$$\Delta \ln GDPPC_t = \alpha_0 + \sum \beta_1 \Delta \ln GDPPC_{t-1} + \sum \beta_2 \Delta\, GFCF_{t-1} + \sum \beta_3 \Delta\, LAB_{t-1} + \sum \beta_4 \Delta PRIM_{t-1} + \delta_1 \ln GDPPC_{t-1} + \delta_2\, GFCF_{t-1} + \delta_3\, LAB_{t-1} + \delta_4\, PRIM_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta \ln GDPPC_t = \alpha_0 + \sum \beta_1 \Delta \ln GDPPC_{t-1} + \sum \beta_2 \Delta\, GFCF_{t-1} + \sum \beta_3 \Delta\, LAB_{t-1} + \sum \beta_4 \Delta SEC_{t-1} + \delta_1 \ln GDPPC_{t-1} + \delta_2\, GFCF_{t-1} + \delta_3\, LAB_{t-1} + \delta_4\, SEC_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta \ln GDPPC_t = \alpha_0 + \sum \beta_1 \Delta \ln GDPPC_{t-1} + \sum \beta_2 \Delta\, GFCF_{t-1} + \sum \beta_3 \Delta\, LAB_{t-1} + \sum \beta_4 \Delta TER_{t-1} + \delta_1 \ln GDPPC_{t-1} + \delta_2\, GFCF_{t-1} + \delta_3\, LAB_{t-1} + \delta_4\, TER_{t-1} + \varepsilon_t \quad (4)$$

where β_1, β_2, β_3 and β_4 refer to short run while δ_1, δ_2, δ_3 and δ_4 refer to long run parameters.

Once the long-run relationship is proved, then both short-run and long-run equations can be estimated. To check the robustness of the three models, various tests are used namely: serial correlation LM test, normality test, heteroskedasticity test and Ramsey test. In addition, both CUSUM and CUSUMQ are used to check the goodness of fit for ARDL.

5- RESULTS AND DISCUSSIONS:

Prior to use ARDL approach, the primary condition is to check that the series used are integrated I(0), I(1) or mutually cointegrated. But if they are found I(2), then it becomes impossible to use this method. To do so, two stationary tests are performed namely: the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP). Both with the null hypothesis that series have unit root which means that they are non-stationary. The hypothesis of acceptance of unit root at 5% of significance is adopted here. The results of the tests are reported in Table (2). It shows that all variables used in this study are non-stationary variables. They are stationary at first difference I(1).

Table (2): Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) stationary test

Regressor	ADF		PP		
	Intercept	trend + Intercept	Intercept	trend + Intercept	
LnGDP	-0,088612	-0,809630	0,009167	-2,223611	**I (1)**
Δ lnGDP	-3,184266**	-3,356813	-3,166516**	-3,371615	
GFCF	-1,665603	-1,883301	-1,665603	-1,954711	**I (1)**
ΔGFCF	-4,001165*	-4,215233**	-3,914011*	-3,546034	
LAB	-2,579194	-2,551977	-2,535545	-2,500918	**I (1)**
ΔLAB	-6,280807*	-6,205497*	-6,415779*	-6,514189*	
PRIM	0,590660	-1,978898	0,914743	-1,978898	**I (1)**
ΔPRIM	-4,696745*	-4,821284*	-4,697590*	-4,860969*	
SEC	0,566063	-2,034923	1,808715	-1,241542	**I (1)**
ΔSEC	-4,252430*	-5,174371*	-3,892742*	-5,253223*	
TER	2,712323	-0,646769	3,055795	-0,661234	**I (1)**
ΔTER	-3,162637**	-3,677536**	-3,162637**	-3,899827**	

*Notes: * and ** denote significance at 1% and 5% levels respectively*.

Source: computed using E-views (9).

Since all variables are integrated of order I (1), it becomes now possible to apply ARDL method. But prior to that, it is important to choose the optimal lag length. Given a relatively small sample size (26) and the use of annual data, the length used is two as proposed by Pesaran et al. (2001).

To investigate the presence of a long-run relationship among variables, ARDL bounds test is used. The critical values considered here are obtained from Narayan (2005). Based on table (3), F-statistic is higher than the upper bound critical value at significant level 5% for model (1) and 10% for model (2). However, regarding model (3), F-statistic value falls between lower and upper bounds critical values at 5%. This implies that null hypothesis of no long-run relationship is rejected for models (1) and (2). That means there exists a long-run relationship among variables in these two models. For model (3), the F-statistic value falls within lower and upper bounds critical values. Hence, it is not obvious whether there is or there is not a long-run relationship.

Table (3): ARDL co-integration test - bounds test

Models	Optimal Length	F-statistic	
Model 1	3	3,961466	
Model 2	3	3,657881	
Model 3	3	2,935856	
		Critical values	
Significance Level	1 %	5 %	10 %
Inferior limit I (0)	3,65	2,79	2,37
Superior limit I (1)	4,66	3,67	3,2

Source: computed using E-views (9).

In light of these results, only models (1) and (2) will be estimated. To do so, SBC criterion is chosen. We consider ARDL (1,0,0,0) for model (1) and ARDL (4,4,4,4) for model (2). Table (4) shows that both primary and secondary education contribute positively and

significantly to economic growth in the long run, and that primary education contribution is slightly more than secondary education.

Table (4): Estimated long run coefficients based on ARDL approach

Regressors	Model 1		Model 2	
	Coefficient	p-value	Coefficient	p-value
PRIM	0,026	0,01	-	
SEC	-		0,016	0,01
GFCG	-0,013	0,30	-0,024	0,14
L	-0,020	0,17	-0,005	0,74
C	6,802	0,00	8,019	0,00

Source: computed using E-views (9).

In the short run, the results reported in table (5) indicate that only secondary education matters for economic growth, but with limited impact; 1% increase in gross enrolment rate in secondary education will increase GDP by only 0,21%. This finding is consistent with Romer (2001) who suggests that primary education has indirect long-term effects on economy. This is why it might not have any impact in the short term.

Table (5): Error correction representation for the selected ARDL model

Regressors	Model 1		Model 2	
	coefficient	p-value	Coefficient	p-value
ΔPRIM	0,003	0,29	-	
ΔSEC	-		0,002	0,03
ΔGFCG	-0,001	0,47	-0,001	0,30
ΔL	-0,002	0,23	-0,001	0,45
cointEq (-1)	-0,153	0,00	-0,163	0,00

Source: computed using E-views (9).

The coefficient of the error correction term (coinEq(-1)) is the speed of adjustment coefficient towards achieving long-run equilibrium after a short-run shock. Its value is (-0,153) implying that following a chock in the short term, GDP will take 6,5 years to reach equilibrium again (1/0,153). For model (2), equilibrium take place after nearly 6 years after a chock happens in the short run since error correction term is (-0,163).

Finally, to ensure the goodness of fit of the ARDL models, diagnostics and stability tests are conducted. The results shown in table (6) denote that there is no evidence of serial correlation or heteroskedasticity. Also, the residuals are normally distributed and that the functional forms of the three models appear well specified. Furthermore, the stability test for both short-run and long-run using cumulative residuals (CUSUM) and cumulative sum of squares of recurative residuals (CUSUMQ) confirm that the estimated models are stable and correctly specified with no systematic changes observed at 5% significant level. (See Appenix)

Table (6): Diagnostics tests

Tests	Model 1	Model 2	Model 3
Breush-Godfrey serial correlation LM test	0,668792	0,592807	0,827810
	(0,5253)	(0,5638)	(0,4539)
Histogram: normality test Jarque-Bera	0,828638	1,520996	0,955797
	(0,660791)	(0,467434)	(0,620085)
Heteroscedasticity test : Breush- pagan-Godfrey	1,078427	0,130281	0,957942
	(0,3948)	(0,9694)	(0,4530)
Ramsey (RESET) test	0,339763	0,639368	0,507491
	(0,5672)	(0,4344)	(0,4854)

Notes: The probability values for the diagnostic tests are given in parenthesis.

Source: computed using E-views (9).

CONCLUSION:

It is well established since the emergence of human capital theory that education is a key-element of economic growth. For developing countries, defining the education level that matters most for growth is very essential to design effectively education policy and efficiently devote public funds among education levels.

This paper aimed at investigating the short- and long-run relationship between education levels and economic growth in Algeria during the period 1987-2011. To do so, an ARDL cointegration approach was employed. Summing up the results, it can be concluded that both primary and secondary education levels impacts positively and significantly economic growth in the long run. However, in the short run, only secondary education has such impact. These findings corroborate the idea that primary and secondary education levels are more important for developing countries than higher education. This reinforces also the idea that development stage is closely related to educational level.

In the light of these results, it is recommended that devoting much more funds to primary and secondary education can be seen as a rational public choice to strengthen the role of these two sectors in economic growth.

Finally, needless to say that using proxy variable for education quality instead of gross enrolment rate will offer robust results regarding the impact of education levels on growth. Future work will involve this issue. Furthermore, enlarging time series is also desirable since this study used a relatively small size period due to data constraints.

Bibliography List:

1. Becherair, A. (2014). Education and economic growth in Algeria: An emperical investigation by using ARDL approach. *International journal of innovation and applied studies , 7* (3), 1215-1224.
2. Becker, G. (1964). *Human capital: A theoritical and empirical analysis, with special reference to education.* New York: National Bureau of Economic Research.
3. Denison, E. (1962). Education, economic growth and gaps in information. *Journal of political economy , 70*, 124-128.
4. Gumus, S., & Kayhan, S. (2012). The relationship between economic growth and school enrollment rates: Time series evidence from turkey. *Educational policy analysis and strategic research , 7* (1), 24-38.

5. Loening, J. (2005). *Effects of primary, secondary and tertiary education on economic growth: Evidence from Guatimala.* Washington: World Bank policy research working paper.
6. Mendy, D., & Widoto, T. (2018). Do education levels matter on Indonesian economic growth? *Economics and Society , 11* (3), 133-146.
7. Nowak, Z., & Dahal, G. (2016). The contribution of education to economic growth: Evidence from Nepal. *International journal of economic sciences , 5* (2), 22-41.
8. ONS. (2020). *office national des statistiques*. Consulté le 2020, sur www.ons.dz
9. Oukaci, K., Bouzmit, M., Abderrahmani, F., & Ferfira, M. (2015). Contribution du système éducatif à la croissance économique en Algérie. *Les cahiers du MECAS* , 113-123.
10. Pegkas, P. (2014). The link between educational levels and economic growth: A neoclassical approach for the case of Greece. *11* (2), 38-54.
11. Pesaran, M., Shin, Y., & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics , 16*, 289-326.
12. Petrakis, M., & Stamatakis, D. (2002). Growth and educational levels: a comparative analysis. *Economics of education review , 21*, 513-521.
13. Schultz, T. (1960). Investment in human capital. *The American economic review , 51* (1), 1-17.
14. Shamista, S., & Grabowski, R. (2004). Does education at all levels cause growth? India a case study. *Economics of education review , 23*, 47-55.
15. Singh, N., Sieng, L., & Saukani, M. (2018). Impact of education levels on economic growth in Malaysia: a gender base analysis. *Malaysian journal of society and space , 14* (4), 13-26.

APPENDICES:

Fig (1): Primary education

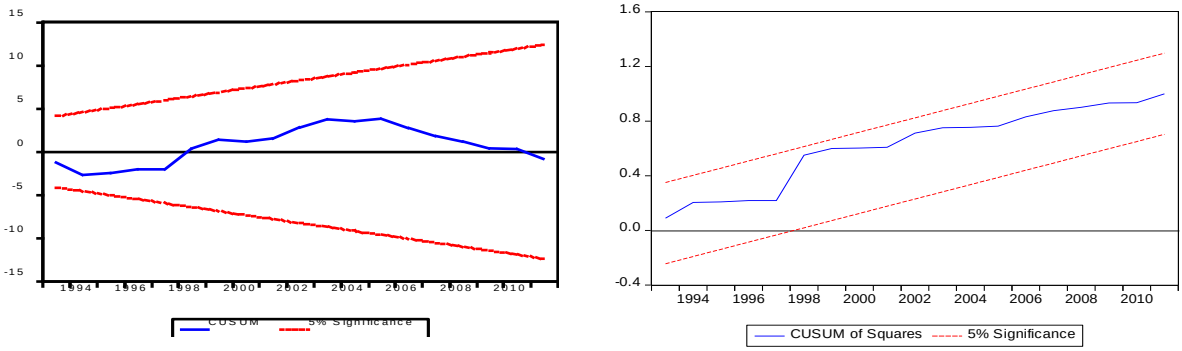

Fig (2): Secondary education

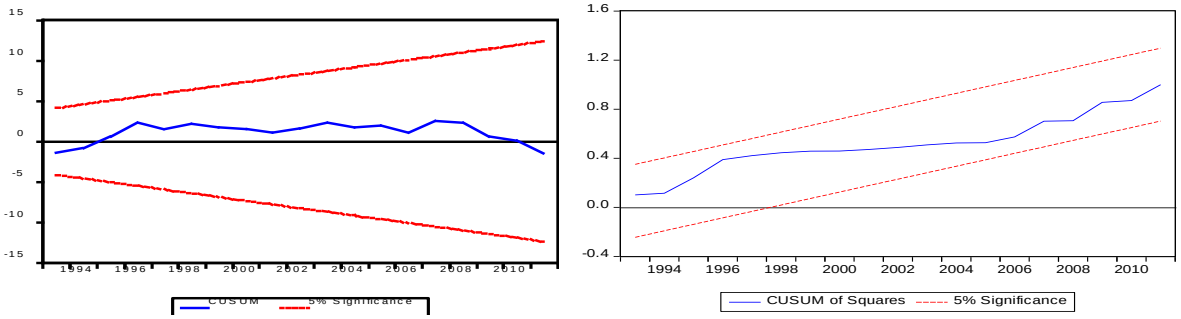

Fig (3): Tertiary education