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The Bidirectional Relationship between Health and Sustainable Economic Growth: An Empirical Analysis with Environmental Mediation

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Abstract

This study investigates the bidirectional relationship between health and sustainable economic growth while incorporating the mediating role of environmental degradation. Using an Ordinary Least Squares (OLS) approach applied to a time-series data analysis for the case of Tunisia, the findings reveal significant but contrasting dynamics. We notice a positive and very significant effect of the two variables, which represents the social environment in Tunisia over the period (1998-2017) on life expectancy, and a negative and very significant effect of (elecpos) represent pollution and the degradation of the physical environment. In Tunisia if the rate of (schoenr) increase by 1% the (gdpc) increases by (84.68), similarly for health expenditure (hexp) increases the (gdpc) increases in a very high level of significance 1% but we must not ignore the negative sign of the variable (elecpos) that linked to pollution and indicates the development of polluting activities which increase the level of the degradation of environments and the decreases of (gdpc). The results show that we have a positive and significant effect of (schoenr) at the level of 5% of significance on life expectancy if the (schoenr) increases 1% the life expectancy increases by (0.0208). For the variable of (gdpc) around the period between (1998 -2017) has a positive and very high level of significance (1%) on life expectancy. For the variable related to environment the production of electricity based of oil sources has a negative and very significant effect on life expectancy if the production of this polluting energy the life expectancy in Tunisia decreases by (0.0273). The Tunisian case confirms the existence of a circular interaction between growth, environment, and health. In the Tunisian case, the econometric results show that school enrolment and health expenditure support both GDP and life expectancy, whereas electricity production from oil sources weakens them; moreover, GDP positively mediates the relationship between social conditions and health but does not offset the detrimental effect of environmental degradation. The central implication is therefore that growth can contribute to better health only when it is embedded in a genuinely sustainable development path.

Keywords: Health; Economic Growth; Sustainability; Environmental Degradation; Mediation Model
JEL codes: O44, I15

1. Introduction

Health and economic growth are deeply intertwined in both economic theory and development practice. Since Solow's (1956) seminal contribution, growth has been understood as a process driven by factor accumulation and technical progress; subsequent human-capital approaches associated with Mincer and Becker further highlighted that the quality of labour is central to long-run productivity. Within this perspective, health is not merely a social outcome but also a productive asset that strengthens human capabilities, supports labour efficiency, and

enhances the returns to education and innovation. Contributions by Barro, Bloom and Canning, and Weil similarly suggest that better health conditions can raise economic performance by increasing productivity, extending working lives, and improving the capacity of populations to accumulate skills and knowledge.

Yet the health-growth nexus cannot be analysed adequately without accounting for the environmental conditions under which growth occurs. While rising income may improve nutrition, access to care, schooling, and life expectancy, growth driven by polluting industrialisation can simultaneously generate substantial external costs through air pollution, carbon emissions, and ecological degradation. These environmental pressures undermine well-being directly through morbidity and premature mortality and indirectly through lower productivity and higher health expenditures. In that sense, the relationship between health and growth is not simply bidirectional; it is conditional on whether economic expansion is environmentally sustainable.

This perspective is consistent with a broad literature. The Preston curve emphasises the positive association between income and life expectancy, while Barro (1996), Bloom and Canning (2005) and Weil (2005) underline the growth-enhancing role of health. At the same time, research on the Environmental Kuznets Curve and on pollution-related health damage, including Fodha and Zaghdoud (2010) for Tunisia, shows that economic expansion may intensify environmental degradation before cleaner structural change takes place. More recent work, such as Lee and Kim's mediation approach, suggests that income may also operate as a transmission channel linking environmental quality and health outcomes. However, relatively few studies examine jointly the reciprocal relationship between health and growth while explicitly integrating environmental mediation across both cross-country and country-specific settings.

Against this background, the present article analyses the bidirectional relationship between health and sustainable economic growth by incorporating environmental degradation as a mediating mechanism.

Economic growth improves several health-related indicators, including life expectancy, health expenditure, yet it also raises pollution emissions. Environmental degradation, in turn, exerts a negative effect on both health and growth, with particularly damaging consequences in more polluted contexts.

Table I. IMF projections of health spending as a share of GDP (2010-2050)

	Expenditure of health at the beginning of period in % GDP	**Expenditure of health at the beginning of period in % GDP**	**Expenditure of health at the end of period in % GDP**	**Expenditure of health at the end of period in % GDP**	**Evolution of expenditure in point of GDP**	**Evolution of expenditure in point of GDP**
	FRANCE	**AVERAGE ADVANCED ECONOMIES**	**FRANCE**	**AVERAGE ADVANCED ECONOMIES**	**FRANCE**	**AV.AD ECONOMIES**
IMF 2010-2050	9%	7.3%	11.6%	13.9%	2.6%	6.4%

The following table shows the evolution of health expenditure and its overall share of GDP, this evolution does not manage to solve health problems in the world so it seems to us that there are other factors that affect the human health but their costs are unmanageable.

2. Literature Review

A wide literature has been consulted on the positive relationship between health and economic growth, Devlin and Hansen, 2001; this relationship was highlighted in the late 1970’s when economic growth takes an endogenous dimension that states the human capital is more important than material capital, Grossman, (1972). The labor force qualities devote significant effort and time in the economic processes, Davis Bloom, David Canning and Jaypee Sevilla. (2004).

In the economic history of the Word, Economic growth, is one of the most controversial speech was punctuated with the role of human development and health. This study we will improve the relationship between health and the sustainable economic.

Several research test the relationship between life expectancy of population and their resources Devlin and Hansen, (2001) and affirmed that the health of individuals depend both the type of health systems and their resources, Elisabeta Jaba, Christiana Brigitte Balan and Ioan-Bogdan Robu. (2014).

Andreas Bergh and Therese Nilsson (2010) examined the relationship between economic, social and political dimensions of globalization and life expectancy. They construct a positive effect of economic globalization on life expectancy.

For the case of Tunisia, this open developing country we note on the increase in life expectancy but remain positive and less sensitive than the rich countries. This is explained by a recent demographic transition in Tunisia and an aging of population, but also pollution and disrespect for the environment will have a negative impact on the health of individuals in Tunisia.

Mouez Fodha and Oussama Zaghdoud (2010) affirmed that in the first stage of economic growth the per capita income increase and the environmental degradation increase (EKC hypothesis). They examine the relationship between economic growth and pollution; its two factors are considered two main determinants of life expectancy.

Many studies focus on the validation of EKC hypotheses for a few single analysis and they would conclude that we have same specific characteristics of each case of country namely technological progress and the specification decoupling of structural relationship between growth and pollution.

Tunisia records an improvement in the indicators of development like everywhere in the world, this evolution of the life expectancy is mainly due to the improvement of the living conditions of the individuals in static terms but if we notice the trend of the curve in terms of growth we will have a decrease, which remains positive but remains decreasing.

The degradation of the environment is hidden behind this decrease in life expectancy, this hypothesis which we seek to validate for the case of Tunisia that despite economic growth and the increase in income per capita main cause of the improvement of several development indicators in Tunisia the lack of respect for the environment will have a negative impact on life expectancy.

3. Methodology

To evaluate the existence of relationship between of a mediating effect of growth GDP on the relationship between health and environment, Cheng Wen Lee and Min Sun Kim (2019) adopted the proposed model of mediator effect of Baron and Kenny (1986); Fitrianto and Midi, (2013); Gunzler Chen Wu and Zeng (2013); Rijnhart and al (2017).

There are a series of regression equations to estimate mediation model Baron and Kenny, 1986; Fitrianto and Midi, 2013; Rijnhart & al, 2017:

$$Y = i_1 + cX + e_1 \quad (1)$$

$$M = i_2 + aX + e_2 \quad (2)$$

$$Y = i_3 + c'X + bM + e_3 \quad (3)$$

Our analysis examines the relationship between life expectancy and social & physical environment for the case of Tunisia during the period of 20 years t=20, (1998-2017).

$$Le_t = c + \beta_1 schoenr_t + \beta_2 hexp_t + \beta_3 elecpos_t + \varepsilon_t \quad \text{Model (1)}$$

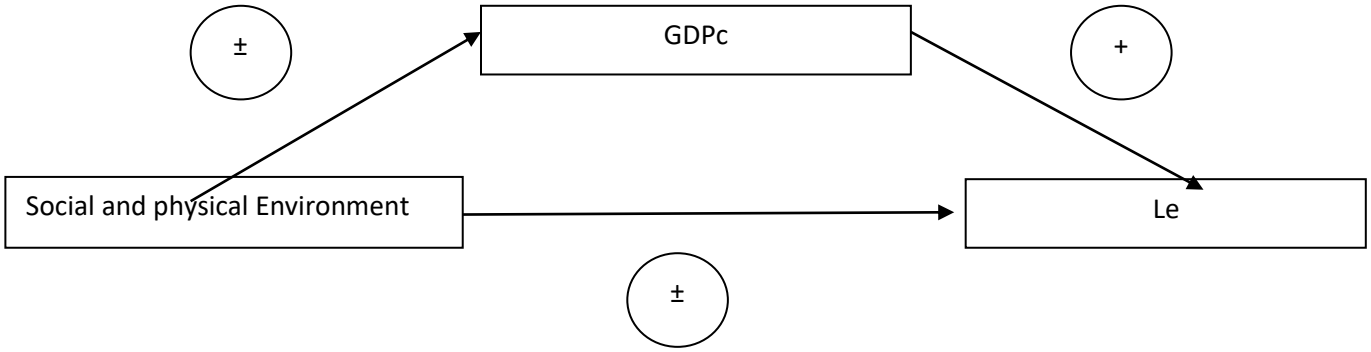
$$gdpc_t = c + \beta_1 schoenr_t + \beta_2 hexp_t + \beta_3 elecpos_t + \varepsilon_t \quad \text{Model (2)}$$

$$Le_t = c + \beta_1 schoenr_t + \beta_2 hexp_t + \beta_3 elecpos_t + \beta_4 gdpc_t + \varepsilon_t \quad \text{Model (3)}$$

Where in:

We proposed a graph of this relationship and the selected specific variable to represent the social and physical environment.

Figure: the overall effect and possible relationships of social and physical environment on growth for the case of Tunisia



Based on the forgoing regression approach for the case of Tunisia we obtained the results of the table below

All preliminary statistical tests are performed; descriptive statistics, Breusch-Godfrey LM test for the presence of serial correlation and Jarque-Bera normality test of the times series over 20 years for the case of Tunisia. We integrated same selected variables related to the social environment (scholenr)(hexp) and the physical environment (elecpos) to test their effects on growth (lgdpc) and health (LE).

The results of the table examine the relationship between life expectancy and the social and physical environment with a mediator variable of GDP.

Table XV. The effect of social and physical environmental degradation on health and growth

	(Model1)	**(Model2)**	**(Model3)**
VARIABLES	**LE TUNISIA case**	**GDP TUNISIA case**	**LE TUNISIA case**
schoenr	0.0736***	84.68**	0.0208**
	(0.0183)	(33.91)	(0.00874)
elecpos			-0.0273**
			(0.00927)
hexpc	0.0111***	24.86***	-0.00575**

	(Model1)	(Model2)	(Model3)
VARIABLES	**LE TUNISIA case**	**GDP TUNISIA case**	**LE TUNISIA case**
	(0.00177)	(3.270)	(0.00232)
gdpc			0.000625***
			(5.91e-05)
L4.elecpos	-0.0508**	-120.6***	
	(0.0182)	(33.60)	
Constant	64.58***	-4,679	68.02***
	(2.126)	(3,930)	(0.978)
Observations	16	16	20
R-squared	0.922	0.944	0.992

5. Discussion

In our analysis we presented three equations (1) (2) and (3) to test the effect of social and physical environment on life expectancy , then the effect of social and physical environment on growth (gdpc) to test finally the existence of a mediating effect of GDP on the relationship between health and environment.

In our model we selected two variables to represent the social environment of the population in Tunisia, health expenditure and school enrollment rate, its two variables reflect the evolution and improvement of standard of living of individuals over the period (1998-2017).

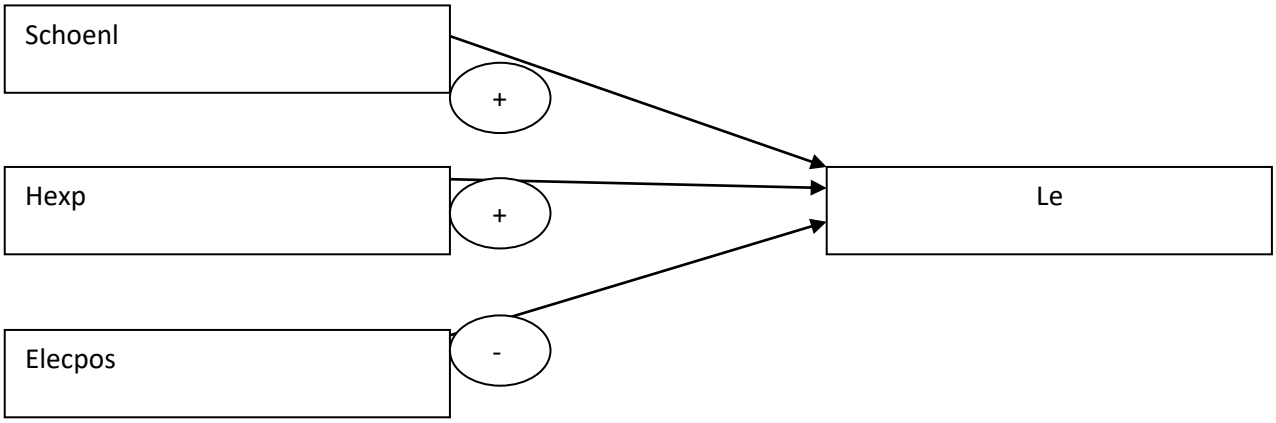
Tunisia continues overall the 20 years period to make progress in human development and continues to record an increase in certain indicators related to health such as the accessibility of health care services and the school enrollment but behind its progress hides other effects related to the development of industrial activities.

The variable (elecpos) production of electricity from oil sources represents the degradation of the physical environment, the production of this electricity is a major source of global warming and combustion of its products results in twice the Co2 emissions that can damage the environment.

In the light of the final table of results, in the first model (1) we notice a positive and very significant effect of the two variables, which represents the social environment in Tunisia over the period (1998-2017) on life expectancy, and a negative and very significant effect of (elecpos) represent pollution and the degradation of the physical environment.

1. $Le_t = c + \beta_1 schoenr_t + \beta_2 hexp_t + \beta_3 elecpos_t + \varepsilon_t$

Figure: the overall effect of social and physical environment on life expectancy, * indicate the significance of coefficient at the *** p<0.01, ** p<0.05, * p<0.1



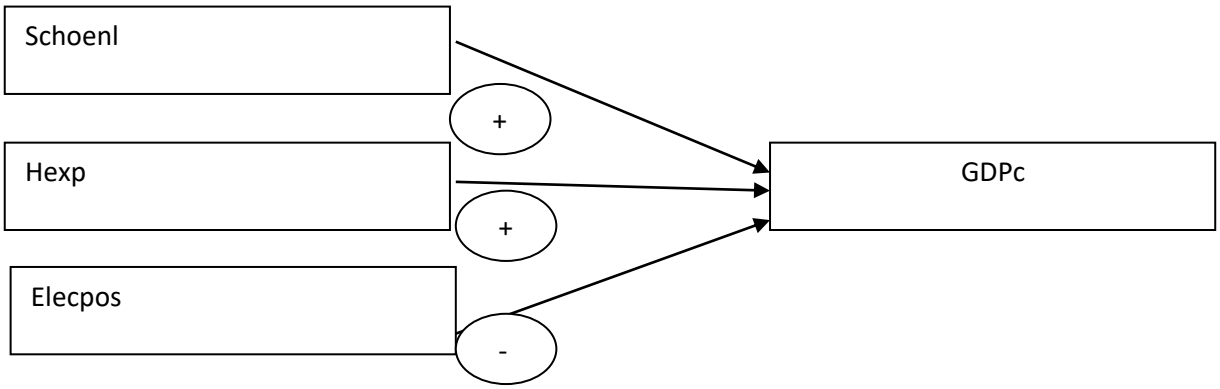
The second equation (model2) we tested the effect of these same selected variables on GDP and we had as a results a positive and significant effect of (Schoenl) on the (gdpc) at 5% level of significance.

In Tunisia if the rate of (schoenr) increase by 1% the (gdpc) increases by (84.68), similarly for health expenditure (hexp) increases the (gdpc) increases in a very high level of significance 1% but we must not ignore the negative sign of the variable (elecpos) that linked to pollution and indicates the development of polluting activities which increase the level of the degradation of environments and the decreases of (gdpc).

Mouez Fodha and Oussama Zaghdoud (2010), investigates the relationship between economic growth and Dioxide Carbone (Co2) Emessions and sulfur dioxide (So2) as the environmental indicators for the case of Tunisia covering the period 1961-2004 using cointegration analysis based on the hypothesis of EKC, their causality results show that the relationship between and income and pollution in Tunisia has a unidirectional causality with income causing environmental changes.

2. $gdpc_t = c + \beta_1 schoenr_t + \beta_2 hexp_t + \beta_3 elecpos_t + \varepsilon_t$

*Figure: the overall effect of social and physical environment on growth, * indicate the significance of coefficient at the *** p<0.01, ** p<0.05, * p<0.1*



Finally, the 3rd equation is sharp to validate our hypothesis which stipulates that despite the economic and social development, the advances made in terms of health and living conditions of individuals worldwide and in particular in Tunisia. The life expectancy has a downward trend in terms of growth around the world this claims

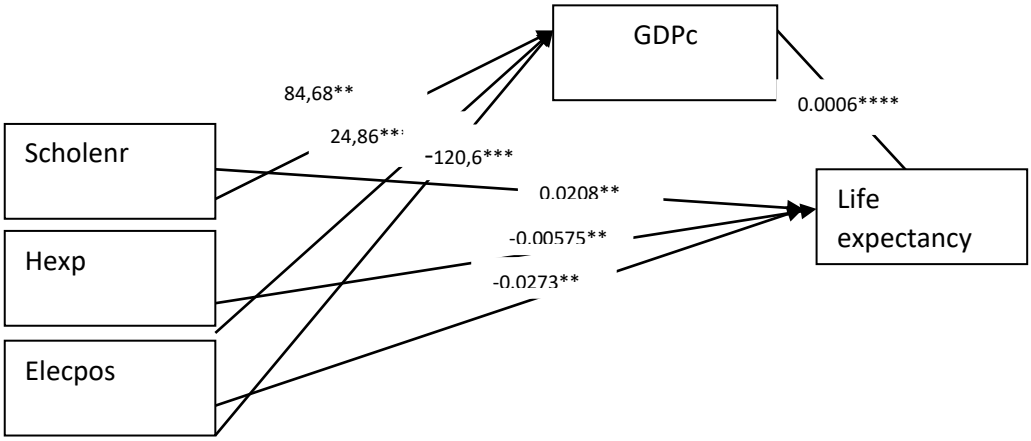
that there are indirect effects which affect negatively health of individuals and life expectancy. Pollution is one of the main factors behind this decrease.

3. $$Le_t = 68.02 + 0.0208 schoenr_t + (-0.00575) hexp_t + (-0.0273) elecpos_t + 0.000625 gdpc_t + \varepsilon_t$$

The 3rd regressions equations in the mediating model are used to illuminate the direct and indirect effect of the social and physical environment on life expectancy for the case of Tunisia. The results show that we have a positive and significant effect of (schoenr) at the level of 5% of significance on life expectancy if the (schoenr) increases 1% the life expectancy increases by (0.0208). For the variable of (gdpc) around the period between (1998 -2017) has a positive and very high level of significance (1%) on life expectancy.

For the variable related to environment the production of electricity based of oil sources has a negative and very significant effect on life expectancy if the production of this polluting energy the life expectancy in Tunisia decreases by (0.0273).

*Figure: the overall direct and indirect effect of social and physical environment on health and growth, * indicate the significance of coefficient at the *** p<0.01, ** p<0.05, * p<0.1*



That means that even if Tunisia has experienced an improvement in several economic and social indicators since 1998 the unmanageable costs of pollution have had a disastrous effects on health which explains the downward trend in the curve of life expectancy in terms of growth and the costs of pollution on the health of individuals are out of control if we do not establish a model of sustainable economic growth.

Our research comes to contradict the results of the research investigation of Mouez Fodha and Oussama Zaghdoud (2010) which concluded that we have not a negative effect of pollution on growth (GDP) for the case of Tunisia.

According to new statistics from the air quality life index, the average of years lost in life expectancy due to fine particulates (air pollution) records 1.8 years lost in life expectancy which is the highest average even after other illnesses for the use of polluted water, this generates 7 months less in life expectancy.

6. Conclusion

This study examines the relationship between health and economic growth by introducing environmental degradation as a central transmission channel rather than treating it as a peripheral externality. Across the empirical analyses presented in the article, the evidence confirms that the interaction between health and growth is real, economically meaningful, and fundamentally conditional on the environmental quality accompanying the growth process.

The Tunisian case provides a strong support for this interpretation. The mediation models indicate that school enrolment and health expenditure exert positive and statistically significant effects on both GDP and life expectancy, whereas electricity production from oil sources has a negative and significant impact on these two dimensions. The coefficient of GDP remains positive in the life-expectancy equation, confirming the income-health channel, but the adverse role of polluting energy demonstrates that environmental degradation weakens the quality and durability of this relationship.

These findings extend the logic of Lee and Kim's mediation framework and suggest, for Tunisia, a stronger harmful effect of pollution on growth and health than earlier studies had identified.

Improving health outcomes does not depend exclusively on expanding output or increasing medical spending in isolation. What matters is the quality of growth: investment in education, effective health expenditure, cleaner energy systems, and stronger environmental regulation must advance together if gains in life expectancy and welfare are to be durable. A development strategy that neglects environmental costs may temporarily raise income while progressively increasing the hidden health burden borne by households and public systems.

Although the analysis is necessarily limited by the selected variables and the period under study, the central conclusion remains robust: economic growth alone is insufficient to secure better health outcomes unless it is environmentally sustainable. Future research could extend this work through dynamic panel methods, broader measures of environmental damage, and more comprehensive indicators of human well-being. Nevertheless, the evidence presented here strongly supports a simple proposition: health and growth reinforce one another most effectively when the development model protects both human capital and the natural environment on which it depends.

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