

Relationship between economic growth and the human development index in Algeria: econometric study between 1990 and 2022

Djamila Gribi^{#1},

[#] Assistant professor at Hassiba Ben Bouali University Chlef Algeria

Laboratory of: "entrepreneurship and corporate governance"

¹d.gribi@univ-chlef.dz

Abstract— The objective of our study is to establish a relationship between growth and economic development in Algeria. For this purpose, we will study the evolution of GDP and the human development index over the period (1990-2022).

Different econometric methods were used: regression, correlation and Granger causal test to establish a relationship between the two indicators: gross domestic product (GDP) and the human development index (HDI). Our results showed the non-existence of a relationship between the two variables contrary to what the economic theories stipulate.

Keywords— GDP, IDH, causality test, linear regression, economic growth

I. INTRODUCTION

Economic growth and development are two inseparable terms. Since Adam Smith, these two concepts have formed the heart of scientific research [1], [2], [3]. Several models have been developed to provide a theoretical framework for growth and economic development, which are mainly intended for developing countries.

Economic growth is seen as a concern of every country in the world. It can be defined as a quantitative phenomenon that measures the change in GDP (Gros Domestic Product) between two successive years. Economic theories to explain the causes of economic growth are numerous ranging from models of exogenous growth such as the SOLOW model [4] and endogenous growth models such as Schumpeter's [5]. Often the indicator used to measure economic growth is GDP growth or GDP/capita growth.

As for development, it is a qualitative phenomenon that takes into account the economic, social, political and living structures of the population. There are also many models of economic development, all of which have stressed the importance of making investments to improve economic conditions, health, education, housing... [6], [7]. The main indicator used to measure development is the HDI (Human Development Indicator) developed by UNDP in 1990.

In Algeria, since its independence, the concept of development has been highlighted in all policies adopted and models retained. Economic growth does not seem to be a priority until the implementation of the structural adjustment plan in 1994. The transition from a administered to a market economy forced the government to marry the two terms in order to improve the economic and social situation of its population.

Our study tries to highlight the relationship between economic growth (measured by GDP growth) and economic development (measured by the HDI) in Algeria.

Thus, in order to analyse the impact of economic growth on the human development index, scientific curiosity leads to the following questions:

How have economic growth and the human development index evolved in Algeria?

To what extent is growth affecting the human development index?

What are the explanatory factors?

Assumptions:

The following assumptions have been made based on empirical knowledge and observations:

Economic growth in Algeria has followed a positive trend.

. The human development index has followed a positive trend.

. Economic growth has a significant effect on the human development index in Algeria.

These assumptions are checked in the body of work.

Methods used:

Our scientific work follows a specific and adapted methodological approach. Therefore, the econometric method is requested.

It will allow us to analyse the impact of economic growth on the human development index and the evolution over time of these variables (between 1990 and 2022), on the one hand, the processing of the data collected and the interpretation of the results, on the other hand. To operationalize this method and collect the necessary data for the work, several techniques were used, namely: documentary technique and observation.

The objective of the research is to:

The general objective of this study is to analyse the degree of relationship between economic growth and the human development index in Algeria.

With regard to the specific objectives, the following are discussed:

-To analyse the evolution of economic growth on the one hand and of the human development index in Algeria on the other hand during 1990-2022;

-Assess the impact of economic growth on the human development index;

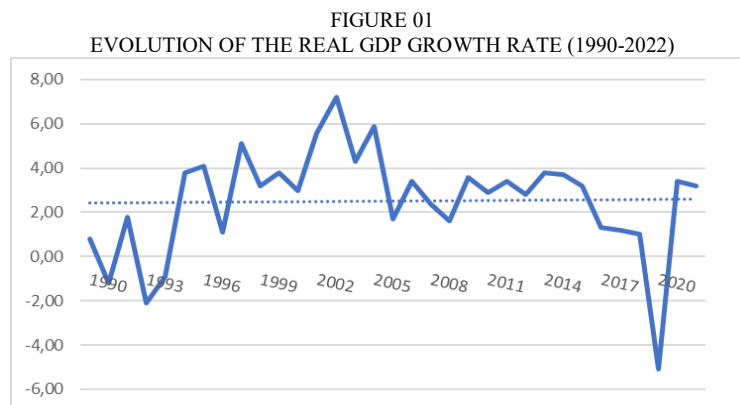
-Identify the explanatory factors.

II. REALITY OF GROWTH AND DEVELOPMENT IN ALGERIA

Growth and development in Algeria has been influenced by various economic, social and political factors over the years. In this section, we will look at their evolution between 1990 and 2022 and try to find the explanatory factors.

A. Economic Growth in Algeria

Economic growth in Algeria has fluctuated over the last thirty years, influenced by various internal and external factors, but the general trend was rather stable. (The trend is shown in Fig 01).



Economic growth in Algeria has fluctuated over the last thirty years, influenced by various internal and external factors, but the general trend was rather stable. (Fig 01)

In the recent period, Algeria has faced economic challenges such as excessive dependence on hydrocarbon exports, volatile oil prices, as well as structural problems such as high unemployment and low economic diversification.

In general, economic growth in Algeria has been supported largely by oil revenues, but this dependence has also made the economy vulnerable to fluctuations in oil prices on world markets. Periods of high oil prices have often stimulated growth, while periods of low prices have had a negative impact on the economy.[8]

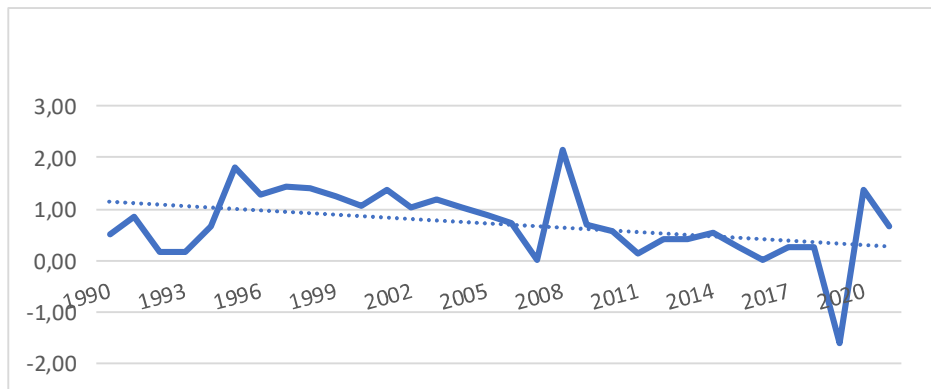
To diversify the economy and reduce dependence on hydrocarbons, Algeria has undertaken several economic reforms, including efforts to promote the private sector, encourage investment in sectors other than oil and gas, and improve the business climate. However, these reforms have often been slow to implement and have faced political and institutional obstacles.

In summary, economic growth in Algeria is influenced by the dynamics of the world oil market and by the government's efforts to diversify the economy and stimulate investment in non-oil sectors. Fluctuations in oil prices in the world market have a direct impact on economic growth in Algeria, according to the graph (top), economic growth was not strictly increasing, nor strictly decreasing, it was rather fluctuating.

B. Economic Development in Algeria

The Human Development Index (HDI) is a composite indicator that measures a country's level of human development by taking into account factors such as per capita income, life expectancy at birth and level of education.

FIGURE 02
EVOLUTION OF THE HUMAN DEVELOPMENT INDEX IN ALGERIA (1990-2022)



However, according to data from 1990 to 2022, Algeria is ranked among the countries with average human development according to the United Nations Development Program (UNDP). Its HDI was generally located in the lower end of the spectrum of average human development countries. But it should be noted that the HDI recorded a negative trend over the period considered (the trend is indicated in dotted line in Fig 02)

Algeria has made significant progress in several areas of human development in recent decades, including poverty reduction, improved access to education and health care, and increased life expectancy. However, challenges remain, such as high unemployment, socio-economic inequalities and regional disparities.

III. EMPIRICAL STUDY OF THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND THE HUMAN DEVELOPMENT INDEX.

In this part, we will try to find empirical evidence of the relationship between economic growth as measured by real GDP growth rate and economic development as measured by the Human Development Index. For this, different techniques will be used.

A. Data and sources

The data used in the study are composed of the annual growth rate of real GDP (GDP in %) and the Human Development Index (HDI) in Algeria from 1990 to 2022. The real GDP growth rate is obtained from the World Bank's website at: <https://worldcbdata.banqueale.org/indicator/NY.GDP.MKTP.KD.ZG?locations=DZ> while the HDI is available on the website of the United Nations Development Programme (UNDP): <https://hdr.undp.org/data-center/country-insights#/ranks>

B. Data analysis methods

The following techniques were used in this study:

- The Pearson correlation coefficient;
- Dickey Fuller Unit Root Test;
- Linear regression;
- The granger causality test;

C. Results and discussion

In this part we will discuss the results of the econometric study.

1) The correlation

Correlation Matrix			
	PIB	IDH	
PIB	1.000000	0.222260	
IDH	0.222260	1.000000	

The correlation coefficient $r=0.22$ indicates a very low relationship between gross domestic product and the human development index.

2) Stationary series

We start by choosing the number of lags (p)

	GDP%		HDI	
	AKAI KE	Schwartz	AKAIKE	Schwartz
P=0	8,6	8,74	-7,9	-7,81
P=1	8,71	8,85	-7,6	-7,69
P=2	8,82	9	-7,75	-7,57
P=3	8,91	9,15	-7,76	-7,52

It is clear that the number of lags that minimizes the AK and SC criteria is P=0 for both GDP and HDI series.

We will therefore apply the unit root test (ADF test) on the Pib (GDP) series with $p=0$.

Let's start with the model (3): with constant and trend

$$lpib = \alpha pib(-1) + \beta T + c$$

The test result is then presented:

Augmented Dickey-Fuller Unit Root Test on PIB				
ADF Test Statistic	-6.552091	1% Critical Value*	-4.2712	
		5% Critical Value	-3.5562	
		10% Critical Value	-3.2109	

*MacKinnon critical values for rejection of hypothesis of a unit root.

We note that: calculated ADF = -6.55 < tabulated ADF = -3.55

The H₀ hypothesis of the existence of a unit root at the 5% threshold is rejected.

Moving to model (2): with constant

$$l\text{pib} = \alpha l\text{pib}(-1) + c$$

Augmented Dickey-Fuller Unit Root Test on PIB				
ADF Test Statistic	-6.189472	1% Critical Value*	-3.6496	
		5% Critical Value	-2.9558	
		10% Critical Value	-2.6164	

*MacKinnon critical values for rejection of hypothesis of a unit root.

We note that: calculated ADF = -6.189 < tabulated ADF = -2.9

The H₀ hypothesis of the existence of a unit root at the 5% threshold is rejected.

Moving on to model (1): no constant or trend

$$l\text{pib} = \alpha l\text{pib}(-1)$$

Augmented Dickey-Fuller Unit Root Test on PIB				
ADF Test Statistic	-5.630008	1% Critical Value*	-2.6369	
		5% Critical Value	-1.9517	
		10% Critical Value	-1.6213	

*MacKinnon critical values for rejection of hypothesis of a unit root.

We note that: calculated ADF = -5.63 < tabulated ADF = -1.95

The H₀ hypothesis of the existence of a unit root at the 5% threshold is rejected.

The GDP series is therefore flat.

Unit root test on IDH series:

We will therefore apply the unit root test (ADF test) on the IDH series with $p=0$.

Let's start with the model (3): with constant and trend

$$IDH = \alpha IDH(-1) + \beta T + c$$

The test result is then presented:

Augmented Dickey-Fuller Unit Root Test on IDH				
ADF Test Statistic	-0.061073	1% Critical Value*	-4.2712	
		5% Critical Value	-3.5562	
		10% Critical Value	-3.2109	

*MacKinnon critical values for rejection of hypothesis of a unit root.

We note that: t calculated = -0.06 > T tabulated = -3.55

We accept the H₀ hypothesis of the existence of a unit root at the 5% threshold.

Moving to model (2): with constant

$$IDH = \alpha IDH(-1)$$

Augmented Dickey-Fuller Unit Root Test on IDH				
ADF Test Statistic	-1.797514	1% Critical Value*	-3.6496	
		5% Critical Value	-2.9558	
		10% Critical Value	-2.6164	
*MacKinnon critical values for rejection of hypothesis of a unit root.				

We notice that: $t_{\text{calculated}} = -1,79 > -2,95$

We accept the H0 hypothesis of the existence of a unit root at the 5% critical value.

Moving on to model (1): no constant or trend

$$IDH = \alpha IDH(-1)$$

Augmented Dickey-Fuller Unit Root Test on IDH				
ADF Test Statistic	5.457807	1% Critical Value*	-2.6369	
		5% Critical Value	-1.9517	
		10% Critical Value	-1.6213	
*MacKinnon critical values for rejection of hypothesis of a unit root.				

We note that: $t_{\text{calculated}} = 5.45 > -1.95$

We accept the H0 hypothesis of the existence of a unit root at the 5% critical value. The process is therefore not stationary.

We will differentiate the HDI series only once by the equation $DIDH = IDH - IDH(-1)$ and we test all three models:

Let's start with the model (3) with constant and trend

$$DIDH = \alpha DIDH(-1) + \beta T + c$$

Augmented Dickey-Fuller Unit Root Test on DIDH				
ADF Test Statistic	-5.326839	1% Critical Value*	-4.2826	
		5% Critical Value	-3.5614	
		10% Critical Value	-3.2138	
*MacKinnon critical values for rejection of hypothesis of a unit root.				

The ADF value calculated $= -5.32 < -3.56$ at the threshold of 5%, we therefore reject the H0 hypothesis of the existence of a unit root.

Moving on to model (2): (with constant)

$$DIDH = \alpha DIDH(-1) + c$$

Augmented Dickey-Fuller Unit Root Test on DIDH				
ADF Test Statistic	-4.774965	1% Critical Value*	-3.6576	
		5% Critical Value	-2.9591	
		10% Critical Value	-2.6181	
*MacKinnon critical values for rejection of hypothesis of a unit root.				

The ADF value calculated $= -4.77 < -2.95$ at the threshold of 5%, we therefore reject the H0 hypothesis of the existence of a unit root.

We are now testing the model (1) (without constant or trend)

$$DIDH = \alpha DIDH(-1)$$

Augmented Dickey-Fuller Unit Root Test on DIDH				
ADF Test Statistic	-2.822238	1% Critical Value*		-2.6395
		5% Critical Value		-1.9521
		10% Critical Value		-1.6214

Note that ADF calculated=-2.82<-1.95 at the 5% threshold, which means that there is no unit root in this model.

After the first differentiation the HDI series became stationary and we can now apply the different statistical tests.

3) The Granger causality test:

First we choose the number of lags (p) that minimizes the AKAIKE and SCWARTZ criteria.

VAR Lag Order Selection Criteria

Endogenous variables: DIDH PIB

Exogenous variables: C

Date: 04/14/24 Time: 17:07

Sample: 1990 2022

Included observations: 28

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-10.95149	NA	0.008647	0.925107	1.020264	0.954197
1	-1.113315	17.56818*	0.005707*	0.508094*	0.793566*	0.595366*
2	1.518487	4.323675	0.006332	0.605822	1.081610	0.751275
3	2.136162	0.926512	0.008175	0.847417	1.513519	1.051051
4	2.925240	1.070893	0.010549	1.076769	1.933186	1.338584

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

According to the table above, the delay number that minimizes the two Akaike and Schwartz criteria is $P=1$, we will perform the causality test with this delay number. The results are presented in the following table:

Pairwise Granger Causality Tests			
Date: 04/14/24 Time: 17:19			
Sample: 1990 2022			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Probability
PIB does not Granger Cause DIDH	31	19.9323	0.00012
DIDH does not Granger Cause PIB		0.15942	0.69272

According to the result of the Granger test, the null hypothesis (H_0 : PIB does not granger cause DIDH) is rejected because the probability $P=0.00012 < 0.05$. Which means that GDP causes HDI.

While the second hypothesis H_0 : DIDH does not granger cause PIB is accepted because the probability $p = 0,69272 > 0.05$.

The relationship between the two stationary variables GDP and DIDH goes in a single direction «GDP causes the HDI»

4) *Linear regression*

From the results of the Granger test, we will estimate the Human Development Index (HDI) according to the growth rate of gross domestic product (GDP) by the equation:

$$DIDH = aPIB + bT + C$$

GDP: the growth rate of gross domestic product in %.

DIDH: the human development index differentiated only once.

T: trend or trend.

C: the constant.

The result of the estimate is presented in the following window:

Dependent Variable: DIDH
Method: Least Squares
Date: 04/20/24 Time: 14:17
Sample(adjusted): 1991 2022
Included observations: 32 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIB	1.65E-05	4.87E-05	0.339782	0.7365
@TREND	-0.000165	9.02E-05	-1.834426	0.0769
C	0.007386	0.001656	4.459123	0.0001
R-squared	0.104297	Mean dependent var		0.004750
Adjusted R-squared	0.042524	S.D. dependent var		0.004670
S.E. of regression	0.004569	Akaike info criterion		-7.849823
Sum squared resid	0.000605	Schwarz criterion		-7.712410
Log likelihood	128.5972	F-statistic		1.688401
Durbin-Watson stat	1.875280	Prob(F-statistic)		0.202478

4.1) *The coefficient of determination (R squared):*

The coefficient of determination R^2 measures the degree of determination of the variable DIDH by the explanatory variables.

R-squared=0.10 indicates that our model explains only 10% of HDI variation, which probably means that we are dealing with a bad model.

4.2) *Global significance of the model coefficients:*

We will test the quality of the coefficients of the model taken together, asking us the hypotheses:

H0: $a=b=0$

H1: there is at least one coefficient different from zero.

F-statistic	1.688401
Prob(F-statistic)	0.202478

We use the Fisher test (indicated in the table above). The p-value associated with the Fisher statistic =0.202478 > 0.05

We accept H0 and reject H1 which stipulates that at least one of the coefficients of the model is different from zero. So it's a bad model.

4.3) *significance of individual coefficients:*

We use the Student:

Let's start with the coefficient (a) of the explanatory variable (GDP)

H0: $a=0$

H1: a is different from zero

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIB	1.65E-05	4.87E-05	0.339782	0.7365

We note that the P-value associated with this statistic =0.7365 > 0.05

We accept H0 and we reject the hypothesis H1 which says that the coefficient of a is different from zero, so it is not significant at the 5% threshold.

The two tests of global and individual significance, as well as the low coefficient of determination, show that the variable GDP has no effect on the variable HDI.

IV. CONCLUSIONS

Through this study, we wanted to investigate the existence of a relationship between economic growth measured by the growth rate of Gross Domestic Product and economic development measured by the Human Development Index. According to data from Algeria from 1990 to 2022, the rate of economic growth was fluctuating with a stable trend, which allows us to refute the first hypothesis that assumed a positive evolution of this indicator. Our study also showed that the evolution of the HDI was fluctuating with a general negative trend over the research period, which allows us to refute the second hypothesis that stipulated that the HDI experienced positive growth.

For the study of the relationship between GDP growth and HDI, we first calculated the correlation coefficient which was very low ($r=0.22$) showing the weakness of the linear relationship between the two variables. Then, after stationing the study variables, we performed a Granger causality test to see if one variable causes the other. This test showed that the variable PIB causes the variable HDI.

Based on Granger's test results, we regressed the HDI variable to the GDP variable using the ordinary least squares method to measure the impact of the economic growth rate on the HDI. Using the Fisher and Student tests and with a low coefficient of determination, we concluded that the specified model was not good.

The results of our study finally allow us to say that there is no relationship between economic growth and the human development index in Algeria.

Explanatory factors: Growth does not lead to human development in Algeria because :

- ✓ Economic growth in Algeria is not inclusive, it does not provide opportunities for socio-economic development for as many people as possible, such as that young people, women and the rural population;
- ✓ It can be explained by bad governance and corruption;
- ✓ The rentier character of the Algerian economy which escapes all the rules and contents of economic theory.
- ✓ Statistically speaking, it may be that linear modeling is not the right one so no linear relationship, but there could be a relationship of other type which will require further research.

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