# *The Impact of Investment in Education on Economic Growth in Algeria (1980-2015), Econometric StudyUsing ARDL Model*

# أثر الاستثمار في التعليم على النمو الاقتصادي في الجزائر (1980–2015)، دراسة اقتصادية باستخدام نموذج ARDL

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*Received*: 26/11/2019 *Accepted*: 27/02/2020

**Résumé:** Cette étude vise à examiner l'impact de l'investissement en éducation sur la croissance économique en Algérie durant la période (1980-2014), en se basant sur la fonction de production agrégée développée par Mankiw, Romer et Weil (MRW, 1992) et en utilisant le modèle autorégressif à retards échelonnés.

Les résultats de cette étude ont montré qu'il existe une relation d'équilibre et à long-terme entre la croissance économique (PIB) et l'éducation (le nombre moyen d'années d'études), mais cette relation est inverse et ceci ne concorde pas avec la théorie économique.

***Mots clés :*** Education ; Croissance économique ; ARDL ; Capital Humain ; Algérie

**Abstract:** This study aims to examine the impact of investment in human capital through education on the economic growth in Algeria during the period (1980 - 2015), according to the aggregate production function of Mankiw, Romer and Weil model, by using the ARDL model.

The results of this study have revealed that there exists a long-term equilibrium relation-ship between economic growth (GDP) and education (average number of years of study), but this relation- ship is inverse and this does not fit with economic theory.

***Key Words*:** Education; Economic growth; ARDL; Human capital; Algeria.

**JEL Codes :** H52, I22.

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**Introduction:**

Since the early 1960s, interest in education has taken a new turn. Many prominent economists such as Adam Smith, John Stuart Mill, Karl Marx, Alfred Marshall, and others have emphasized the importance of developing human knowledge and skills through educational processes and their contribution to the growth and development of the economy. The growth of the individual's abilities and readiness through education increases their productive capacities.

Such studies have also contributed to the analysis of the economic function of education so that education economics has become a major topic in the field of economics and even a branch of science itself, through its contributions in different economic, social, political, cultural and other aspects.

Algeria, like other countries, has paid special attention to human resources through free health and education systems. It has also devoted efforts to develop its educational system through educational planning, and has allocated significant amounts to its various sectors in order to obtain high quality outputs that contribute in economic growth.

**Research problem:** *What is the impact of investment in education on economic growth in Algeria?*

**The main hypothesis:** There is a significant positive correlation between education and long-term economic growth in Algeria.

**Research objectives:** The main purpose of the research derives from the fact that the development in the developed countries was the result of devoting greater attention to human resources, and focusing on the education and training of the human element and raising its awareness. Therefore, this study attempts to measure the quantitative impact of investment in education on the economic growth in Algeria and modelize this relationship during the period (1980-2014).

**Research Methodology:** To achieve the objectives of the study by responding to its questions and analysing and confirming the hypothesis, we have adopted a descriptive approach and analytical methods to tackle some important concepts about education and economic growth. We also used econometric tools (Eviews) to explain and analyze this relationship with an attempt to modelize it. We have also used a set of data provided by official sources such as: the National office of Statistics, World Bank data and the Barrow and Lee database.

**1. Previous studies and research findings:**

A number of studies and researches have been reviewed, including:

**1.1** The study of **BAOUNI Laila** entitled: "**Study of the relationship of human capital to economic growth - with an application on the case of Algeria -"**

This study aimed to examine the relationship between human capital and economic growth using panel data, as well as to highlight the importance of investment in human capital as a mainstay to create a competitive advantage for enterprises. This study has shown that there is a strong and significant impact of human capital on the economic growth for the countries sample, while finding that

human capital is one of the factors causing the delay of economic growth in Algeria, after the projection of the assessment results on Algeria.

**1.2** The study of **Hani Mohamed Nabil and Benmeriem Mohamed** entitled: **"Estimating the relationship between economic growth and human capital using the Augmented Solow model of MRW in Algeria".**

This study examined the impact of human capital, physical capital and labor on economic growth according to the Augmented Solow model of MRW. The study has revealed a positive and strong moral impact of the rate of human capital and physical capital growth on the rate of GDP growth, while a significant negative and strong impact of the rate of employment growth on the rate of GDP growth.

**1.3** The study of **Mehmet Mercan, SevgiSezer**(Mehmet Mercan, 2014, pp. 925-930)entitled: "**The effect of education expenditure on economic growth: The case of Turkey".**

The aim of this study was to investigate the relationship between education expenses and Turkish economic growth for the period 1970-2012, using the bounds test approach to test the existence of a cointegration relationship between education expenditure and economic growth expressed in real GDP. In addition, the unrestricted error correction model and the regression estimation model have been used to determine a short and long term relationship. The study found a positive correlation between education expenditures and economic growth, where an increase of 1% in education expenditures lead to an increase of economic growth by 0,3 per cent.

**1.4** The study of **Arusha V. Cooray**(Cooray, 2009, pp. 1-27)entitled: "**The role of education in economic growth".**

This study focused on the impact of the quantity and quality of education on economic growth during the period 1999-2005, using a number of quantitative and qualitative variables to measure education in a group of low- and middle-income countries estimated at 46 countries identified by the World Bank. This study has concluded that the impact of human capital on economic growth tends to be based on econometric methods. The results have indicated that school enrollment rates are positive and very important for economic growth, and increased government spending on education improves the quality of education, which in turn positively affects economic growth.

## 2. Conceptual Framework for Investment in Education:

During the last few decades, economists have shown great interest to the importance of education and investment in human capital as a vital element in the increase of economic growth.

### 2.1 Definition of Education:

*Education*, according to UNESCO, is defined as the teaching of individuals (including education and training) and the development of their capacities in a comprehensive, integrated, individual and collective manner to qualify them for

active and positive participation in development plans. Education is a human investment and a form of intellectual and non-material investment.

*Education* is a mental activity that identifies, guides and controls processes for using them with new information so that they become an essential part of the knowledge stored in the student's memory for a long time (Wood, 2011, p. 12).
With the advent of the theory of human capital, the perception of the concept education has changed. Hence, it has been defined as a rational behavioural economic activity aiming at building mental, behavioral, moral, social and intellectual capacities of an individual. And this must be carried at random and by any means, because it tries to develop and increase the individual's knowledge, skills and attitudes.

**2.2 Education indicators:**

The most important indicators of the educational system agreed upon by researchers can be classified as follows:

**a. Schooling rate**: The schooling rate refers to the ratio of the number of pupils enrolled in the primary and middle stages to the number of children between the ages of 6 and 15, as well as secondary and even higher education.

**b**. **Average number of years of schooling**: refers to the average number of years of schooling for children aged 15 years and above, based on the level of educational attainment of the population calculated by the years of study that the student is supposed to spend at each stage of education (ONU, 2010, p. 228).

**c. Illiteracy Index:** The illiteracy rate is one of the most important indicators used to quantify the stock of human capital. The spread of illetracy affects the productivity of the individuals and constitutes an obstacle to the improvement of development conditions and poverty eradication. Two indicators are proposed:

**c1. The illiteracy rate for the age group 15-24 years**

**c2. The illiteracy rate for the age group 15 years and above.**

**d. Literacy rate**: refers to the proportion of the population aged 15 years and above who have the ability to write, read and understand a short and easy passage about their daily lives (ONU, 2010, p. 229).

**e. Public expenditure on education**: the sum of public expenditures on education, plus subsidies and transfers for private education at different levels of education, calculated as a percentage of GDP.

**f. Outputs of the educational system**: includes the outputs of basic, secondary and higher education, as well as the outputs of education and vocational training and vocational centers, and it also includes drop out of different stages of education.

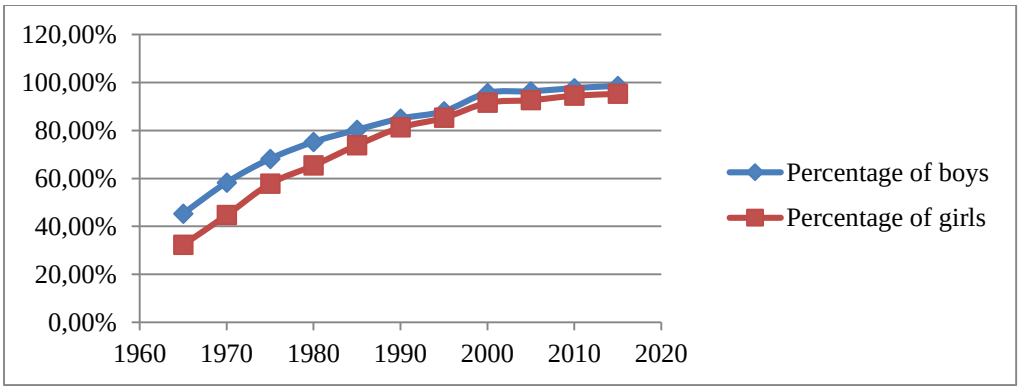
**g. Education Index:** a combination of primary, secondary and tertiary enrollment rates, literacy rate and framing rates.

**2.3 Some indicators of education in Algeria:**

**a. Evolution of the proportion of schooling**: School attendance is related to the number of pupils enrolled or attending in primary and secondary schools, these children are aged between 6 and 15 years.

The following figure summarizes the data on school attendance rates for the period (1965-2015):

**Fig.1: Evolution of school attendance rate for children aged 6-15 years (1965-2015)**

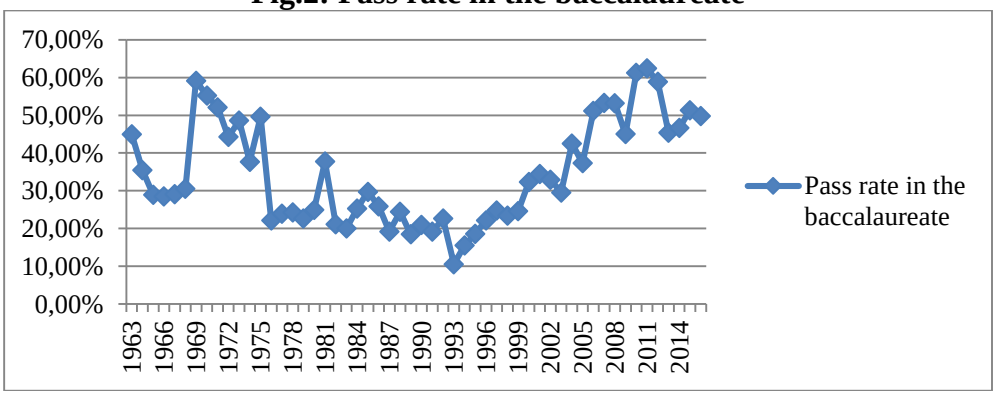



**Source**: This figure is based on the National office of Statistics data

From the above curve, the rate of schooling has been steadily improving since independence, reaching 45.28% in the 1965/66 academic year, and rising slowly in the early 1970s. During the 1980s, the rate of schooling witnessed a significant improvement and increased significantly in the nineties, hence it was estimated at 87.92% in the school year 1995/96, as a result of the improvement of security conditions in the country, to reach the highest rate of schooling in 2014/2015 by 98.48%. The percentage of girls participation in education was very low at the beginning of independence and reached about 32.28% in the academic year 1965/66 to increase gradually in the following years reaching 57.79% in the academic year 1974/75. In the 1990s, it exceeded 80% to reach 95.26% in the 2014/2015 school year.

**b. Evolution of exam results:** The following figure shows the evolution of the results of the baccalaureate exam from 1963 to 2015:

**Fig.2: Pass rate in the baccalaureate**



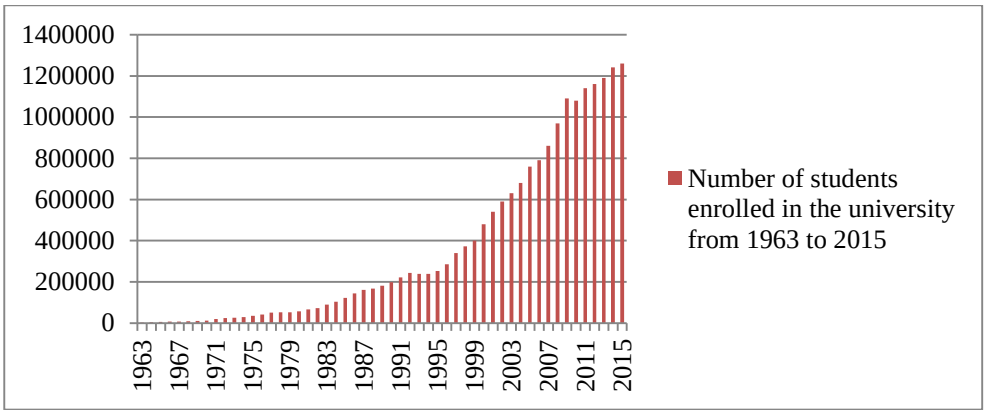

**Source**: The National office of examinations and contests

There are two stages: the pre-1990s period during which the results were generally low with an average of less than 30%. The second period of the 1990s and beyond, mainly after the academic year of 1992/93 which witnessed the lowest pass rate in the history of secondary education with a percentage of 11.98%. After that, there has been a constant improvement in the results which reached about 53.3% in 2007, and then the percentage has been kept stable between 45% and 60%.

**c. Evolution of the number of students enrolled and the number of university graduates**:

The number of students enrolled in higher education represents the most important element of the inputs of the productive process of the sector. It largely affects the expansion of the university network both in terms of infrastructure and in terms of the number of branches and disciplines. The following figure shows the evolution of the number of students enrolled in the university during the period (1963-2015):

**Fig.3: Number of students enrolled in the university (1963-2015)**

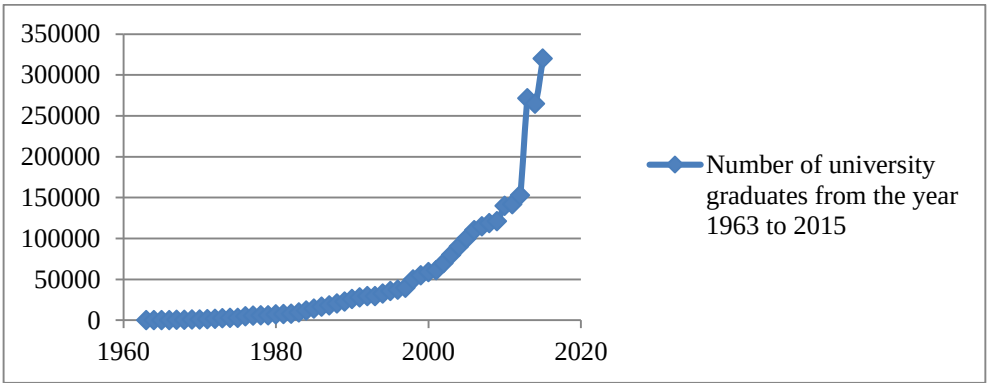



**Source**: This figure is based on data from the Ministry of Higher Education and Scientific Research, Directorate of Development and Planning

We notice from the statistical data represented in the figure above that there is a significant increase in the number of students enrolled in higher education. The number of students in Algerian universities rose from 2725 students in 1962/63 to 181350 students in 1989/1990, and has steadily increased to account for 1241550 students in 2014 / 2015. This increase results from the increasing access to higher education and the remarkable improvement in the success rate of the baccalaureate exam. This evolution has led to a doubling of the number of university graduates.

The following figure shows the evolution of the number of university graduates during the period (1964-2015):

**Fig.4: Number of university graduates (1963 to 2015)**




**Source**: This figure is based on data from the Ministry of Higher Education and Scientific Research, Directorate of Development and Planning

We notice from the figure above that within 40 years since independence, the Algerian University has managed to form nearly 600,000 graduates. The Decade 2001-2011 witnessed the graduation of 1393000 students, as 271430 students graduated in the academic year 2013/2014.

## 3. Conceptual Framework for Economic Growth:

Economic growth has attracted the attention of many economists from different countries. Today, it is one of the most important key terms for economists, being the key to measuring the evolution and progress of nations; it represents the development of the overall economic activity.

### 3.1 Definition of Economic Growth:

The concept of economic growth is regarded as the quantitative and qualitative increase in the level of the national product of goods and services resulting from the increase of factors of production and the improvement of their productive efficiency over a relatively long period of time. Thus, economic growth seems to result from economic expansion over a relatively long period of time (Vanhove, 1996, p. 53).

- Jacques Lecaillon defined economic growth as "The amount of expansion or increase in domestic production in the long run, so that economic growth differs from the concept of economic expansion which implies a situational increase in production".
- Economic growth is also defined as increasing the capacity of the country to produce goods and services. The greater the growth rate of the national economy than the population growth rate is, the better that is, because it will lead to higher living standards for individuals.

### 3.2 The relationship between education and economic growth:

Many studies have attempted to investigate the impact of education on the increase in GNP using statistical processing such as calculating the correlation between increasing spending on education or increasing the number of years of

schooling, or improving the educational level of workers, and the increase the productivity of educated workers on the other hand.

Factor analysis methods were used to calculate the role of each factor of production, in addition to calculating the role of the technical level of machines, the performance of workers, their skills and their level of education or training in income generation and growth. Education also contributes to economic growth through all its phases. For low-income countries, education should focus on basic or primary education through education for all. Moreover, investing in secondary education and vocational training yields individual and social benefits and provides the skills required for the economic growth of low- and middle-income countries. Higher education as well, provides quality outputs linking the university with private and public sectors and thus contributing to growth.

Education also contributes to macroeconomic growth through the following elements: (Todaro, 2014, p. 124)

• Creating a more productive workforce and providing it with the necessary knowledge and skills.

• Providing employment opportunities for teachers and school workers.

• Accreditation of a group of teacher educators to replace foreigners in government, union's private enterprises and professional and vocational training projects.

• Providing some kind of training and basic skills and encouraging the acceptance of modern trends by people.

It has been stated in the study of Denison on economic growth in the United States of America in the years 1909-1929 and 1929-1957 that about 10% of economic growth in the period 1909-1929 was due to improved education, both by increasing the number of years of schooling and the number of school days, and that about 21% of the growth from 1929 to 1957 was also due to the impact of education improvement.

Denison also examined the role of education in increasing growth in Europe in the 1950s and 1960s, yielding 5% to 15% of growth from the impact of education. While Schultz's study attributed 20% of economic growth in the United States of America from 1929 to 1957 to the improved level of education.

Several recent studies have tackled such relationship, including the Barrow study using data from 98 countries from 1960-1985, and student enrolments rates in primary and secondary schools as variables reflecting the initial human capital. He concluded that these rates have a positive impact on the growth of Gross Domestic Product per capita. These studies have confirmed the increasing role of education in increasing production, although they tend to differ from each other in evaluating this role.

**3.3 Human capital in endogenous growth models (MRW model):**

The most important characteristic of the theory of endogenous growth is that it gives great importance to knowledge and human capital. In this study we adopted the model proposed by Mankiw, Romer and Weil (MRW), in which they developed the Solow model by incorporating human capital separately from

physical capital and considering it as an internal variable that directly affects production. This factor is thus added to the model just as other factors (physical capital and labor. The model is based on the premise that human capital accumulates in the same way as physical capital does, which can be expressed in physical units. Thus, human capital develops with the development of knowledge due to investment in education and health with regard to the fact that the accumulation of years of study of the working class contributes to the doubling of labor productivity and thus to the increase of the overall economic productivity. In this sense, the model is known as the Solow model of human capital and the mathematical formula for this model is written as follows (Mankiw & Romer, 1992, p. 416):

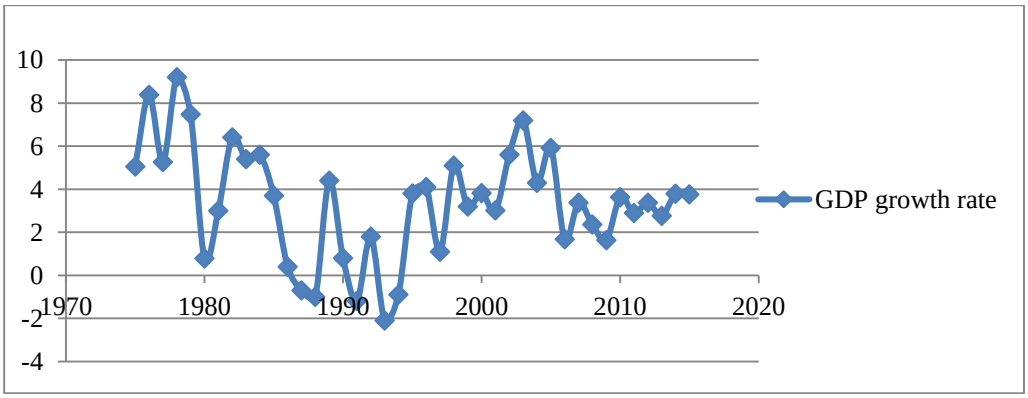
$$\gamma_{t=K_t^{\alpha} H_t^{\beta} (A_t L_t)^{1-\alpha-\beta}} \ldots\ldots(1)$$

So that α and β are constants, γt represents the level of production, At represents the technological level, Kt represents the physical capital, Ht human capital, Lt work, At Lt reflects the volume of efficient labor.

**3.4 Evolution of the GDP Growth Rate in Algeria:**

During the last two decades, GDP has undergone several changes and fluctuations resulting from the instability of the national economy as a whole, given the situation in Algeria at that time. The following figure shows the evolution of growth rates of GDP in Algeria during the period (1980-2015):

**Fig.5: Gross Domestic Product rate (GDP)**




**Source**: This figure is based on data from the World Bank

The above graphical representation shows the fluctuating and unstable changes in the growth rate. During the period 1982-1988, the growth rates decreased significantly and became negative, it shifted from 6.4% in 1982 to -0.7% in 1987 and -1% in 1988. This was due to many reasons such as: the sharp decline in oil prices in international markets, the deterioration in the value of the dinar in 1987 which led to the deficit in foreign trade and the adopted economic policy (five-year plan).

In early 1989, GDP growth rates were positive as Algeria engaged in a set of economic reforms and foreign debt. However, despite the goals that the state attempted to achieve through these reforms, the results were not satisfactory, and the growth rate turned negative again estimated at -1.2% in 1991. This led Algeria to make an agreement with the International Monetary Fund in 1994 and set a program for economic balance which had positive effects except for the social side as the results of that time have shown.

Since 1995, growth rates have turned positive to reach 5.1% in 1998. Hence, growth rates have been kept stable in positive values, although they recorded some declines in 2000 and 2001. In the following years, however, a significant rise to 7.2% has been achieved in 2003 due to the oil revenues. The level of growth was defined as a real economic breakthrough starting from the implementation of the economic recovery program and the complementary program (2001-2009), as well as the program of consolidating growth (2010-2015).

## 4. Modeling the relationship between education and economic growth in Algeria during the period (1980-2015) based on the model (ARDL):

Economic growth is influenced by many internal and external variables and factors. In this econometric study of the impact of investment in education - measured by the average number of years of study - on economic growth - measured by GDP - in Algeria, I have chosen the period between 1980-2015 for the availability of information about variables in this period. Annual data were counted on 35 views of each variable in local currency at constant prices, and information was obtained from various sources such as the National Bureau of Statistics ONS, the World Bank database WB and the database of Barrow and Lee.

### 4.1 ARDL introduced:

The ARDL methodology was developed by Shin and Sun (1998), Pesaran (1997) and et al Pesaran. This method is distinguished from other tests as it does not require time series integration of the same order. The general formula of the ARDL model is composed of the dependent variable Y and the number of K explanatory variables x1, x2,…xk as:

$$\Delta\boldsymbol{\gamma_t} = \boldsymbol{c} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{p}} \boldsymbol{\beta_{1i}}\Delta\boldsymbol{Y_{t-1}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{q_1}} \boldsymbol{\beta_2}\Delta\boldsymbol{X_{1_{t-1}}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{q_2}} \boldsymbol{\beta_3}\Delta\boldsymbol{X_{2_{t-1}}} + \cdots + \sum_{\boldsymbol{i=0}}^{\boldsymbol{q_k}} \boldsymbol{\beta_k}\Delta\boldsymbol{X_{k_{t-1}}} + \boldsymbol{\alpha_1 Y_{t-1}} + \boldsymbol{\alpha_2 X_{2_{t-1}}} + \boldsymbol{\alpha_3 X_{3_{t-1}}} + \cdots + \boldsymbol{\alpha_k X_{k_{t-1}}} + \boldsymbol{\epsilon_t}$$

Where: c fixed term, Δfirst order differences, K number of variables, P period of slowing dependent variable, q1, q2,… qk intervals of slow explanatory variables x1, x2,… xk respectively, β1, β2,… β k Short-term relationship coefficients, α1, α2,… αk long-term relationship coefficients, t random error limit.

The ARDL model is tested by two hypotheses:

- Null hypothesis: Lack of common integration (long-term equilibrium relationship) between variables, which is:

$\alpha_1= \alpha_2= \alpha_3= \alpha_4= \alpha_5= \alpha_6= 0$

- Alternative hypothesis: the existence of a common integration (long-term equilibrium relationship) between the variables, which is:

$\alpha_1\neq\alpha_2\neq\alpha_3\neq\alpha_4\neq\alpha_5\neq\alpha_6\neq 0$

The ARDL model test involves testing a long-term equilibrium relationship between model variables. Once the relationship is confirmed, we proceed to estimate long-term parameters as well as parameters of independent variables in the short term. The econometric method can be summarized by the ARDL model in the following steps:

• Ensuring that all time series are stable from class 0 or class I, except class II.

• Creating an unrestricted error correction model which is a special model of the ARDL model.

• Ensuring that the model is free from the serial link problem.

• Ensuring the stability of the model dynamics.

• Determining the optimal slow-down period for the first differences of the values of variables in the UECM model, using several different criteria to determine this period: Akaike (AIC 1973), Schwarz (SC1978), Hannan and Quinn (1979), Final Prediction Error (FPE).

• Applying of Bounds test to find out if there is a long-term equilibrium relationship by comparing Fstatistic with tabular values set by Pesaran et al (2001) at the lower and upper bounds and at the established moral bounds to test the possibility of a common integration relationship between Variables. Thus, we distinguish between three cases:

- If Fstatistic is greater than the proposed upper bound of critical values, we reject the null hypothesis and accept the alternative hypothesis which means the existence of a long-term equilibrium relationship between the study variables.
- If Fstatistic is less than the suggested upper bound of critical values, we accept the null hypothesis which means the non-existence of a long-term equilibrium relationship between the study variables.
- If Fstatistic falls within the lower and upper bounds proposed for critical values, the results will be inconclusive, meaning that the decision cannot be made to determine whether there is a cointegration between the variables or not.

• If the results are positive i.e., they confirm the existence of a cointegration relationship; the long-term relationship should be estimated separately from the unrestricted error correction model (UECM).

• Using the results of the model estimated in the previous step to measure the dynamics of the effects of the short-term relationship and the long-term equilibrium relationship between the variables.

**4.2 Variables and model of the study:**

Based on the previous experimental studies, this study is based on the production function of the type Cobb-Douglas, proposing a study model derived from endogenous growth models of the MRW model. The **EVIEWS** program is also used to examine and test the variables as well as to estimate the model. We have relied on the following variables:

Dependent variable: Economic growth expressed in real **GDP**.

Independent variables: The average years of schooling for adults aged 15 years and over, referring to by **H**, **K** stands for capital stock, **L** stands for labor force, **X** stands for exports.

The mathematical form can be formulated as follows:

GDP = f (H. K. L. X)

**a. Study of Time Series stationarity:** The stability of time series variables of the study variables was tested using the Augmented Dicky Fuller test (ADF) and Philip Peron (PP). The stability of the variables was judged by the ADF test by comparing the tabular value with the calculated T value (absolute value). If the tabular value is greater than the calculated T, this means that the variable is non-stationary and vice versa.

The unit root test revealed that all variables are stationary at the first difference I(1) and at a significant level of 5%, and that there are no stationary variables from the second I(2). This is a prerequisite for estimating the ARDL.

**b. Estimation of ARDL**: Our model can be formulated according to the following equation:

$$\Delta LGDP_t = c + \sum_{i=1}^{p} \beta_{1i} \Delta LGDP_{t-i} + \sum_{i=0}^{q1} \beta_2 \Delta LH_{t-i} + \sum_{i=0}^{q2} \beta_3 \Delta LK_{t-i} + \sum_{i=0}^{q3} \beta_4 \Delta LL_{t-i} + \sum_{i=0}^{q4} \beta_5 \Delta LX_{t-i} + \alpha_1 LGDP_{t-1} + \alpha_2 LH_{t-1} + \alpha_3 LK_{t-1} + \alpha_4 LL_{t-1} + \alpha_5 LX_{t-1} + t$$

**Hence:** Δ first order differences, C constant bound, P, q1, q2, q3, q4 the upper bound of time slots for the variables LX, LL, LK, LH, LGDP, respectively, t time direction, t random error bound, β1 , β2, β3, β4, β5 short-term relationship factors (error correction), α1, α2, α3, α4, α5 long-term relationship factors.

**c. Determining the optimal number of time slots for variables**: The information standard (Akaike) which is the most common standard as well as Schwarz and Hannan-Quinn standards were used.

The following table shows the results of the test of the optimal time delay periods P, q1, q2, q3, q4 for dependent and independent variables.

**Table 01: Test Results of optimal time delay periods**

| optimal time delay periods | Q1 | Q2 | Q3 | Q4 | P |
|---|---|---|---|---|---|
| **Model** | 1 | 0 | 0 | 1 | 2 |

**Source**: This table is based on the output of 9 Eviews

**d. The bounds test of the ARDL model:** shows that the statistical value of the bound test is 4.54, which exceeds the critical value at the significant level of 2.5% for the upper bound 4.49.Accordingly, the null hypothesis which states that there is no long-term relationship between variables is rejected.

**Table 02: Bounds test results**

| Statistical test | the value | Numb.indep.var | The result |
|---|---|---|---|
| **Fstatistic** | 4.547434 | 4 | Long-term equilibrium relationship greater than level of 1% |
| **Tabular values of bounds** | Lower bound I(0) | Upper bound I(1) | |
| **At the level of 1%** | 3.74 | 5.06 | |
| **At the level of 2.5%** | 3.25 | 4.49 | |
| **At the level of 5%** | 2.86 | 4.01 | |
| **At the level of 10%** | 2.45 | 3.52 | |

**Source:** This table is based on the output of 9 Eviews

**e. Error correction model ARDL:** The following table shows the results of estimating the ARDL.

**Table 03: ARDL model estimation results**

| Variables | coefficient | Statistic t | probability |
|---|---|---|---|
| **Short-term model estimates** | | | |
| **D(LGDP(1-))** | -0.204846 | -2.045922 | 0.0519 |
| **D(LH)** | -0.461445 | -2.425657 | 0.0232 |
| **D(LK)** | 0.218297 | 7.780879 | 0.0000 |
| **D(LL)** | 0.070080 | 2.657007 | 0.0138 |
| **D(LX)** | 0.332943 | 6.531588 | 0.0000 |
| **CointEq(1-)** | -0.424682 | -6.076992 | 0.0000 |
| **Long-term model estimates** | | | |
| **LH** | -0.005013 | -0.040145 | 0.9683 |
| **LK** | 0.514024 | 15.307566 | 0.0000 |
| **LL** | 0.165016 | 2.302575 | 0.0303 |
| **LX** | 0.354422 | 7.045710 | 0.0000 |
| **C** | 2.385229 | 1.811591 | 0.0826 |

**Source**: This table is based on the output of 9 Eviews

**f. Test of the estimated model quality:** To detect the existence of the problem of autocorrelation we rely on LM Test, as for the problem of instability of Variance,

we rely on the Breusch-Pagan- Godfrey test. For the normal distribution of the residuals, we use the Jarque-Beratest. The results are shown in the following table:

**Table 04: Auto-correlation Test Results**

| | | | |
|---|---|---|---|
| **Fstatistic** | 1.413061 | Prob, f(2,22) | 0,2646 |
| **Obs*R-squared** | 3,756608 | Prob Chi-square | 0,1528 |

**Source:** This table is based on the output of 9 Eviews

From the table above, the value of Prob Chi-square is greater than 5%, ie 0.1528> 0.05 when the correlation score 2 is chosen. We therefore accept the null hypothesis which states that there is no autocorrelation among residuals and reject the alternative hypothesis. As for the test of the instability of the variance, the results are shown in the following table:

**Table 05: Variance test results**

| | | | |
|---|---|---|---|
| **Fstatistic** | **0.590280** | **Prob, f(8,24)** | **0.7761** |
| **Obs*R-squared** | 5.425545 | Prob Chi-square | 0.7113 |

**Source:** This table is based on the output of 9 Eviews

The above table shows that the value of Prob Chi-square is greater than 5%, i.e. 0.7113> 0.05.This confirms the null hypothesis i.e., there is no problem of inconsistency of error variation. For residual distribution, the following table shows the test results:

**Table 06: Residual distribution test results**

| | | | |
|---|---|---|---|
| **Probability** | 0.560933 | **Jarque-Bera** | 1.156307 |

**Source:** This table is based on the output of 9 Eviews

From this table we can see that the residuals follow the normal distribution thus, (0.05 <0.7761 P-value.

**4.3 Study results:**

**a. Statistical analysis:** We notice from the top of the table above which represents the error correction model (the short-term relationship), that all variables are statistically significant between the level 5% and 10%, and that the variables have negative and positive effect as follows:

- A high significance of the error correction factor of 0.0000 at 1% with a negative signal, which confirms the accuracy of the long-term equilibrium relationship and that the error correction mechanism is present in the model and this parameter reflects the speed of the model's adaptation to move from short-term imbalances to long-term equilibrium.
- The parameter (-0.424682) in our study model indicates that economic growth is moderate towards its equilibrium value by 42.46%, i.e., when growth during the

period (t-1) deviates from its long-term equilibrium value, 42.46% is corrected in the current period (t).

- The parameter number of years of study is significant but negative. It proves an inverse relationship between the variables, thus, an increase of 1% in the average school years leads to a drop of 0.4614% in GDP in the short term.
- Physical capital has a positive and significant effect on GDP growth in the short term, and an increase of 1% in physical capital leads to an increase in GDP by 0.21%.
- Employment has a positive and significant effect on GDP growth in the short term, and a rise of 1% in employment leads to an increase of GDP by 0.07%.
- Exports have a positive and significant effect on GDP growth in the short term, and a 1% increase in exports leads to a 0.33% increase in GDP.
- The bottom of the table represents the long-term relationship between economic growth and the independent variables under study, expressed in the equation below:

LGDP = -0.0055LH + 0.514LK = 0.165LL + 0.3544LX + 2.3852

- We notice from the previous equation that all the variables were statistically significant at the level of 5% and have a positive effect except for the variable of the average of the study years which proves to be non-significant and has a negative effect.

**b. Economic analysis:** It is clear from the previous results that the most influential variable in the rates of economic growth is physical capital, given that all the factors of physical production used by institutions to follow up their productive activity or services to increase production which positively affects the GDP and thus economic growth rates.

Added to that, the incompatibility of education outputs with the labor market, and the existence of a large number of learners suffering from unemployment or work in disciplines that do not much their area of specialization. The increase in the average number of years of schooling indicates an increase in the share of public expenditure allocated to education in GDP, but this increase is only quantitative, both in the number of teachers and in the size of the basic structures of education.

The increasing impact of the variable of employment on economic growth in the long term may be attributed to the experience and knowledge the workers and employees acquire through continuous training in various economic sectors, whether internally or in training missions abroad in order to have control over the techniques and methods of production and modern technologies.

**Conclusion:**

In this study, we attempted to tackle the nature of the relationship between investment in human capital - through education - and economic growth in Algeria during the period (1980-2015). Algeria has not neglected the importance of investing in human capital through education and its contribution to economic growth. However, despite the efforts made by the Algerian state to develop the educational system, unlike many other countries, Algeria could not achieve the objectives of this investment.

The inverse relationship of the average years of schooling can be analyzed and correlated with the qualitative aspect of educational achievement results and the quality of education, Although the average number of years of schooling has increased over the years, the quality of educational attainment and the level of students are declining, in other words, education did not create human capital, perhaps as a result of not giving too much importance to the qualitative aspect.

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