Human Capital Investment and Sustainable Development in Algeria: An Empirical Analysis from 1992 to 2021

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ABSTRACT

This study delves into the significance of human capital investment in fostering sustainable development in Algeria, spanning a comprehensive three-decade period from 1992 to 2021.

To emphasize the role of this investment in bolstering one of the cornerstones of sustainable development, particularly the economic dimension, we have meticulously selected variables intricately tied to human capital. These chosen variables are pivotal to our endeavor to elucidate the interplay between human capital and sustainable development.

Through this approach, we aim to provide a nuanced comprehension of how investments in various facets of human capital, including education, skill enhancement, and vocational training, can serve as catalysts for both economic growth and the promotion of sustainable development. Moreover, our strategic variable selection extends beyond immediate impacts, seeking to unveil the enduring effects that ripple through time, shaping the economic landscape and paving the way for a sustainable future.

Our methodology employs the Vector Autoregressive (VAR) model, a robust framework for our analysis. The results we've obtained corroborate the notion that investments in human capital, in all their diverse forms, exert a positive influence on both the economic growth and the sustainable development of Algeria throughout the study period.

1.INTRODUCTION

In the pursuit of societal progress and prosperity, the role of human capital investment cannot be overstated. The strategic allocation of resources to enhance education, skills development, vocational training, and the overall development of a skilled and knowledgeable workforce holds the promise of transformative change, not only in terms of economic growth but also as a pivotal instrument for achieving sustainable development goals. In this vein, our comprehensive empirical analysis embarks through three decades, spanning from **1992 to 2021**, to investigate the intricate interplay between human capital investment and sustainable development within the context of Algeria.

Algeria, a nation with significant natural resources and untapped potential, is poised to take a pivotal stride towards sustainable development. This study serves as an illuminating exploration of the profound impact that strategic investments in human capital can have on the Algerian landscape. By focusing on variables intricately linked to human capital, we aim to unravel the underlying dynamics of this relationship and underscore the multi-faceted contributions of human capital investment in fostering sustainable development.

Our chosen variables transcend mere statistical measures; they represent investments in knowledge, skills, and the very bedrock upon which sustainable development stands. Moreover, they encapsulate not only the immediate influence of these investments but also their far-reaching and enduring effects. The strategic selection of these variables is a testament to our endeavor to provide a holistic understanding of the enduring implications of human capital investment, paving the way for a more sustainable future in Algeria.

At the heart of our analysis lies the Vector Autoregressive (**VAR)** model, a powerful tool that allows us to scrutinize the dynamics between human capital investment and sustainable development. The results obtained from this meticulous investigation offer compelling insights, affirming the transformative potential of human capital investments in shaping Algeria's economic landscape and steering it toward a more sustainable and prosperous future. This study serves not only as an empirical exploration but also as a call to action, advocating for strategic investment in human capital as an indispensable vehicle for achieving sustainable development in Algeria.

1.1 RESEARCH PROBLEMATIC

Algeria, like many countries, is faced with the quest for economic development that is both sustainable and balanced.

Since the 1990s, Algeria has undertaken a constant commitment to the development of policies aimed at sustainable development. In order to better assess the impact of human capital on this development, we formulate the following research question:

How does the enhancement of human capital contribute to fostering sustainable development in Algeria?

1.2. STUDY HYPOTHESES

In addressing our inquiry, we propose the following hypotheses**:**

- Human capital serves as a crucial foundation for sustainable development ;
- Investing in various aspects of human capital—such as public expenditure in education, initiatives to enhance the human development index, and technological advancement—will contribute significantly to fostering sustainable development ;
- The employability of women, promoting societal equity, stands as a vital factor in driving sustainable development**.**

1.3. RESEARCH OBJECTIVES

Our study aims to assess the influence of investing in human capital on the economic aspect of sustainable development, specifically focusing on the **GDP per capita variable**. We've exclusively incorporated human capital development-related variables to evaluate the significance of human capital within this dimension during the period spanning from **1992 to 2021**. It's important to note that the selection of variables is based on both the study's objectives and data availability. Additionally, adjustments were made in the **VAR** (Vector Autoregression) model to account for missing data**.**

1.4. RESEARCH METHODOLOGY

In pursuit of our goal, we assembled a database encompassing five variables. Our research seeks to ascertain the degree to which investment in human capital development initiatives will further sustainable development in Algeria, particularly in its economic aspect. The macroeconomic data gathered have been extracted from the World Outlook Database, comprising annual series spanning from **1992 to 2021**. These data will be analyzed using **Eviews** software**.**

2. SUSTAINABLE DEVELOPMENT: FUNDAMENTAL CONCEPTS

Sustainable development has emerged as a redefined model for economic growth, evolving from the shortcomings of past economic policies that led to issues such as unemployment, energy crises, and environmental degradation. The pivotal Brundtland Report of 1987, authored by the United Nations Commission on Environment and Development, introduced the foundational concept of sustainable development: « Development that satisfies present needs while safeguarding the ability of future generations to fulfill their own requirements » (**Brundtland, 1987).**

This multifaceted concept of sustainable development rests on three core pillars: economic, environmental, and social dimensions. It recognizes the finiteness of global resources and emphasizes the harmonization of these three pillars to prevent their depletion. The fundamental premise is the interconnectedness of environmental health, economic prosperity, and societal well-being (**Strange, T., & Bayley, A. 2008, p.141**).

Put differently, attaining sustainable development necessitates a tight interconnection and mutual reliance among three pivotal components: the economic, social, and environmental facets of progress. Disregarding either the social or environmental dimension would adversely affect the economic dimension. These three pillars collectively encompass the challenges inherent in sustainable development, aiming to achieve the following objectives:

- **Environmental Preservation:** Aimed at conserving natural resources, reducing pollution, and mitigating climate change to maintain the health and integrity of ecosystems**.**
- **Economic Prosperity:** Seeking to promote economic growth that is inclusive, resilient, and fosters prosperity while considering long-term consequences and minimizing negative impacts on the environment and society**.**
- **Social Equity and Inclusivity**: Striving for fair and equitable distribution of resources, opportunities, and benefits to ensure the well-being and quality of life for all, regardless of differences such as gender, race, or socio-economic status.

These objectives collectively drive the pursuit of sustainable development, aiming to create a balanced, harmonious, and thriving future for both current and future generations.

Fig.1: The three pillars of sustainable development

Source : https://amazonia.fiocruz.br

3. INDICATORS FOR MEASURING SUSTAINABLE DEVELOPMENT

Sustainable development indicators serve as measurement tools utilized to evaluate the sustainability of an economic system, environmental impact, or social performance within a specific country. The following table provides an overview of the primary sustainable development indicators.

Table 1. Indicators of sustainable development

Economic indicators	
International cooperation to accelerate sustainable development	GDP per capita
	Share of total fixed investment in GDP
	Exports of goods and services / imports of goods and services
Changing consumption patterns	Current account balance as a percentage of GDP
	Annual energy consumption per capita
Financial resources mechanisms	Debt/GDP
	Total public development aid provided or received
Social indicators	
Combating poverty	Unemployment rate

	Human poverty index
	Number of people living below the poverty line
Demographic dynamics and sustainability	Population growth rate
Promoting education, public awareness and training	Adult literacy rate
	Gross secondary school enrolment rate
Protecting and promoting human health	Life expectancy at birth
	The number of people without access to drinking water
	Number of people without access to sanitation
	Number of people without access to health services
Promoting the sustainable development of human settlements	Proportion of the population in urban areas
Environmental indicators	
Protecting the quality of freshwater resources and supplies	Renewable resources / population
	Renewable water use / precautions.
Promoting sustainable agriculture and rural development	Combating deforestation and desertification affected by desertification
	Share of agricultural land per capita
	Change in forest area
Use of fertilisers	Proportion of land

Source :MESBAHI Fatima Zahra, (2020), « Évolution du concept de développement durable en Algérie: Stratégie et perspectives », Modern Economic and Sustainable Development review Volume 40, p:25-39

4. HUMAN CAPITAL'S SIGNIFICANCE IN FOSTERING SUSTAINABLE DEVELOPMENT

Human capital, referring to the knowledge, skills, abilities, and health possessed by individuals, plays a vital role in fostering sustainable development. So, the development and investment in human capital are crucial for fostering sustainable development as they contribute to economic growth, innovation, environmental consciousness, improved health, and social progress.

The interconnectedness of sustainable development with three fundamental dimensions—economic, environmental, and social—is evident. Notably, the economic aspect is gaining greater significance. Research, exemplified by **Boidin (2004)**, indicates that developing nations

are emphasizing human and social factors, recognizing their centrality in achieving sustainable development. In these contexts, the human dimension pertains to advancing or upholding human welfare. This progress is pursued through enhancements in education systems, healthcare provisions, individual freedoms, and similar measures.

The attained degrees of sustainable development mirror the determination and capabilities of political and economic leaders alongside the available human and material resources. As per the United Nations Development Programme (UNDP) in their **Report (2022, p. 220)**, "Unleashing our human potential requires us to embrace adaptability, originality, unity, and inclusivity to envision and construct a future in which everyone can thrive**".**

In the Human Development Report (**2016)**, a critical query arises: How can we ensure universal human development**?**

Emphasizing the report's key points, it highlights the necessity for revamped global governance coupled with fairer multilateralism to advance human development universally**.**

Furthermore, the report accentuates that human development encompasses the quality of human existence, extending beyond the mere economic prosperity of nations.

HOW IS HUMAN DEVELOPMENT MEASURED?

The assessment of human development is primarily accomplished through the Human Development Index (**HDI)**, which serves as a composite index encompassing three crucial dimensions of human development. These dimensions include life expectancy at birth, indicative of the ability to lead a long and healthy life, reflecting good health. Additionally, the average length of schooling and the anticipated duration of schooling signify the capacity to acquire knowledge. Moreover, the gross national income per capita is a metric reflecting the ability to sustain a decent standard of living. The HDI ranges up to an upper limit of 1.0.

For a more comprehensive evaluation of human development, the Human Development Report introduces four additional composite indices. The Inequality-adjusted HDI modifies the HDI based on the extent of inequality present. The Gender Development Index compares the HDI values between women and men. The Gender Inequality Index emphasizes the empowerment of women. Lastly, the Multidimensional Poverty Index assesses poverty using aspects beyond income considerations **(UNDP, 2016)**.

5. EMPIRICAL STUDY

Our research study focuses on establishing a connection between a key sustainable development indicator, GDP per capita, and several human development-related variables.

The primary objective is to assess how investing in human capital influences the overall improvement of GDP per capita. The study spans a duration of 30 years (1992-2021), utilizing data extracted from the World Outlook database.

Based on both the availability of data and the significance of the variables, we have selected the following parameters for analysis:

- ✓ **GDP per capita,** derived from Gross Domestic Product (GDP), serves as a measure of a country's total production of goods and services within a given year. It is calculated by dividing the GDP value by the population count, thereby considering the size of the population, irrespective of their individual levels of education or skills.

- ✓ **The Human Development Index (HDI)** is a composite index that evaluates longevity, education, and standard of living within a country. It serves as a metric to gauge a country's level of development, emphasizing the quality of life experienced by its citizens rather than purely economic data. The index ranges in value from 0 to 1 annually, reflecting the country's developmental status.

- ✓ **Internet users (INT):** This variable measures the number of Internet users per 100 inhabitants.

- ✓ **Public expenditure on education (EDUC)**, represented as a percentage of GDP, indicates the portion of spending allocated to public education, encompassing subsidies for public schools.

- ✓ **Female employability (EMPF)** is the proportion of the female workforce engaged in employment.

The Vector Autoregressive (**VAR**) model assumes that each variable under study is influenced by its own previous values as well as the past values of other variables. Consequently, all variables are considered endogenous within this model framework. To create a VAR model, the following steps are typically followed:

5.1 Study of the stationarity of series

The Augmented Dickey Fuller (ADF) test enables us to study the stationarity of the proposed variables. The results in Table 2 indicate that the HDI, EDUC and EMPF variables are stationary (in level- and in first difference) and the GDP/capita and INT variables are stationary in second difference for a significance level of **5%**. These results also indicate the absence of a cointegrating

relationship between the proposed variables, which allows us to continue with our VAR modelling.

Table 2: Stationarity of the series

	In level		
	Critical value	t statistique	p
PIB/hab	-2.967767	-0.965092	0.7520
IDH	-2.967767	-3.001455	0.0466
INT	-2.981038	3.180615	1.0000
EDUC	-3.144920	-2.324136	0.1802
EMPF	-2.967767	-1.244611	0.6410
	First difference		
	Critical value	t statistique	p
PIB/hab	-2.976263	-2.720059	0.0837
IDH			
INT	-2.986225	-2.489116	0.1299
EDUC	-3.098896	-4.174604	0.0074
EMPF	-2.971853	-4.547240	0.0012
	Second difference		
	Critical value	t statistique	p
PIB/hab	-2.976263	-7.652709	0.0000
IDH			
INT	-3.040391	-3.370799	0.0265
EDUC			
EMPF			

Source: **Compiled by the author from EVIEWS10 results**

5.2. Determining the optimum number of lags

Identifying the Optimal Lag Order - In order to ascertain the most suitable number of delays, denoted as "P," for the VAR model, we applied two information criteria: the Akaike Information Criterion (AIC) and the Schwarz Criterion.

According to the Akaike (AIC) and Shwarz (SC) information criteria, the optimal number of delays is P=1. The following table 3 shows the results of these two criteria.

Table 3: Determining the optimal number of lags

Lag	AIC	SIC
0	0.335411	0.571428
1	-7.164788*	-5.748687*

AIC: Akaike information criterion
SC: Schwarz information criterion

Source: **Compiled by the author from EVIEWS10 results**

5.3 Estimation of the VAR model

Data processing using **Eviews.10** software gave us the first results (see **appendix 01**). The coefficients of determination are satisfactory, varying between **0.8 and 0.99**. The number of equations obtained is equal to five, but we are particularly interested in the first equation relating to the GDP/capita variable.
The first equation obtained is as follows:

PIB_HAB = 0.385*PIB_HAB(-1) + 0.454*IDH(-1) -0.0002*INT(-1) + 0.002*EDUC(-1) + 0.001*EMPF(-1) + 1.766

All the introduced variables exhibit a positive impact on the enhancement of the GDP per capita, aligning with our initial expectations. However, the variable associated with the number of internet users stands out by showcasing a negative influence on its value. To elaborate, any rise in the values of GDP per capita, the Human Development Index (HDI), expenditure on education (EDUC), and the female employability rate (EMPF) observed in the preceding period will lead to an escalation in the future value of GDP per capita**.**

Regarding the adverse effect linked to the number of Internet users, it suggests that Algeria has yet to reach a developmental stage where this factor significantly contributes positively to its sustainable development policy.

We also note that this equation contains non-significant coefficients at the 5% threshold. The next step is to eliminate them using the WALD test in order to keep only the significant variables. The results are as follows.

$PIB\_HAB = 0.471*PIB\_HAB(-1) + 0.006 *EDUC(-1) + 1.86$

Within this concluding equation, solely GDP per capita and expenditure on education notably and positively contribute to the enhancement of the aggregate under investigation. To further explore the impact of the remaining variables, the subsequent step involves analyzing the causal relationships between these variables within the VAR 1 model.

Table 4: Estimation results for the study equations
System: UNTITLED
Estimation Method: Least Squares
Date: 05/12/23   Time: 23:34
Sample: 2007 2021
Included observations: 15
Total system (balanced) observations 75

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.471648	0.169426	2.783797	0.0077
C(4)	0.006374	0.002626	2.427579	0.0190
C(6)	1.865548	0.599342	3.112660	0.0031

Equation: $PIB\_HAB = C(1)*PIB\_HAB(-1) + C(4)*EDUC(-1) + C(6)$

Observations: 15

R-squared	0.787901	Mean dependent var	3.605546
Adjusted R-squared	0.752551	S.D. dependent var	0.015488
S.E. of regression	0.007704	Sum squared resid	0.000712
Durbin-Watson stat	2.247447		

Source: **Compiled by the author from EVIEWS10 results**

5.4 Study of the causal relationship between the variables studied

To analyse the causal relationship between the variables in the VAR1 model, we will use the GRANGER test. This test allows us to check whether a variable significantly causes another variable.

Table 5: GRANGER causality test

Pairwise Granger Causality Tests
Date: 05/12/23   Time: 23:41
Sample: 1992 2021
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
IDH does not Granger Cause PIB_HAB	29	6.20990	0.0194
PIB_HAB does not Granger Cause IDH		0.01679	0.8979
INT does not Granger Cause PIB_HAB	26	5.53901	0.0275
PIB_HAB does not Granger Cause INT		7.56100	0.0114
EDUC does not Granger Cause PIB_HAB	15	5.89314	0.0319
PIB_HAB does not Granger Cause EDUC		0.07273	0.7920
EMPF does not Granger Cause PIB_HAB	29	1.94588	0.1748
PIB_HAB does not Granger Cause EMPF		10.3055	0.0035

Source: **Compiled by the author from EVIEWS10 results**

As per the test outcomes, the HDI variable Granger causes the GDP per capita variable at the 5% threshold. Additionally, although not deemed a significant variable based on determining GDP per capita equation parameters, the number of users variable Granger causes the GDP per capita variable at the 5% threshold.

Meanwhile, expenditure on education Granger causes the GDP per capita variable at the 5% threshold. However, the EMPF variable does not Granger cause it at the same threshold. Notably, it is the female employability (EMPF) that Granger causes GDP per capita at the 5% threshold.

6.CONCLUSION

Our empirical investigation validates the premise that investing in human capital significantly fosters sustainable development, particularly within the economic dimension of sustainable development. The study identifies the contributing factors that enhance the GDP per capita value, including the human development index, Internet penetration level, and expenditure on education.

In this research, we specifically concentrated on assessing the impact of a singular category of factors linked to the advancement of human capital. Both the VAR(1) model and the analysis of causal relationships affirm that investing in human capital emerges as a highly advantageous approach for enhancing Algeria's macroeconomic landscape.

Based on the empirical findings, we suggest the following recommendations:

- ✓ Elevate the significance of nurturing human capital development.
- ✓ Augment investment, particularly in public spending, directed towards education, higher education, and vocational training.
- ✓ Combat digital illiteracy as a means to advance sustainable development initiatives.

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APPENDICES

Appendix 1. VAR 1 model results

System: UNTITLED
Estimation Method: Least Squares
Date: 05/12/23   Time: 23:25
Sample: 2007 2021
Included observations: 15
Total system (balanced) observations 75

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.385519	0.272984	1.412242	0.1648
C(2)	0.454003	0.376537	1.205730	0.2342
C(3)	-0.000291	0.000229	-1.271010	0.2103
C(4)	0.002903	0.003635	0.798695	0.4287
C(5)	0.001281	0.001957	0.654707	0.5160
C(6)	1.766726	0.793900	2.225374	0.0311
C(7)	0.012325	0.145230	0.084864	0.9327
C(8)	0.680166	0.200321	3.395386	0.0014
C(9)	4.00E-06	0.000122	0.032842	0.9739
C(10)	0.002985	0.001934	1.543421	0.1297
C(11)	-0.000217	0.001041	-0.208428	0.8358
C(12)	0.193315	0.422361	0.457701	0.6494
C(13)	16.33050	67.03744	0.243603	0.8086
C(14)	176.0392	92.46735	1.903798	0.0633
C(15)	0.947711	0.056207	16.86099	0.0000
C(16)	-1.064805	0.892698	-1.192794	0.2392
C(17)	1.145076	0.480479	2.383194	0.0214
C(18)	-270.6624	194.9603	-1.388295	0.1719
C(19)	-36.37447	19.07992	-1.906427	0.0630
C(20)	76.33779	26.31768	2.900628	0.0057
C(21)	-0.026156	0.015997	-1.634994	0.1090
C(22)	0.159020	0.254076	0.625877	0.5346
C(23)	0.320305	0.136752	2.342231	0.0237
C(24)	54.72306	55.48880	0.986200	0.3293
C(25)	-11.94861	26.50072	-0.450879	0.6542
C(26)	93.20714	36.55348	2.549884	0.0143
C(27)	-0.106534	0.022219	-4.794638	0.0000
C(28)	0.015129	0.352894	0.042872	0.9660
C(29)	0.107422	0.189939	0.565561	0.5745
C(30)	50.46944	77.07021	0.654850	0.5159

Determinant residual covariance9.75E-12

Equation: PIB_HAB = C(1)*PIB_HAB(-1) + C(2)*IDH(-1) + C(3)*INT(-1) +
C(4)*EDUC(-1) + C(5)*EMPF(-1) + C(6)
Observations: 15

R-squared	0.837455	Mean dependent var	3.605546
Adjusted R-squared	0.747152	S.D. dependent var	0.015488

S.E. of regression	0.007788	Sum squared resid	0.000546
Durbin-Watson stat	2.039011		

Equation: IDH = C(7)*PIB_HAB(-1) + C(8)*IDH(-1) + C(9)*INT(-1) + C(10)*EDUC(-1) + C(11)*EMPF(-1) + C(12)

Observations: 15

R-squared	0.958194	Mean dependent var	0.739400
Adjusted R-squared	0.934969	S.D. dependent var	0.016247
S.E. of regression	0.004143	Sum squared resid	0.000154
Durbin-Watson stat	2.666987		

Equation: INT = C(13)*PIB_HAB(-1) + C(14)*IDH(-1) + C(15)*INT(-1) + C(16)*EDUC(-1) + C(17)*EMPF(-1) + C(18)

Observations: 15

R-squared	0.994168	Mean dependent var	32.66 907
Adjusted R-squared	0.990927	S.D. dependent var	20.07848
S.E. of regression	1.912497	Sum squared resid	32.91880
Durbin-Watson stat	2.582607		

Equation: EDUC = C(19)*PIB_HAB(-1) + C(20)*IDH(-1) + C(21)*INT(-1) + C(22)*EDUC(-1) + C(23)*EMPF(-1) + C(24)

Observations: 15

R-squared	0.806815	Mean dependent var	6.374267
Adjusted R-squared	0.699490	S.D. dependent var	0.992957
S.E. of regression	0.544327	Sum squared resid	2.666627
Durbin-Watson stat	1.990568		

Equation: EMPF = C(25)*PIB_HAB(-1) + C(26)*IDH(-1) + C(27)*INT(-1) + C(28)*EDUC(-1) + C(29)*EMPF(-1) + C(30)

Observations: 15

R-squared	0.822260	Mean dependent var	81.84766
Adjusted R-squared	0.723516	S.D. dependent var	1.437824
S.E. of regression	0.756034	Sum squared resid	5.144280
Durbin-Watson stat	1.935931		

Source: Results displayed by eviews10.