Journal of Economic Integration | Vol: 10 -N°: 01 / (March 2022) | pp: 165-182

Effect of health on economic growth in Algeria: An application of ARDL bounds test to cointegration

تأثير الصحة على النمو الاقتصادي في الجزائر: تطبيق اختبار حدود ARDL على التكامل المشترك

Boumediene Mohamed

Tlemcen University – Tlemcen (Algeria), mohammed.boumediene @univ-tlemcen.dz

Received: 11/01/2022 **Accepted:** 31/03/2022 **Published:**31/03/2022

Abstract:

In this paper, the growth effect of health in Algeria is examined for the period 1970 to 2019. We use life expectancy at birth, and Government Expenditure on Health as a proxy for health, and real per capita GDP as a proxy for economic growth. After employing ARDL bounds test approach to cointegration, and controlling for the effects of Government Expenditure education, inflation, and Gross fixed capital formation, the study concludes that the improvement in life expectancy positive affects economic growth in Algeria .An inverse relationship between Govern expenditure on health and PGDP was found with a 1% increase in Govern expenditure on health leading to a decline in PGDP of about 0.60% per annum. The implication is that improvement in health status of the population raises output in the economy. In this regard, policy should aim at raising health sector investment and strengthen the healthcare system to improve health status

Keywords: Human capital**,** Health, life expectancy at birth, economic growth and ARDL approach

JEL Classification Codes: .O15 ،O40

ملخص:

في هذه الورقة ، تم فحص تأثير النمو الصحي في الجزائر للفترة من 1970 إلى 2019. نستخدم متوسط العمر المتوقع عند الولادة ، والإنفاق الحكومي على الصحة كبديل للصحة ، ونصيب الفرد من الناتج المحلي الإجمالي الحقيقي كمؤشر للنمو الاقتصادي. بعد استخدام نهج اختبار حدود ARDL للتكامل المشترك ، والتحكم في تأثيرات الإنفاق الحكومي على التعليم ، والتضخم ، وتكوين رأس المال الثابت الإجمالي ، خلصت الدراسة إلى أن التحسن في متوسط العمر المتوقع الإيجابي يؤثر على النمو الاقتصادي في الجزائر. تم العثور على الصحة و PGDP مع زيادة بنسبة 1 ٪ في الإنفاق الحكومي على الصحة مما أدى إلى انخفاض في PGDPبنحو 0.60 ٪ سنويًا. المعنى الضمني هو أن التحسن في الحالة الصحية للسكان يرفع الإنتاج في الاقتصاد. في هذا الصدد ، يجب أن تهدف السياسة إلى زيادة الاستثمار في قطاع الصحة وتعزيز نظام الرعاية الصحية لتحسين الوضع الصحي

الكلمات المفتاحية: رأس المال البشري ، الصحة ، العمر المتوقع عند الولادة ، النمو الاقتصادي ، نهجARDL

تصنيف Jel: . O40،O15

Corresponding author: Boumediene Mohamed**, Email:** boumediene.ahmed65@mail.com

1- INTRODUCTION:

One of the oldest and most important questions in economics is. 'Why are some nations rich and others poor? Why, since Second World War, Japan has grown much faster than Western countries and try to maintain dominance at any cost, Why China and the so-called East Asian Tigers aspiring to take their place increasingly expand their spheres of influence of individual actions and processes at the international level. Whereas that of many African countries is considered a failure. Those questions typically invite considerable and inconclusive debate.

Theories of economic growth have proposed numerous explanations for what increases a country's level of economic wealth. And empirical studies of aggregate economic growth have studied country-by-country differences. With so many proposed explanations, understanding which factors cause greater wealth has proven difficult. These differing perspectives are not in necessarily opposition, as academics tend to specialize in narrow fields so they can better understand the issues at hand. Economists studying this issue focus on different aspects. These different approaches can be complementary and should be understood together.

In fact there is a new area in economics called the new growth economics, which has with great sophistication -all kinds of mathematical, wonderful formulas-shown sources of economic growth seeks to explain a number of issues that are pertinent to today's analysis of economic growth, by emphasizing the role of human capital through health and education, has yielded considerable insight into the possibility of self-sustaining growth. According to new growth theorist Robert J. Barro, (Barro, 1999) " Human-capital accumulation is an important part of the development process, and this accumulation is influenced in major ways by public programs for schooling and health." In addition, ILO report (2003) as cited Kidanemariam (2016,)(Gebrehiwota, 2016) states that, "the knowledge and skills endowment of a country's labor force, rather than its physical capital, determines its economic and social progress, and its ability to compete in the world economy." An additional role for human capital may be as an engine for attracting other factors, such as physical capital, which also contributes measurably to per capita income growth (Benhabib, 1994).

Almost universally, economists have found that, across a variety of nations, Knowledge, skills and competences constitute a vital asset in supporting economic growth and reducing social inequality .This asset, which is often referred to as human capital has been identified as one key factor in combating high and persistent unemployment and the problems of low pay and poverty, is also seen as a sustainable path to ensuring social equality.

In view of that, the question may arise here is that: does investment in human capital through health necessarily in Algeria enhance economic growth? There are compelling reasons that it should, but the empirical evidence does not always support this conclusion. The response to this question is essential in the debates on health policy in the world in general and in developing countries (DC) in particular

Effect of health on economic growth in Algeria: An application of ARDL bounds test to cointegration

1-1 Objectives of the Study

This being so, the aim of this article is to examine the impact of human capital development on economic growth in Algeria while the specific objective is to analyse the dynamic relationship between health and economic growth. The rest of the paper is organized as follows: After the introduction, the literature review as Section II. This is followed by an Overview of health in Algeria. Section III includes specification of model, data sources and methodology. Empirical results are discussed in Section IV .The paper concludes with a few minimalist observations on possible areas for future study.

1-2 LITERATURE REVIEW

1-2-1 Theoretical Literature Different views on Human Capital

The history of Human Capital and its operational definitions trace back to the foundational theorist of economic growth theory, where Adam Smith, a pioneer of the political economy, provided the first concepts of capital, which gave rise to the modern notion of human capital. Another important economist Robert Malthus expresses economic growth by population theory. Whereas David Ricardo says that the increase in productivity is the result of the increase in the quantity and quality of the factors available to work,

The main recent contributions to the empirical literature on the role of human capital in economic growth start with an expanded version of the neoclassical growth model of Solow and Swan (1956). According to this model, economic growth is only possible by exogenous variables such as technological changes and population rate. They consider the rate of technical progress that is necessary to prevent population pressure from moving the economy to a Malthusian outcome. It also they are of the view that government can influence the population growth rate, saving rate and incentive to invest in human and physical investment through its different policies such as such as fiscal, monetary, income and exchange rate policies. These policies can change the equilibrium factor ratio or affect the transition path of steady state growth rate.

The question of legitimacy of consideration the set of human capabilities as a capital actualized in the Western Science in the 1960s, where economists first develop the idea of human capital, such as T.W. Schultz. When he said: “Although it is obvious that people acquire useful skills and knowledge, it is not obvious that these skills and knowledge are a form of capital that this capital is in substantial part a product of deliberate investment(Schultz, 1961) . Another representative of the “Chicago School” - G.S. Becker (1962) produced the seminal work on the economics of employer-provided training. Becker’s approach still remains the principal theoretical construct that is used for understanding human capital investment, both from the perspective of the individual and the firm. The Nobel prize-winning economist, (1993) also extended the concept of the productive human capital by inclusion of human health and even his behavior: "The concept of the human capital also includes harmful addictions, such as smoking and drug use. The human capital in the form of positive work habits or addictions to alcohol has a significant positive or negative impact on productivity both in the market sector and outside of it » (Becker, 1993)

Since the mid-1980s, the study of the determinants of economic growth has been one of the most important areas of research in economics. This area of research has been focused

renewed attention on the role of knowledge capital in aggregate economic growth; with a prominent role for knowledge spillovers .Lucas (1988) contributed that the growth rate of human capital is determined by time spent in education or training, which describes the way human capital affects current production. This was supported by Barro& and Sala – Martin (1995) which put forward that education attainment (measured by average years of schooling) is significantly correlated with subsequent growth and that Public spending on education also has a significant positive effect on growth. More recently, Kumar and Chen (2013) who studied the impact of health and education on the growth rate of total factor productivity. They pointed out the importance of including health capital on the design of policies which facility technology diffusion.(Blázquez-Fernández, 2014), Indeed, the World Health Organisation (WHO) posits that improvement in health, such as increases in life expectancy at birth, has a great potential to raise economic growth in such regions as SSA (WHO, 2001).

Despite the proliferation of human capital definitions to the above literature, a number of key elements seem to be common as (skills and knowledge, attitudes and behavior, transferable to other organizations).Also all the literatures reviewed on the concept of human capital imply or emphasize the same thing in their various definitions, that there is need for more investment in education and training and health for organizations to succeed in the contemporary world of competition.

1-2-2Empirical Literature

Many studies have been carried out to observe the relationship between health and education and economic growth in different countries; we limited literature review by referring some highly significant studies that provide a useful framework for the analysis of the HCEG paradigm, followed by some studies carried for Algeria.

Different scholars have designed conceptual frameworks that incorporate human capital as one of the determinant factors of economic growth differently. Among those Pioneering researchers:

- **Lucas (1988):**(LUCAS, 1988) has formulated the production function as Y=AK (where A is factors affecting technology and K covers both human and physical capital), Lucas strongly stated that both human capital and physical capital is the engine of growth In contrast to the classical view. He also redefined the relationships between human capital-education and technology, and stated due to complementary relationship between human capital and technology. Development models of Lucas indicate that the growth rate of human capital is determined by time spent in education or training, which describes the way human capital, affects current production. This was supported by Barro& and Sala – Martin (1995) which put forward that education attainment (measured by average years of schooling) is significantly correlated with subsequent growth and that Public spending on education also has a significant positive effect on growth(Gebrehiwot, 2016)
- (Barro R. J., 1991) . He estimated in cross-section, the growth rate of the product per capita over the period 1960-1985 of 98 countries using the initial values of the primary and secondary school enrollment rate, the literacy rate, the supervision ratio, the mortality rate. The results of this study show that the initial primary and secondary school enrollment rates (1960) exhibited positive effects on growth over the period 1960-1985 - 0.0323 and 0.027 respectively - while the supervision ratio increased, negative effects for the primary - and not significant for the secondary. The effects of the literacy rate are negative when the other variables are introduced into the model. in another work of Barro

(2013) have formulated a model that includes physical capital inputs, level of education, health capital, and the quantity of hours worked.(Barro R. , 2013)

- **Mankiw, Roomer & Weil (1992)**(Mankiw, Romer, & Weil, 1992) start with an expanded version of the neoclassical growth model of Solow and Swan (1956) that accounts for technological interdependence among regional economies. Interdependence is assumed to work through spatial externalities caused by disembodied knowledge diffusion. This model has become an important tool for understanding the proximate factors that determine interregional differences in output levels and growth.
- **Benhabib and Spiegel (1994)**(Benhabib, 1994) examined the role of human capital in economic development as well as the reason for the differences between countries in the level of human capital and technology. Using the growth accounting framework in different countries, He specifies an alternative model introduced by Nelson & Phelps (1966) which suggest that human capital is mainly used to import and adopt new technologies and propose to specify the rate of growth of technical progress, Tests of this specification indicate a positive role for human capital. The result also suggests that the role of human capital in economic growth is to facilitate the adoption of technologies from abroad and the creation of appropriate domestic technologies
- **Pasali & Martin Kaboine** (Kaboine, 2019)**:** This paper empirically investigates the relationship between health expenditures, health outcomes and economic growth in Africa using data from 48 African countries over the period 2000-2015 in a panel data regression framework. The paper first finds that maternal, infant and child mortality rates are all negatively and significantly associated with economic growth in Africa. In addition, life expectancy at birth is positively associated with economic growth. A 9.4-year increase in life expectancy leads to 1 per cent increase in real GDP per capita. Second, the paper finds that health expenditures have direct and indirect effects on economic growth that are positive and economically meaningful. In particular, a 10 per cent increase in health expenditures leads to an increase in annual average real GDP per capita by 0.24 per cent.
- (Bloom, 2001) And all are among seminal papers that provide strong empirical evidence in favor of health as well as demographic variables in determining economic growth find that a 1% increase in life expectancy results in an increase in GDP per capita growth rate of over 3% per year over the period of study. Furthermore, over the same period, over half of the difference in growth rates between Africa and the rest of the world is explained by health and demographic variables. (Bloom D. a., 2004) **.**He estimate a production function model of aggregate economic growth including two variables that micro economists have identified as fundamental components of human capital: work experience and health. The result finds that good health has a positive, sizable, and statistically significant effect on aggregate output even when we control for experience of the workforce. He argue that the life expectancy effect in growth regressions appears to be a real labor productivity effect, and is not the result of life expectancy acting as a proxy for worker experience

- (Well, 2007)**:** The study use microeconomic estimates of the effect of health on individual outcomes to construct macroeconomic estimates of the proximate effect of health on GDP per capita. The author employ a variety of methods to construct estimates of the return to health, which he combine with cross-country and historical data on height, adult survival rates, and age at menarche. Using his preferred estimate, eliminating health differences among countries would reduce the variance of log GDP per worker by 9.9 percent and reduce the ratio of GDP per worker at the 90th percentile to GDP per worker at the 10th percentile from 20.5 to 17.9. While this effect is economically significant, it is also substantially smaller than estimates of the effect of health on economic growth that are derived from cross-country regressions.
- (Manfred, 2015)**:** The objective of this study is the impact of life issue through an analysis of the impact of life expectancy on the growth of Gross National Income (GNI) per capita in Developing countries. Using a dynamic panel of 141 DC over the period 2000- 2013, the study concludes that the improvement in life expectancy positive affects economic growth in DC. However, the results are mixed when classifying DC according to their level of income. We observe that the effect is not significant in the middle-income DC.
- (KolawoleOgundariaTitusAwokuse, 2018)**:** This paper revisits the debate on the possible impact of human capital on economic growth in Sub-Saharan Africa (SSA) and considers two alternative measures of human capital: health and education. The study employs a dynamic model based on the system generalized method of moments (SGMM) and analysed a balanced panel data covering 35 countries from 1980–2008. The empirical results show that the two measures of human capital have positive effects on economic growth, although the contribution of health is relatively larger than the impact of education. This finding emphasizes the importance of both measures of human capital and aligns with the argument in the literature that neither education nor health is a perfect substitute for the other as a measure of human capital

When we come to the Algeria case, some researchers have tried to investigate the relationship between human capital development and economic growth in Algeria as;

- **Rashid SALMI (*) & Mohamed RETIA(2017)**(RETIA, 2017) carried out an empirical investigation on the relationship between human capital and economic growth in Algeria over the period1970 to 2017, using secondary school enrollment as a proxy for human capital. The benchmark analysis revealed a statistically significant correlation between variations in human capital and economic growth as well as causal correlation between the two factors. This means that GDP in Algeria increases by about 1.088 % following a 1% increase in human capital, All the variables including, (labour force, gross fixed physical capital and Inflation rate) appear with the expected positive signs and are statistically significant (except labour force) .The study suggested that a concerted effort should be made by policy makers to enhance educational investment in order to accelerate growth, which would engender economic development in Algeria
- (Mourad, 2021)**:** This paper analyzes the impact of human capital development on growth economy in Algeria, through the presentation of different empirical studies and an econometric analysis of ARDL models, over the period from 1986 to 2017. The results of the study confirm the existence of a positive relationship between primary and

secondary school enrollment on economic growth and a negative effect of health spending on economic growth.

2- The evolution of the human development index (HDI) in Algeria

The Algerian state has invested heavily in the components of the HDI (education, health, and income), the results are very remarkable, and after more than forty years over the period 1970-2019 have seen progress, very visible.

The latest statistics from the UNDP affirmed that Algeria's HDI is 0.754 for the year 2017, which allowed it to position itself in the category of countries with the highest HDI, between 1990 and 2018 Algeria's HDI rose 18.2% from 0.577 to 0.759. (Mourad, 2021)

Table 1 Human Development Indices and Indicators

year	Life expectancy at birth	Expected years of schooling	Average years of schooling	GNI per capita (2011 PPP $)	The value of the HDI
1990	66.7	9.6	3.6	9,910	0,577
1995	68.1	9.8	4.7	8,841	0 ,600
2000	70.3	10.9	5.9	9,637	0,644
2005	72.8	12.3	6.9	11,537	0,692
2010	74.7	14.00	7.1	12,876	0,729
2015	75.9	14.03	7.9	13,338	0,749
2016	76.1	14.03	8.0	13,809	0,752
2017	76.3	14.4	8.0	13 ,802	0,754
2018	76.7	14.7	8.0	13.639	0,759

Source: (UNDP, 2018

2-1 HEALTH SITUATION

Algeria has made notable progress in health. The vaccination coverage rate is over 90%. The incidence of maternal mortality is 60.3 per 100,000 births in 2016 against 230 in 1989 and the child mortality rate is 25.4 per 1,000 in 2013 while it was 55.7 per 1,000 in 1990. Infant mortality is 22.4 in 2013 against 46.8 per 1,000 in 1990. For neonatal mortality it was 23 per 1,000 live births in 1990 against only 14 in 2013. The incidence of tuberculosis is 53.5 per 100,000 inhabitants in 2013 against 62.8 in 2003. The same trend is observed for microscopy-positive pulmonary tuberculosis, the incidence of which fell from 27.3 cases in 2003 to 18.6 cases in 2013.

Despite the government’s challenging fiscal situation, the health master plan for the period 2009-2025 provides for investments of 20 billion Euros for the construction of new health infrastructures and the modernization of existing hospitals». This program, which will be financed by the State, aims to double in 2025 the rate of beds per inhabitants which is currently 1.7 per 1,000, the share of the total national operating budget allocated to health reached 7.3% in 2018. The 2018 finance law outlined a health budget of DZD 392,16bn ($3.27bn). This was increased to DZD 398,97bn ($3.33bn) in the 2019 finance law. The following graph clearly shows the two trends in state budgets and that allocated to health, especially after 2000.2017

2-2 Health polices and systems

WHO, in its role of technical partner of reference in health, has been able to provide the Ministry of Health with the technical and sometimes financial support necessary for the

development of policies, strategies and plans for strengthening the health system health. This support has contributed to ensuring that the country has relevant strategic documents, in particular: a document on the multisectoral strategy for the fight against non-communicable diseases. The support also focused on the development of the action plan for the implementation of the International Health Regulations (IHR). Support for the development of the health human resources strategy and the establishment of the Algerian Observatory for Health Human Resources. Within the framework of Universal Health Coverage (UHC), WHO provides support to progress towards UHC in a dynamic way.

2-3 Cooperation for health

It was recommended by the United Nations that developing countries should invest a minimum of 26% on education and the world Health Organisation specified at least 5% on health.

World Health Organization cooperation with Algeria(WHO) is part of several plans and strategies for the period 2009-2025.The first strategic priority is to strengthen the fight against communicable and non communicable diseases, while the second focuses on strengthening preparedness, alert and response. The third priority relates to improving the health of mothers, children and newborns. The fourth priority, for its part, is focused on strengthening the health system. The priorities agreed in this SCP will guide the development of new biennial work plans over the next five years, which will facilitate the orientation of WHO's activities in the country, in a spirit of harmonized and aligned support for achievement of Algeria's national health goals. For the next ten years, our health system will be faced with two categories of challenges: - Taking charge of the evolution of health problems linked to the modification of the population structure by age, - Strengthening the capacity of public authorities to controlling costs, protecting the environment, and promoting information for citizens and training of staff.

Algeria's Health ministry, the Delegation of the European Union (EU) in Algeria and the United Nations Development Programme (UNDP) are implementing a €43 million (US$50 million) agreement signed in December last year to support the Algerian Government's efforts to curb the spread of the Corona virus pandemic in the country and mitigate its impact. The project "European Solidarity Response to COVID-19 in Algeria" will provide public health facilities with medical equipment, COVID-19 testing kits and protective gear for healthcare workers. The first shipments of testing kits received this week will be distributed to health facilities by the publicly administered Central Pharmacy of Hospitals and Pasteur Institute Algeria, which coordinate the project on behalf of the Health Ministry.

3- METHODOLOGY

The level of economic development is represented by GDP per capita at purchasing power parity, expressed in natural logarithmic terms, as is commonly used in growth literature. As control variables, we include Govern expenditure on health, Life expectancy as indicator of population health. We use life expectancy at birth as a proxy of population health. Although health is a multi-dimensional concept and life expectancy is one of the most widely used indicators of population health. We employ life expectancy at birth as the indicator of population health for two reasons. First, the data pertaining to life expectancy enables a better empirical examination between population health and economic growth. Second, life expectancy has a strong, albeit not perfect, correlation with most other indicators of population health. Govern expenditure on education to GDP, inflation, Gross fixed capital

formation. It is a proxy for physical capital stock in the economy and it is derived by dividing the gross fixed capital formation adjusted through PGDP deflator to real PGDP.

3-1 Sources of Data

The research applies annual time series data over the period 1970-2019 in Algeria which were gathered from the World Bank database (Global Development Index) and the National Office of Statistics. The variables used for the Work includes. Government Expenditure on Education, Government Expenditure on Health. Eviews 9 software is utilized to carry out the analysis of the data.

3-2 Mode Specification

Based on the growth literature, we adapt neo-classical production function as a framework for this study. The neo-classical model based Cobb-Douglas function is given as:

PGDP = f (EGH LEB EGE GCF INF,)….. (1

GDP = $\alpha 0+\alpha 1$ EGH + $\alpha 2$ LEB, +$\alpha 3$ EGE, +$\alpha 4$ GCF +$\alpha 4$ INF + Ut..... (2

Equation (1.2) would be transformed into equation (3) in order to linearize the non-linear variables

LnPGDP = α + $\alpha 1$Ln(EGH)+ $\alpha 2$ Ln LEB + $\alpha 3$Ln EGE + $\alpha 4$Ln GCF + $\alpha 4$Ln INF + Ut... (3

Where:

LnPGDP = Natural logarithm of GDP per capita

Ln(EGH) = Natural logarithm of Govern expenditure on health

Ln(LEB) = Natural logarithm of life expectancy at birth

Ln EGE = Natural logarithm of Govern expenditure of education.

Ln GCF = Natural logarithm of Gross fixed capital formation.

Ln INF = Natural logarithm of inflation

In this study, the Auto Regressive Distributed Lag (ARDL) approach to co-integration, which is proposed by Pesaran and Shin (1997) further advanced by Pesaran, et al. (2001) is used to test the long-run co-integration relationships between variables.. The approach has recently been credited for its advantages over the traditional cointegration techniques such as full maximum likelihood, based on Johansen and Juselius (1990), and the residual based approach (Engle & Granger, 1987). Another key advantage of the ARDL approach is that it helps to avoid the uncertainties generated by unit root pre-testing as it can be applied irrespective of whether the regressors are of I(0), I(1) or mutually integrated. More so, both the short- and the long-run relationship can be simultaneously estimated. If we intend to capture the short-term and long-term effects of the above explanatory variables on economic growth, the ARDL representation of the function (1) will be:

$$\Delta y_t = \alpha_0+\alpha_1 x_{t-1}+ \alpha_2 y_{t-1} + \sum_{J=0}^{k1} \beta_1 \Delta x_{t-J} + \sum_{j=1}^{k2} \beta_2 \Delta y_{t-J}$$

α_0 ، α_1 are coefficients that measure long run relationship. β1 , β2 are coefficients that measure short run relationships.

3-3 Unit Root (Stationarity) Test

Before conducting the empirical analysis, it is important that all the variables used be subjected to unit root tests. This is important in order to ensure that no variable is integrated of order two or higher. The Dickey-Fuller (ADF) and Phillips-Peron (PP) unit root test results (see Table 1) show that all the variables are integrated of order 0 or 1. The unit root tests results indicates that we can implement Ardl models using the upper bound critical value reported in Pesaran et al 2010for determination of cointegration .

Table 2: Unit root test

Variables	difference	**ADF**		PP	
		t-stat	**5% C.V**	**t-stat**	**5% C.V**
l PGDP	l PGDP	1.803511	3.508508	1.885138	3.504330
	D (l PGDP)	9.653550*	2.923780	8.984208*	3.506374
LGCF	lGCF	3.160448	3.506374	2.120504	3.504330
	D(lGCF)	4.387159*	3.506374	4.423585*	3.506374
LEGE	lEGE	0.607259	3.504330	0.780264	3.504330
	D (lEGE)	6.357887*	3.504330	6.357887*	3.506374
LEGH	l EGH	4.783346*	2.925169	4.792945*	4.156734
	D (l EGH)	1036888*	3.506374	11.40876*	3.506374
LLEB	l LEB	2.283663	3.508508	3.890808*	*3.508508**
	D (l LEB)	3.506374*	3.378760	3.029733*	1.948140
LINF	l INF	4.104325*	2.922449	4.023237*	2.922449*
	D (l INF)	8.231931*	2.925169	13.20680*	2.923780*

Source: Author's Computation (2022)

3-4 Bounds test approach to cointegration

The choice of the ARDL model was based on the assumption that there was a unique relationship humain capital and economic growth. Following Pesaran et al. (2001) the conditional ARDL-error correction model is thus specified as:

$$\Delta \boldsymbol{LPGDP}_t = \boldsymbol{\alpha} + \boldsymbol{B_1 LPGDP}_{t-1} + \boldsymbol{B_2 L}\mathrm{EGH}_{t-1} + \boldsymbol{B_3 L}\mathrm{LEB}_{t-1} + \boldsymbol{B_4 L}\mathrm{EGE}_{t-1} + \boldsymbol{B_5}\mathrm{GCF}_{t-1} + \boldsymbol{B_6}\mathrm{INF}_{t-1} + \sum_{i=1}^{p} \boldsymbol{y_1 \Delta LPGDP}_{t-p} + \sum_{i=1}^{p} \boldsymbol{y_2 \Delta L}\mathrm{EGH}_{t-p} + \sum_{i=1}^{p} \boldsymbol{y_3 \Delta}\mathrm{LEB}_{t-p} + \sum_{i=1}^{p} \boldsymbol{y_4 \Delta L}\mathrm{EGE}_{t-p} + \sum_{i=1}^{p} \boldsymbol{y_5 \Delta L}\mathrm{GCF}_{t-p} + \sum_{i=1}^{p} \boldsymbol{y_6 \Delta L}\mathrm{INF}_{t-p} \boldsymbol{\varepsilon t}$$

In the above equations, the terms ($y_1 y_2 y_3\ y_4\ \ y_5 y_6$) represents the error correction or short run dynamic, while the terms with β1 *β2 β3 β4 β5 β6* are the long run multipliers respectively, α is the intercept or drift, εt is the error correction term, Δs is the difference operator. Then proceed to conduct the Wald test or *F* test for joint significance of the coefficients of lagged

variables. This will enable us to examine the existence of a long-run relationship among the variables. The null hypothesis is *(*H0*)*: $\beta 1 = \beta 2 = \beta 3 = \beta 4 = \beta 5 = \beta 6 = 0$, which means that there is no cointegration among the variables. The alternative hypothesis is *(*H1*)*: $\beta 1 \neq \beta 2 \neq \beta 3 \neq \beta 4 \neq \beta 5 \neq \beta 6 \neq 0$. Then, the calculated *F* statistic is evaluated with the critical value (upper and lower bound) given by Pesaran et al. (2001). The results of the bound test are given in Table 2

Table 3: Bound test cointegration

Test statistic	Value	K
F Statistics	5.809707	5
Critical Value Bounds (Peseran et al 2001)		
Significance	0 Bound	1 Bound
10 %	2.2	3.09
05 %	2.56	3.49
01%	2.88	3.87

Source: Author's Computation (2022)

As seen in Table 3, the calculated F-statistics is 5.80 while upper critical bound at significance level 1% is 3.87. This implies that there is long run relationship among GDP, explanatory variables, over the period of 1970-2017 in Algeria. Therefore we can proceed to ARDL Error Correction Model. The investigation would be based on short-run analysis and long-run analysis of ARDL to determine the dynamic relationship

3-5 Estimation of the long-run and error correction mechanism

Given the presence of cointegration, the short- and long-run parameters are estimated to determine the causal relationship between humain capital and on Economic Growth in Algeria The results of the coefficients are presented in Tables 3 and 4.

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEGE	0.060218	0.030727	1.959791	0.0613
LEGH	-0.530683	0.135689	-3.911015	0.0006
LGCF	0.409370	0.089944	4.551386	0.0001
LINF	-0.062472	0.019320	-3.233545	0.0034
LLEB	2.061429	0.877175	2.350078	0.0270
C	1.803409	3.376868	0.534048	0.5980

Source: Author's Computation (2022)

The estimated long run results in Table 4 above show a positive and a statistically significant relationship between life expectancy at birth to PGDP at 5% level of significance. This means that Gross Domestic Product (PGDP) in Algeria increases by about 2.06% following a 1% increase in life expectancy at birth to PGDP). The findings of this research concerning the long run positive impact of the health human capital are consistent with the endogenous growth theories (mainly advocated and/or developed by Lucas (1988) , Romer (1990), Mankiw, Roomer and Weil (1992)) which argue that improvement in human capital (skilled and healthy workers) leads to productivity improvement that enhances output. This result clearly gives the message to

Algerian authorities there is a high contribution of health to economic growth and ultimately socio-economic development of developing countries.

An inverse relationship between Govern expenditure on health and PGDP was found with a 1% increase in Govern expenditure on health leading to a decline in GDP of about 0.60% per annum. This result can be attributed to lack of sound policy implementation and the dominance of the unproductive and inefficient government spending that could not add any value to the economy (like wages and salaries).

In addition, the estimated coefficients of Gross fixed capital formation are statistically. This indicates that, in the long run, holding other things constant, a one percent change in Gross Domestic Product brought 40% percent change in real PGDP. This result conforms to the endogenous growth theories Barro and Sala-I-Martin (1995; 2004), because the accumulation of the capital is supposed to favor the growth of the real PGDP by fostering further production of new goods and services. The finding of this research is also similar to Teshome (2006) and Tofik (2012). The results also revealed that there is negative long-run relationship between inflation and economic growth. While govern expenditure on education is not statistically significant. These results are not analogous to the findings of Baldwin and Borelli (2008) and Mallick et al., (2016).

3-6 Estimation of short-run and error correction mechanism

The short run dynamics were captured through error correction. The error correction results are reported in Table 5.

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LPGDP(-1))	0.529646	0.104458	5.070401	0.0000
D(LPGDP(-2))	0.263547	0.065376	4.031266	0.0005
D(LEGE)	0.017260	0.004234	4.076397	0.0004
D(LEGH)	-0.012695	0.024149	-0.525695	0.6037
D(LEGH(-1))	0.082609	0.025297	3.265578	0.0032
D(LGCF)	0.088149	0.025862	3.408442	0.0022
D(LGCF(-1))	-0.051392	0.035287	-1.456390	0.1577
D(LGCF(-2))	-0.137523	0.037325	-3.684527	0.0011
D(LGCF(-3))	0.092420	0.029229	3.161890	0.0041
D(LINF)	-0.001673	0.001953	-0.856668	0.3998
D(LINF(-1))	0.005935	0.002243	2.646372	0.0139
D(LINF(-2))	0.004306	0.002046	2.104748	0.0455
D(LLEB)	-0.948464	0.589851	-1.607973	0.1204
D(LLEB(-1))	-0.952381	0.639462	-1.489347	0.1489
D(LLEB(-2))	1.943977	0.526541	3.691977	0.0011
CointEq(-1)	-0.240204	0.040641	-5.910320	0.0000

Cointeq = LPGDP - (0.0602*LEGE -0.5307*LEGH + 0.4094*LGCF -0.0625 *LINF + 2.0614*LLEB + 1.8034)

The Error Correction Term (ECTt-1) which assesses the speed of adjustment between the short-run disequilibrium (actual) and the long-run equilibrium (expected) has the correct sign and is statistically significant. This result confirms the existence of long run relationship among variable. With a coefficient value of 0.24, it indicates a rapid adjustment process with

accumulated disequilibrium of the preceding years adjusting back to the long-run equilibrium in the present period. Other estimated coefficients show that in the short run. Govern expenditure on education was positive at 5% level of significance impact on economic growth.

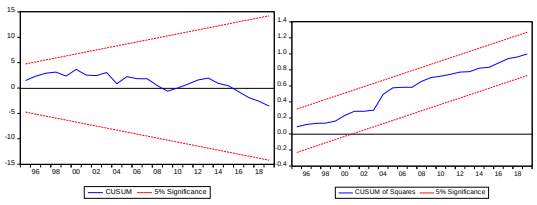
3-7 Robustness tests Diagnostic

Diagnostic tests were performed to assess the robustness of our model: The Lagrange multiplier test for the autocorrelation of the residues, the Ramsey functional form test (RESET), the Jacque Berra test for the normality of the residues and a homoscedasticity test. Below are the results of some tests which show that the residues have all the desired properties.

Residual Normality Test			
Jarque-Bera	0.5375	Prob(J.B)	0.7643
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.683648	Prob. F(2,21)	0.2078
Obs*R-squared	5.874535	Prob. Chi-Square(2)	0.0530
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.595778	Prob. F(5,23)	0.8797
Obs*R-squared	14.84783	Prob. Chi-Square(5)	0.7850

3-7-1 CUSUM and CUSUMSQ

According to Pesaran and Shin (1999), the stability of the estimated coefficient of the error correction model should also be geographically investigated. The results of both CUSUM and CUSUMSQ Squares tests are reported in Figures 1 and 2 below



As can be seen from Figure 1 and 2, since the cumulative sum of recursive residuals and the cumulative sum of squares of recursive residuals fall between the 5 percent significance lines, the parameters of the model are stable over time.

3-7-2 Granger Causality Based on Toda and Yamamoto Procedure

To test the causality between humain capital and economic growth, we use the test procedure of Toda and Yamamoto (1995) from an autoregressive vector modeling (VAR). The optimum lag length of VAR is 2 based on AIC, FPE, HQ, and likelihood ratio criteria. However, all variables are stationary at first difference. This means that d_{max} = 1 in our case. So, we estimate a system of VAR at levels with a total of $k + d_{max} = 2 + 1 = 3$ lags. Test the causality are shown in the Table5appendix. The results in table 5 appendix suggest that there is unidirectional causality running from per capita gross domestic product, Gross fixed capital

formation, life expectancy at birth to Govern expenditure on health, and no evidence of bi-directional causality is found between LPGDP LEGH LEGE LGCF LINF

4- Conclusion

The study has made an attempt to provide the empirical confirmation on the relationship between health and economic growth. From the analysis, it was deduced that there is a positive and a statistically significant relationship between life expectancy at birth to PGDP at 5% level of significance.

Health is key variable for economic growth so that government of Algerian country should be prior health sector and increases its spending on a share of the budget. Workable policies should be put in place to bring about an overall economic growth.

Nevertheless, the key to achieving best results lies not in ordinarily increasing particular budgetary allocation but rather in implementing a public expenditure and revenue and ensuring the usage of the allocated fund as transparently as possible. It is not enough to build medical centers and hospitals in different regions, but it is first necessary to define a model to preserve the quality of health as a whole at the national level. Another area to be examined concerns the distinction between public and private health spending. A key policy question here is to evaluate the rate of return to investment in the public health area

Bibliography List:

Barro. (1999). Human capital and growth in cross-country regressions . Swedish Economic Policy Review 6 , 237-277.

Barro, R. (2013). Health and Economic Growt. Analysis of Economics and Finance, vol 14 (2) , 329-366.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. The Quarterly Journal of Economics, Vol. 106, No. 2 , pp. 407-443.

Becker, G. (1993). Human capital: a Theoretical and Empirical Analysis, with Special Reference to Education. Chicago: The University of Chicago Press.

Benhabib, S. l. (1994). - ” The Role of Human Capital in Economic Development”, Evidence from Aggregate Crass-Country Data. Journal of Monetary Economics,vol 34, , 143-173.

Blázquez-Fernández, C. (2014). “Does health enhance economic growth? An empirical evidence for the Spanish region. ” Encuentro de economia publica. vol 30- Enero01 .

Bloom. (2001). The effect of health on economic growth: theory and evidence. National Bureau of Economic Research. https://doi.org/10.3386/w8587 .

Bloom, D. a. (2004). The Effect of Health on Economic Growth: A Production Function Approach overlay panel. World Development Volume 32, Issue 1 , 1-13.

Gebrehiwot, K. G. (2016). The Impact of Human Capital Development on Economic Growth in Ethiopia: Evidence from ARDL Approach to Co-Integration. Bahir Dar j educ. Vol 16 No.1 , 34-55.

Gebrehiwota, K. G. (2016). The Impact of Human Capital Development on economic Growth in Ethiopia: Evidence from ARDL Approach to Co-Integration . Bahir Dar j educ. Vol 16 No.

Kaboine, J. S. (2019). Exploring the Impact of Healthcare on Economic Growth in Africa. Applied Economics and Finance Vol. 6, No. 3 , 45 -57 .

KolawoleOgundariaTitusAwokuse. (2018). Human capital contribution to economic growth in Sub-Saharan Africa: Does health status matter more than education? Economic Analysis and Policy Volume 58, n 01 , 131-140.

LUCAS, R. E. (1988). ON THE MECHANICS OF ECONOMIC DEVELOPMENT. Journal of Monetary Economics -Holland , 3-42.

Manfred, N. N. (2015). The Impact of Life Expectancy on Economic Growth in Developing Countries. Asian Economic and financial Review Vol. 5 No. 4 (2015) , 653-660.

Mankiw, G., Romer, D., & Weil, D. N. (1992). A Contribution to the Empirics of Economic Growth . NThe Quarterly Journal of Economics, Vol. 107, No. 2 , 407-437.

Mourad, I. F. (2021). Education, health and economic growth in Algeria: Econometric study using the ARDL model . Dirassat Journal Economic Issue Vol. 12, N.1 , 753 -769.

RETIA, R. S. (2017). Econometric Study of the Impact of Human Capital on Economic Growth in Algeria during the Period (1970-2014) . Journal Researcher No17 , 259-270.

Schultz, T. (1961). Investment in human capital . The American Economic Review, Vol.51, No.1. , 1-17.

Well, D. N. (2007). Accounting for the Effect of Health on Economic Growth . The Quarterly Journal of Economics, Volume 122, Issue 3 , 1265-1306.

-Appendices

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LPGDP(-1))	0.529646	0.104458	5.070401	0.0000
D(LPGDP(-2))	0.263547	0.065376	4.031266	0.0005
D(LEGE)	0.017260	0.004234	4.076397	0.0004
D(LEGH)	-0.012695	0.024149	-0.525695	0.6037
D(LEGH(-1))	0.082609	0.025297	3.265578	0.0032
D(LGCF)	0.088149	0.025862	3.408442	0.0022
D(LGCF(-1))	-0.051392	0.035287	-1.456390	0.1577
D(LGCF(-2))	-0.137523	0.037325	-3.684527	0.0011
D(LGCF(-3))	0.092420	0.029229	3.161890	0.0041
D(LINF)	-0.001673	0.001953	-0.856668	0.3998
D(LINF(-1))	0.005935	0.002243	2.646372	0.0139
D(LINF(-2))	0.004306	0.002046	2.104748	0.0455
D(LLEB)	-0.948464	0.589851	-1.607973	0.1204
D(LLEB(-1))	-0.952381	0.639462	-1.489347	0.1489
D(LLEB(-2))	1.943977	0.526541	3.691977	0.0011
CointEq(-1)	-0.240204	0.040641	-5.910320	0.0000

Cointeq = LPGDP - (0.0602*LEGE -0.5307*LEGH + 0.4094*LGCF -0.0625 *LINF + 2.0614*LLEB + 1.8034)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEGE	0.060218	0.030727	1.959791	0.0613
LEGH	-0.530683	0.135689	-3.911015	0.0006
LGCF	0.409370	0.089944	4.551386	0.0001
LINF	-0.062472	0.019320	-3.233545	0.0034
LLEB	2.061429	0.877175	2.350078	0.0270
C	1.803409	3.376868	0.534048	0.5980

ARDL Bounds Test
Date: 01/11/22 Time: 11:17
Sample: 1974 2019
Included observations: 46
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	5.809707	5

Critical Value Bounds

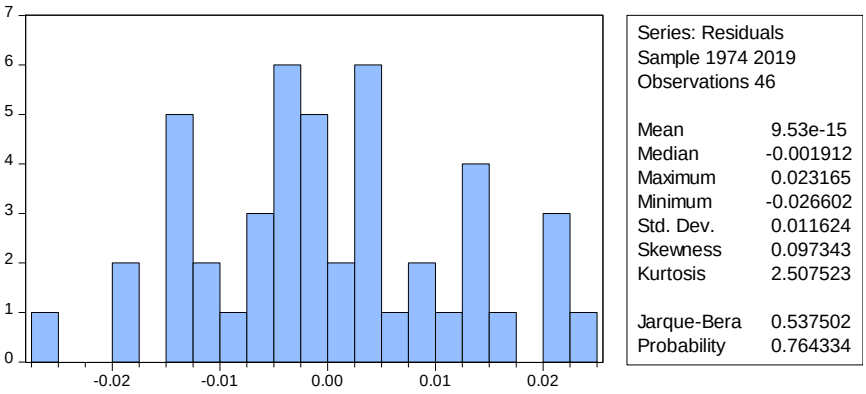
Significance	I0 Bound	I1 Bound
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.595778	Prob. F(20,25)	0.8797
Obs*R-squared	14.84783	Prob. Chi-Square(20)	0.7850
Scaled explained SS	3.305684	Prob. Chi-Square(20)	1.0000

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.683648	Prob. F(2,23)	0.2078
Obs*R-squared	5.874535	Prob. Chi-Square(2)	0.0530



VAR Granger Causality/Block Exogeneity Wald Tests
Date: 01/11/22 Time: 16:44
Sample: 1970 2019
Included observations: 48

Dependent variable: LPGDP

Excluded	Chi-sq	df	Prob.
LEGE	1.874822	2	0.3916
LEGH	1.319935	2	0.5169
LGCF	3.179510	2	0.2040
LINF	5.295945	2	0.0708
LLEB	0.341944	2	0.8428
All	32.07698	10	0.0004

Dependent variable: LEGE

Excluded	Chi-sq	df	Prob.
LPGDP	2.044891	2	0.3597
LEGH	0.417406	2	0.8116
LGCF	3.897128	2	0.1425
LINF	0.168989	2	0.9190

LLEB	0.397878	2	0.8196
All	34.70783	10	0.0001

Dependent variable: LEGH

Excluded	Chi-sq	df	Prob.
LPGDP	10.50677	2	0.0052
LEGE	0.755827	2	0.6853
LGCF	29.21259	2	0.0000
LINF	0.809385	2	0.6672
LLEB	16.70501	2	0.0002
All	34.05244	10	0.0002

Dependent variable: LGCF

Excluded	Chi-sq	df	Prob.
LPGDP	0.601435	2	0.7403
LEGE	2.217221	2	0.3300
LEGH	1.295658	2	0.5232
LINF	1.535487	2	0.4641
LLEB	2.407744	2	0.3000
All	7.774026	10	0.6509

Dependent variable: LINF

Excluded	Chi-sq	df	Prob.
LPGDP	2.727820	2	0.2557
LEGE	0.153111	2	0.9263
LEGH	2.938486	2	0.2301
LGCF	3.328953	2	0.1893
LLEB	4.067790	2	0.1308
All	12.88759	10	0.2300

Dependent variable: LLEB

Excluded	Chi-sq	df	Prob.
LPGDP	2.192144	2	0.3342
LEGE	2.474973	2	0.2901
LEGH	0.947163	2	0.6228
LGCF	5.849815	2	0.0537
LINF	0.333862	2	0.8463