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Human capital at the heart of sustainable development in Algeria

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Abstract:

The objective of our work is to demonstrate the contribution of human capital in sustainable development. Our study is spread over a period of 22 years, it aims to test the effect of several explanatory variables relating to the development of human capital on certain factors of sustainable development, namely: gross domestic saving, CO2 emission and a third factor measuring the percentage of the population in urban areas, which we have integrated into our empirical model; referring to multiple regression models on panel data.

The variables used in our final models indicate a significant effect of the majority of explanatory variables relating to human development on sustainable development in Algeria.

Keywords: human capital, sustainable development, Algeria.

1. Introduction:

In an ever-changing world, the pursuit of sustainable development has become a global priority. Sustainable development encompasses three interrelated pillars: economic, environmental and social. The challenges we face, such as climate change, poverty and social injustice, require innovative solutions and a comprehensive approach. At the heart of this enterprise is human capital, an intangible asset that embodies the sum of skills, knowledge, health and education of the population.

Algeria, rich in history, diverse landscapes and vibrant culture, is at the crossroads of sustainable development. In this vast country, economic, environmental and social aspirations converge towards a vision for the future that must meet the needs of the current population while preserving resources for future generations. At the centre of this complex undertaking is a crucial question: *To what extent does human capital contribute to promoting sustainable development in Algeria?*

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To address the above issue, we have made two assumptions:

H1:*Human capital is a key factor in achieving sustainable development policies in Algeria.*

H2:*the impact of human investment is positive on the three pillars (economic, environmental and social pillar) of sustainable development in Algeria.*

To test the hypotheses, we performed a multiple regression between the three sustainable development indicators we chose (gross domestic savings, CO2 emissions and the percentage of the population in agglomeration) with other human capital development variables: percentage of female labour force, human development index (HDI), life expectancy at birth and number of Internet users. These variables have been carefully selected to capture the diversity of aspects of human capital, from health education to access to information.

Our goal is to uncover the hidden synergies between human capital and sustainable development, unveil the connections that shape our communities and our planet, and provide valuable insights to shape a more sustainable future. Through this exploration, we pave the way for in-depth reflection on how investment in human capital can catalyze positive transformation and foster balanced sustainable development in a constantly changing world.

2. Conceptual framework of the study:

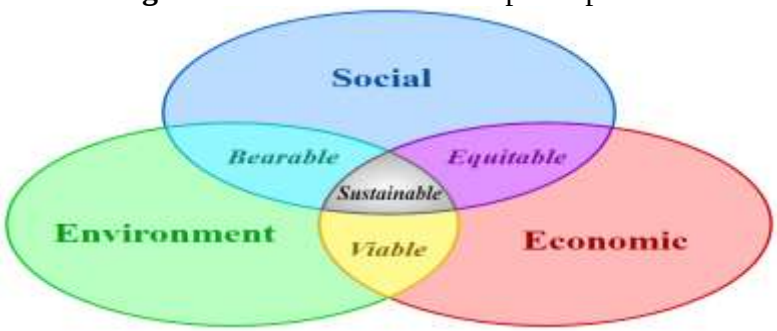
2.1 Sustainable development: definition – pillars- objectives - indicators

According to the Brundtland report, published in 1987 by the United Nations World Commission on Environment and Development, "*Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*" [3] In 1992, the Earth Summit in Rio, held under the auspices of the United Nations, formalized the notion of sustainable development and that of these three dimensions also called the three pillars of sustainable development, namely; the economic pillar, the ecological or environmental pillar and the social pillar. In fact, *sustainable development is economically effective, socially equitable and environmentally sustainable*[4].

[3]Programme des Nations Unies pour le Développement 2015-2030 https://www.undp.org/fr/sustainable-development 16/09/2023

[4]Bovar O, Demotes Mainard M, Dormoy C, Gasnier L, Marcus V, Panier I, Tregouet B. “les indicateurs du développement durable”, P51
file:///C:/Users/pc/Documents/article%20capital%20humain%20et%20d%C3%A9veloppement%20durable/ECOFRA08c.PDF 17/09/2023

Figure n°1 :sustainabledevelopmentpillars



Source :https://circularecology.com/sustainability-and-sustainable-development.html

The Sustainable Development Goals(SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. These goals aim to address a wide range of global challenges, including poverty, inequality, climate change, peace and justice, and protecting the planet[5]. The 17 SDGs are as follows:

Table n°01 : The 17 SDGs

no poverty
zero hunger
good health and well-being
quality education
gender equality
clean water and sanitation
clean and affordable energy
decent work and economic growth
industry, innovation and infrastructure
reduced inequalities
sustainable cities and communities
responsible consumption and production
measures to combat climate change
aquatic life
terrestrial life
peace, justice and effective institutions
partnerships to achieve the objectives

Source : UNDP 2015-2023 www.undp.org/fr/sustainable-development-goals

Sustainable development indicators measure the achievement of sustainable development objectives and monitor the performance of these three pillars (economic, social and environmental). [6]

The economic indicators relating to the economic pillar of sustainable development include the following measures:

[5]Programme des Nations Unies pour le Développement 2015-2030 https://www.undp.org/fr/sustainable-development-goals 17/09/2023

[6]Bovar O, Demotes Mainard M, Dormoy C, Gasnier L, Marcus V, Panier I, Tregouet B. "les indicateurs du développement durable", P54 file:///C:/Users/pc/Documents/article%20capital%20humain%20et%20d%C3%A9veloppement%20durable/ECOFRA08c.PDF 17/09/2023

- GDP (Gross Domestic Product): Measures a country's economic output.
- Unemployment rate: Indicates the percentage of people out of work.
- Gross domestic savings: represents the difference between GDP and final consumption expenditure.
- Investment in research and development: Measures innovation and long-term growth.
- Gini index: Measures income inequality.

Social indicators relating to the social pillar of sustainable development include the following measures:

- Literacy rate: Measures the percentage of people able to read and write.
- Infant mortality rate: Indicates the number of deaths of children under the age of 5 per 1,000 live births.
- Percentage of the population in urban areas with more than one million residents: refers to the percentage of a country's total population living in an urban area with more than one million residents.
- Fertility rate: Measures the average number of children per woman of childbearing age.

The environmental indicators relating to the environmental pillar of sustainable development include the following measures:

- CO2 emissions: Measures the contribution to climate change.
- Renewable energy consumption: Indicates the proportion of energy from renewable sources.
- Sustainable use of natural resources: Assesses the management of resources such as water, forests and soil.
- Air quality index: Assesses air quality in terms of pollution levels[7].

2.2 The importance of investing in people: Previous studies

Human capital in developed economies is at the heart of their sustainable development plans. This intangible wealth, and the continuous efforts to increase and improve this stock of skills and human capabilities, qualifies it as the community's most important resource.

In the literature, the development of the concept of "human capital" can be traced back to Adam Smith's theory of human capital, which defined this intangible resource as the stock of skills and aptitudes acquired by individuals through all forms of education and training. This concept was then enriched by the work of Gary Becker in

[7] « Chapitre3 : les indicateurs du développement durable ». Université Constantine 1, Algérie PP 1-10https://fac.umc.edu.dz/snv/faculte/tc/2020/2eme%20partie%20EDD%20TC%202eme%20ann%C3%A9e.pdf le 17/09/2023.

1964, which gave people a central place in economic policy, hence the need to increase efforts and investment in human capital[8].

Research into the importance of investing in people has continued to grow, and there are many examples of this:
In 2019, a study by N.SADI and O.REZINE, entitled: "HUMAN CAPITAL AND ECONOMIC GROWTH: AN EMPIRICAL ANALYSIS OF PANEL DATA OVER THE PERIOD 1975-2015"[9]. The extended Solow model for six developing economies - Algeria, Morocco, Tunisia, Iran, Jordan and Egypt - shows that human capital, and more specifically the primary and secondary cycles, has a positive and significant impact on real GDP and helps to reduce unemployment. The study reveals that physical capital has a positive influence on economic growth.

Another study, entitled "Le capital humain, commefacteurstimulateur de la croissanceéconomique en Algérie" ("Human capital as a factor stimulating economic growth in Algeria"), by A. Chadlia 2023[10], relates the rate of economic growth to several variables, including human capital. The study covers the case of Algeria from 1997 to 2021. The empirical study reveals that the economic growth rate in Algeria depends on several macroeconomic factors, but the development of human capital remains the most important variable.

3. EMPIRICAL STUDY: "Analysis of the relationship between human capital and sustainable development indicators".

Our econometric study is spread over a 22-year period (from 2000 to 2021). Our objective is to measure the impact of human capital development on certain sustainable development indicators, namely domestic savings, CO2 emissions and the percentage of the population living in urban areas. Our empirical study therefore consists of determining and analysing the equation parameters for these indicators.
In this empirical section, we have carried out a multiple regression between the three sustainable development indicators we have chosen and other variables relating to the development of human capital. It is important to note that for each equation we have retained the same explanatory variables in order to better analyse the importance of human capital in sustainable development.
In our work we have followed the following model:

$$\mathbf{Y_t = a_0 + a_i^{'} X_t + _t \ (3)}$$

Or :

[8]Le capital humain : clé de tout développement par Imane Bouhrara 2 mars 2021 dans actueco.ma
[9]CAPITAL HUMAIN ET CROISSANCE ECONOMIQUE :UNE ANALYSE EMPIRIQUE DE DONNEES DE PANEL
[10]Amel Chadlia 2023, le capital humain comme facteur stimulateur de la croissance économique en Algérie, revue abaadikdissadia

Y_t : observed endogenous variable (sustainable development indicators) ;

a_0 : constant term;

$a_i^{'}$: vector of the k coefficients of the k exogenous variables ;

X_t : vector of k exogenous variables (explanatory variables relating to human capital development)

ε_t the term error.

The variables studied in this research were extracted from the Perspective Monde database In our analysis, we include the following variables to be explained and explanatory variables:

- ***Dependent (endogenous) variables:*** in order to measure the importance of human capital development for Algeria's sustainable development, we chose dependent variables corresponding to the three pillars (axes) of sustainable development.

- **Economic axis:** for the economic axis, we have chosen :

- ✓ **Gross domestic savings (EP):** Overall, gross domestic savings represent the difference between GDP and final consumption expenditure. In other words, it represents the part of national disposable income that is not allocated to final consumption expenditure, whether by households or governments. Gross domestic savings is also the sum of the gross savings of the various institutional sectors. This indicator also measures a country's self-financing capacity without the need for foreign financing resources.

- Environment axis: for this axis we have chosen the variable :

- ✓ **CO2 emissions (kt) (ECO2)**: as defined by the World Bank: "Carbon dioxide (CO 2) is a colourless, odourless and non-toxic gas, formed during the combustion of carbon and the respiration of living organisms, and considered to be a greenhouse gas. Emissions are defined as the release of greenhouse gases or their precursors into the atmosphere over a given area and period of time". These greenhouse gases play an important role in regulating the climate, and are also a factor in global warming and the deterioration of the ozone layer. They are therefore a threat to the ecosystem and the planet.

- Social axis: for this axis we chose the variable :

- ✓ **Percentage of the population living in urban areas with more than one million residents (UP):** This indicator refers to the percentage of the total

population of a country living in an urban area with more than one million residents.

- ***Exogenous (explanatory) variables:*** we used the same variables for all the variables to be explained. These explanatory variables are :

- **Percentage of female labour force (CHF): This** is the percentage of the female labour force who are employed compared to the female population who are looking for work. This variable is used to measure the contribution of the female labour force to sustainable development and also allows us to assess equity or discrimination in the labour market.
- **Human Development Index (IDH)**: this is an index that gives information on the human level in a country. It is based on data on life expectancy, standard of living, education and health. It summarises the main parameters describing the quality of life in a given country.
- **Life expectancy at birth (year)(ESPV): This is** the average number of years people live in a country. This figure requires that the (socio-medical) conditions prevailing at birth remain the same throughout their lives.
- **Internet users (INT):** with technological development, human skills are also measured by the level of mastery of technology. The variable we have included measures the number of Internet users per 100 inhabitants.

The data was processed using eviews10 software. In our work we have chosen three dependent variables (Y1 = EPARG, Y2= ECO2 et Y3 = UP) explained by the same explanatory variables. Before determining the parameters of the variables studied, we must first check their stationarity.

A. Study of the stationarity of exogenous and endogenous series;

The unit root test used is the ADF (Augmented Dickey-Fuller) test. After processing the data with the software, we obtained the following results:

Table n°02: Stationarity of series

	In level		
	Critical value	t statistics	P
LOG EP	-3.012363	-1.963149	0.2994
CHF	-3.012363	-2.889471	0.0635
ESPV	-3.012363	-1.737172	0.3986
IDH	-3.012363	-4.459152	0.0023
INT	-3.012363	-3.012363	0.9998
ECO2	-3.012363	-1.202468	0.6532
UP	-3.012363	-5.773858	0.0002
	First difference		
	Critical value	t statistics	P
LOG EP	-3.020686	-3.746065	0.0114

CHF ESPV IDH INT	-3.020686 -3.020686 -3.020686	-4.004874 -7.374879 -2.557727	0.0066 0.0000 0.1178
ECO2 UP	-3.020686	-3.890588	0.0084
	Second difference		
LOG EP CHF	Critical value	t statistics	P
ESPV IDH			
INT	-3.029970	-5.103849	0.0007
ECO2 UP			

Source: Compiled by the authors from EVIEWS10 results

We note that all the variables are stationary (in level- and in first difference) with the exception of the INT variable which is stationary in second difference for a significance level equal to 5%.

B. Econometric formulation and estimation of model parameters:

To carry out a multiple regression, we make the following assumptions:

1/Stochasticassumptions

- H1: the values$X_{it}$are observed without error.
- H2: E (εt)=0 the mathematical expectation of the error is zero
- H3 : E (εt)= $\sigma^2\varepsilon$ the variance of the error is constant (homoscedasticity)
- H4: E (εt,ε't) = 0, if t ≠ t', the errors are uncorrelated (no autocorrelation of residuals)
- H5: Cov (xtt, εt)=0 the error is independent of the explanatory variables.

2/ Structural assumptions

- H6: absence of collinearity between the explanatory variables, which implies that the matrix (X' X) is regular and that the matrix $(X' X)^{-1}$ exists.
- H7: (X'X)/n tends to a finite and non-regular matrix.
- H8: n>k+1, the number of observations is greater than the number of explanatory series.

After entering the data, the first estimates obtained are as follows:

Table n°03: Initial multiple regressionresults

DependentVariable: LOG_EP

Method: Least Squares
Date: 09/07/23 Time: 18:55
Sample: 2000 2021
Includedobservations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.612827	2.075261	2.704637	0.0150
CHF	0.020087	0.008238	2.438509	0.0260
ESPV	-7.59E-05	0.043524	-0.001745	0.9986
IDH	5.093714	2.293382	2.221049	0.0402
INT	-0.004914	0.002111	-2.327715	0.0325

R-squared	0.875144	Meandependent var	10.76433
Adjusted R-squared	0.845766	S.D. dependent var	0.203991
S.E. of regression	0.080113	Akaike info criterion	-2.014045
Sumsquaredresid	0.109107	Schwarz criterion	-1.766081
Log likelihood	27.15450	Hannan-Quinn criter.	-1.955633
F-statistic	29.78918	Durbin-Watson stat	1.284030
Prob(F-statistic)	0.000000		

DependentVariable: ECO2
Method: Least Squares
Date: 09/08/23 Time: 22:24
Sample: 2000 2021
Includedobservations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.936828	0.366683	8.009175	0.0000
CHF	-0.000788	0.001456	-0.541402	0.5953
ESPV	0.013179	0.007690	1.713666	0.1048
IDH	1.661680	0.405223	4.100651	0.0007
INT	0.001690	0.000373	4.530351	0.0003

R-squared	0.987858	Meandependent var	5.077621
Adjusted R-squared	0.985001	S.D. dependent var	0.115580
S.E. of regression	0.014155	Akaike info criterion	-5.480735
Sumsquaredresid	0.003406	Schwarz criterion	-5.232770
Log likelihood	65.28808	Hannan-Quinn criter.	-5.422322
F-statistic	345.7637	Durbin-Watson stat	1.327792
Prob(F-statistic)	0.000000		

DependentVariable: UP
Method: Least Squares
Date: 09/08/23 Time: 22:25
Sample: 2000 2021
Includedobservations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.710280	0.482323	18.05901	0.0000
CHF	0.008114	0.001915	4.238359	0.0006
ESPV	-0.015168	0.010116	-1.499491	0.1521
IDH	-1.918510	0.533018	-3.599333	0.0022
INT	-0.006614	0.000491	-13.47897	0.0000

R-squared	0.994062	Meandependent var	6.712091
Adjusted R-squared	0.992665	S.D. dependent var	0.217407
S.E. of regression	0.018619	Akaike info criterion	-4.932501
Sumsquaredresid	0.005894	Schwarz criterion	-4.684536
Log likelihood	59.25751	Hannan-Quinn criter.	-4.874088
F-statistic	711.5163	Durbin-Watson stat	1.100092
Prob(F-statistic)	0.000000		

Source: Compiled by the authors from EVIEWS10 results

The first results of the multiple regression indicate that the coefficients of determination for the three equations are very satisfactory, ranging from 87% to 99%. Most of the explanatory variables introduced in this work are significant.

The proposed model can be considered significant because the value of the F statistic is significant at the 1% level. This allows us to suggest that the proposed explanatory variables explain the sustainable development indicators studied.

C. Elimination of non-significant coefficients and conclusion of the ideal model :

In order to obtain an ideal model containing only significant variables, we proceed to eliminate non-significant variables, one by one, until we obtain a model containing only significant explanatory variables.

Table n°04: Final multiple regression results

DependentVariable: LOG_EP
Method: Least Squares
Date: 09/08/23 Time: 22:35
Sample: 2000 2021
Includedobservations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.609359	0.579787	9.674869	0.0000
CHF	0.020089	0.007969	2.520989	0.0214
IDH	5.090658	1.438441	3.539011	0.0023
INT	-0.004916	0.001755	-2.801671	0.0118

R-squared	0.875144	Meandependent var	10.76433
Adjusted R-squared	0.854335	S.D. dependent var	0.203991
S.E. of regression	0.077856	Akaike info criterion	-2.104954
Sumsquaredresid	0.109107	Schwarz criterion	-1.906583
Log likelihood	27.15450	Hannan-Quinn criter.	-2.058224
F-statistic	42.05531	Durbin-Watson stat	1.283699
Prob(F-statistic)	0.000000		

DependentVariable: ECO2
Method: Least Squares
Date: 09/08/23 Time: 22:27
Sample: 2000 2021
Includedobservations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.937642	0.359408	8.173564	0.0000
ESPV	0.013578	0.007503	1.809630	0.0871
IDH	1.528121	0.315105	4.849566	0.0001
INT	0.001793	0.000315	5.691222	0.0000

R-squared	0.987648	Meandependent var	5.077621
Adjusted R-squared	0.985590	S.D. dependent var	0.115580
S.E. of regression	0.013875	Akaike info criterion	-5.554548
Sumsquaredresid	0.003465	Schwarz criterion	-5.356177
Log likelihood	65.10003	Hannan-Quinn criter.	-5.507818
F-statistic	479.7614	Durbin-Watson stat	1.271913
Prob(F-statistic)	0.000000		

DependentVariable: UP
Method: Least Squares
Date: 09/08/23 Time: 22:26
Sample: 2000 2021
Includedobservations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.017571	0.143386	55.91593	0.0000
CHF	0.008390	0.001971	4.257229	0.0005
IDH	-2.529019	0.355739	-7.109202	0.0000
INT	-0.006995	0.000434	-16.11921	0.0000

R-squared	0.993277	Meandependent var	6.712091
Adjusted R-squared	0.992156	S.D. dependent var	0.217407
S.E. of regression	0.019254	Akaike info criterion	-4.899191
Sumsquaredresid	0.006673	Schwarz criterion	-4.700820
Log likelihood	57.89110	Hannan-Quinn criter.	-4.852461

F-statistic	886.4548	Durbin-Watson stat	1.185024
Prob(F-statistic)	0.000000		

Source: Compiled by the authors from EVIEWS10 results

D. Analysis of results:

For the economic axis measured by the domestic savings indicator: The results obtained indicate that GDP per capita in Algeria, during the study period, depends on female employability and the human development index. Each increase in these two variables will contribute to an increase in the domestic savings indicator. These results are significant at the 5% level, which corresponds to our hypotheses. Unlike the variable expressing the degree of internet penetration.

For the environment axis, studied through the rate of CO2 emissions, we note that the variables relating to human development, namely life expectancy, the human development index and the number of Internet users, contribute positively to the increase in the ECO2 indicator at the 10% threshold. These results correspond to our expectations, which explain why in Algeria we have not yet achieved a considerable degree of awareness of environmental culture.

For the percentage of the population in urban areas with more than one million residents, female employability has a positive impact on this indicator, unlike the variables relating to the human development index and the number of internet users.

These results allow us to write the final models as follows:

$\mathbf{LOG\ EP_t} = 5.6 + 0.02\ CHF_t + 5.09\ IDH_t - 0.004\ INT_t + \varepsilon_t$
$\mathbf{ECO2_t} = 2.93 + 0.01\ ESPEV_t + 1.52 IDH_t + 0.001 INT + \varepsilon_{tt}$
$\mathbf{UP_t} = 8.01 + 0.008\ CHF_t - 2.52 IDH_t - 0.006\ INT_t + \varepsilon_t$

with: ε_t the assumed error term and t=1,...22.

4. Conclusion:

Our econometric study confirms that the human factor is a key factor in sustainable development in Algeria. All the sustainable development indicators studied expressed a high degree of significance, which allows us to validate the hypothesis of the positive effect of the HDI, female employability and life expectancy on the economic and social indicators, which allows us to correspond to our hypotheses. The environmental indicator showed an increase of ECO2 as a result of the improvements in the human development variables. This result does not correspond to our hypothesis and leads us to question the level of environmental responsibility in Algeria.

The number of Internet users, even if theoretical, contributes to the improvement of economic indicators as one of the means of commercial development, we only record

a significant effect on the economic pillar of sustainable development. In addition to a negative impact, this also leads us to wonder whether Algeria has not yet reached the level of mastery of the technology that will enable it to achieve favourable results.

Following the example of this study, we conclude that investing in people, in all their forms, will help to improve the indicators of two pillars of sustainable development: the economic and social pillars.

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