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The Interaction Between Life Expectancy and Household Consumption in Algeria: A VAR Model Approach

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Abstract:

The study aims to analyze the dynamic interaction between life expectancy and household consumption in Algeria, using a VAR model over the period 1984–2024. The results show that the relationship between these two variables is generally weak and econometrically insignificant. These findings suggest that in Algeria, life expectancy and household consumption evolve independently, with no direct or strong causal link between them. This conclusion calls for further analysis by incorporating other factors that could influence both variables, to better understand the underlying dynamics and provide more effective guidance for public policies.

Keywords: Life expectancy, household consumption, Algeria, VAR model

Jel Classification Codes : I1, I32, P46.

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1. INTRODUCTION

The social and economic context substantially influences health, while health, in turn, may affect economic behaviour. In Algeria, the post-1990 period was marked by significant economic and social transformations, including changes in the structure of the economy and gradual improvements in health indicators. However, the persistence of social and economic inequalities, together with the vulnerability of low-income households, continues to represent major challenges for poverty reduction.

Previous studies have shown that life expectancy is not merely a health indicator, but may also be influenced by a country's economic and social conditions. In this context, this study seeks to address the following question: To what extent do life expectancy and household consumption in Algeria interact and mutually influence each other?

The central hypothesis of this research is that improvements in life expectancy and household consumption are linked through a complex dynamic, whereby changes in one variable may affect the other.

2. Literature Review

Several studies have explored the complex relationship between health, economic development, and poverty reduction, each offering insights into how health factors contribute to or hinder economic outcomes. Berthélemy (2008) examined the interaction between health improvements and economic development, emphasizing that the relationship is strong yet non-linear. He found that while health progress could drive growth, it could also trap economies in cycles of underdevelopment, particularly in the context of the HIV/AIDS epidemic in Africa. Berthélemy argued that improving health outcomes requires not only increasing health budgets but also institutional reforms that enhance the efficiency and equity of health policies. Building on this, Messaïli and Kaïd Tlilane (2020) assessed the contribution of health to economic growth in Algeria from 1974 to 2013, using the ARDL approach to model the relationships between public health expenditures, life expectancy, and mortality rates. Their findings revealed that public health expenditure, life expectancy, and crude mortality rates significantly impacted real GDP, while infant mortality had no significant effect. In the long term, education also played a crucial role, although it did not show a short-term impact. Meanwhile, Boughaleb and Jerry (2021) analyzed the socio-economic determinants of out-of-pocket (OOP) health

expenditures across twelve African countries between 2000 and 2021. Their econometric panel data study showed that economic growth and life expectancy significantly reduced OOP expenditures, while population growth increased them. The study also found that rural population share had a marginally significant effect, whereas unemployment, inflation, and premature mortality were not significantly associated with OOP payments. In Morocco, Es-Salmani et al. (2021) used ARDL modeling to analyze poverty dynamics, concluding that in the long run, shocks to annual per capita expenditure (a proxy for poverty) corrected at an adjustment rate of approximately 43%. They found that in the short term, factors such as unemployment, education, and inflation had a positive and significant effect on poverty, while economic growth showed a negative but significant relationship. However, in the long run, only unemployment continued to influence poverty levels. Kafando (2021) examined the role of health in poverty reduction across sub-Saharan Africa, using a fixed-effects model on data from 30 countries between 1995 and 2015. The study revealed that improvements in health, particularly life expectancy, had a direct and significant effect on income growth and poverty reduction, underscoring the importance of investing in health as a strategy for sustainable economic development and poverty alleviation. In North Africa, Achchab and Bennaceur (2025) explored the relationship between health expenditures and economic growth using panel data from six countries between 1990 and 2020. They employed the Generalized Method of Moments (GMM) and found a significant positive relationship between health expenditures and GDP growth, particularly in the long run, emphasizing the crucial role of health investments in sustaining economic development. Finally, Boughaleb and Jerry (2025) revisited the socio-economic determinants of out-of-pocket health expenditures in Africa, concluding that economic growth and life expectancy significantly reduced OOP payments, while population growth had an opposing effect. They stressed the importance of policies that integrate economic growth, reduce territorial inequalities, and enhance health coverage to alleviate the financial burden of healthcare on African households.

Contribution of the Study

While previous research has primarily focused on the impact of health on economic growth, poverty, or direct healthcare expenditures, this study

examines the dynamic interaction between life expectancy and household consumption in Algeria. It thus makes an innovative contribution by treating health as a direct influencing factor on consumption behaviours and, reciprocally, analyzing how improvements in consumption levels can support increases in life expectancy.

The adoption of the VAR model also represents an important methodological advancement, allowing both variables to be treated as endogenous and exploring their reciprocal relationships over time. This approach contrasts with more unidirectional models such as ARDL, OLS, or cross-sectional analyses, offering the opportunity to identify dynamic effects, responses to shocks, and the respective contributions of each variable to the evolution of the other.

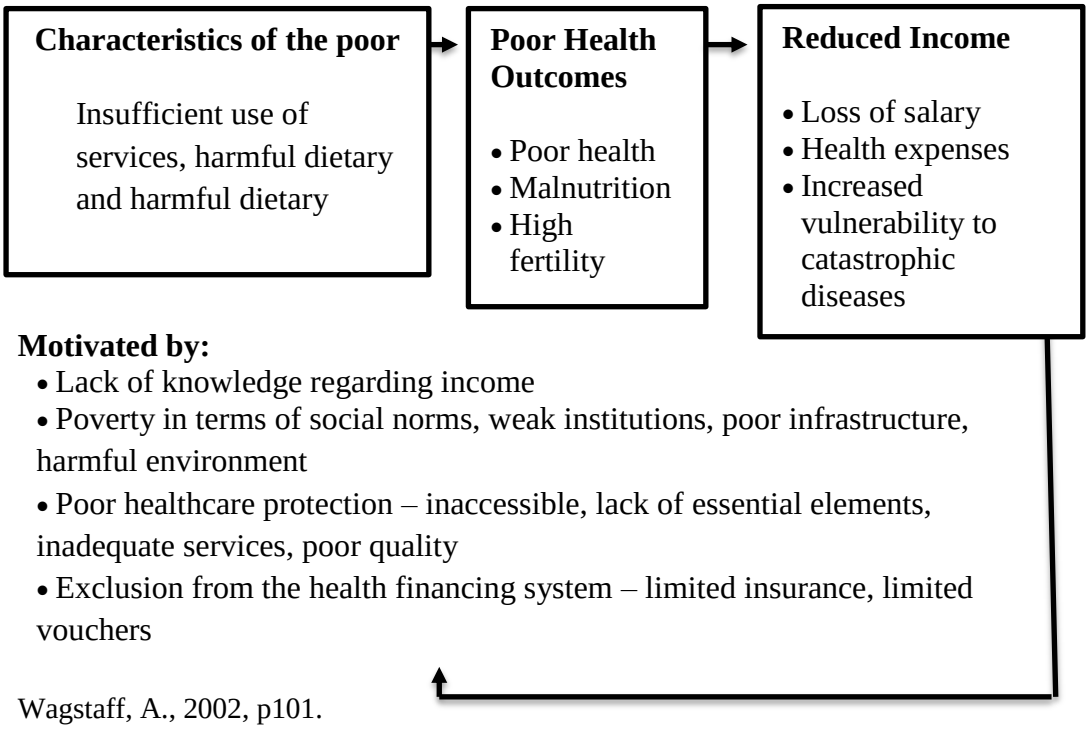
3.Theoretical Framework

Poor health is both a cause and a consequence of poverty. Illness can deplete a household's savings, reduce learning capacity, lower productivity, and compromise quality of life—thereby creating or perpetuating poverty. Conversely, the poor are exposed to greater individual and environmental risks, are less well-nourished, less informed, and have more limited access to healthcare services. They are therefore more vulnerable to the risk of diseases and disabilities (World Health Organization, 1999, p. 2).

"Benzeval" and "Judge" present the findings of 16 studies based on eight datasets from four countries, in which numerous health indicators were used (subjective reports from individuals, mortality rates, emotional stability, chronic diseases, general life satisfaction, physical functions) and various socio-economic measures (current income, recent income changes, poverty indicators, operating profits, average income over multiple periods, relative position in the income distribution curve, number of poverty episodes). The authors conclude that, "in all studies that include income measures, income is significantly related to health status" (Phipps, S., 2003, p. 14).

Poverty and poor health go hand in hand. In terms of health, poor countries tend to achieve worse outcomes than wealthier countries, and within the same country, the poor are generally in worse health than the rich.
This association reveals a bidirectional causal link: poverty leads to poor health, and poor health sustains poverty. Poor health or exceptionally high fertility can significantly affect household income and even make the difference between being above or below the poverty line. Moreover, poor health is often associated with high healthcare costs. However, poverty and low incomes are also causes of poor health. Poor countries, and the poor within countries, suffer from a multitude of deprivations that result in high levels of poor health. Therefore, the poor are trapped in a vicious cycle: poverty leads to poor health, and poor health sustains poverty (Wagstaff, A., 2002, p. 100).
This vicious cycle can be illustrated as follows:

Figure 1: The Cycle of Health and Poverty



Wagstaff, A., 2002, p101.

There are many reasons why illness places a heavier burden on the poor. First, they are much more vulnerable to illness because they have less access than others to clean water, effective sanitation, safe and hygienic housing, medical care, preventive health information, and proper nutrition. Second, the poor are much less able to access medical care, even when urgently needed, because they live farther from healthcare providers, lack the financial resources to pay for care, and are often unaware of the best measures to take in the face of a health episode. Third, as previously mentioned, the expenses associated with severe illness can drive them into destitution, forcing them to incur debt or sell or mortgage productive assets (such as land). Such an illness can plunge a household into prolonged misery, which may even extend to the next generation when children are forced to leave school to work (Sachs, J. D., 2001, p. 25).

It is often noted that while longevity and per capita income rates do not systematically align, a generalization can be made: a large number of indicators drawn from cross-country comparisons suggest that, on average, income and life expectancy tend to move together. From this generalization, some commentators may have jumped to conclusions by asserting that economic progress is decisive in improving health and increasing longevity. It has even been claimed that concerns about the divergence between rising income levels and survival chances are misplaced because, in general, the statistical relationship between the two is quite strong (World Health Organization, 1999, May 18, p. 4).

From an economic perspective, health and education are the two pillars of human capital, which, as Nobel laureates Theodore Schultz and Gary Becker have demonstrated, form the foundation of economic productivity. Just as the economic well-being of households is critical, so too is the good health of the population, as it is essential for reducing poverty, fostering economic growth, and ensuring long-term economic development at the societal level (Sachs, J. D., 2001, pp. 23-24).
The relationship between growth and health progress has been the subject of both theoretical and empirical debate among economists. It is quite natural to observe a correlation between living standards, as measured by GDP in terms of purchasing power parity, and health levels. Part of the work of the Commission on Macroeconomics and Health, chaired by Sachs, aimed to demonstrate the importance of investing in health for

economic development, starting from this relationship between economic performance and health improvement (Berthélemy, J.-C., 2008, p. 904). Health status can also influence economic performance through more indirect channels, such as education (Berthélemy, J.-C., 2008, p. 906).

4. Methodology

This section presents the methodological approach adopted to analyze the relationship between household consumption, as a proxy variable for poverty, and life expectancy in Algeria. It outlines the data sources utilized, the variables selected, and the econometric tool employed.

4.1. Definition of the Study Variables

- **Household Consumption** refers to the total expenditures made by households for the purchase of goods and services intended to meet their needs. It includes spending on food, housing, transportation, healthcare, education, and leisure, and is often used as an indirect indicator of living standards or poverty in economic studies.
- **Life Expectancy at Birth**: Refers to the average number of years a newborn can expect to live if subjected, throughout their life, to the mortality conditions observed at the time of birth.

4.2. The Econometric Model

The Vector Autoregressive (VAR) model is a multivariate model in which the current value of a variable is determined both by its own past values and by the past values of other variables included in the model. It allows for the analysis of interdependencies between time series variables.

As mentioned earlier, this study aims to analyze the relationship between household consumption and life expectancy in Algeria, using annual data covering the period from 1984 to 2024.

The VAR model of order p for a set of m variables can be written as follows:

VAR(p) Model

$$Y_t=A_0+A_1Y_{t-1}+A_2Y_{t-2}+\cdots+A_PY_{t-p}+u_t \qquad (1)$$

A_0: a (m×1) vector of constants
mmm: The number of variables included in the study (referred to as endogenous variables).
$A_1,\ldots,A_p$: Represent the coefficient matrices of dimension (m×m) associated with lags 1 through p, respectively.
u_t : Refers to a random error vector of dimension m×1m \times 1m×1.

quation (1) can be simplified, in the case where p=2p and where two endogenous variables are considered, as follows:

VAR(2) Model

$$Y_{1t} = A_{10} + A_{11}\, y_{1t-1} + B_{11}\, y_{2t-1} + A_{12}\, y_{1\,t-2} + B_{12}\, y_{2\,t-2} + u_{1t} \qquad (2)$$

$$Y_{2t} = A_{20} + B_{21}\, y_{2t-1} + A_{21}\, y_{1t-1} + B_{22}\, y_{2\,t-2} + A_{22}\, y_{1\,t-2} + u_{2t}$$

Based on the above, the empirical model of the study, after applying logarithmic transformation to the variables and differentiation, can be expressed as follows:

$$DlCONSO_t = A_{10} + A_{11}\, DLCONSO_{t-1} + B_{11} DLESP_{t-1} + A_{12} DLCONSO_{t-2} + B_{12} DLESP_{t-2} + U_{1t} \qquad (3)$$

$$DLESP_t = A_{20} + B_{21}\, DLESP_{t-1} + A_{21} DLCONSO_{t-1} + B_{22} DLESP_{t-2} + A_{12} DLCONSO_{t-2} + U_{1t}$$

Given that:

$DLCONSO_t$: the first difference of the logarithm of household consumption at period t.

$DLCONSO_{t-1}$: the first difference of the logarithm of household consumption at period t−1

$DLCONSO_{t-2}$: the first difference of the logarithm of household consumption at period t−2.

$DLESP_t$: the first difference of the logarithm of life expectancy at period t.

$DLESP_{t-1}$: the first difference of the logarithm of life expectancy at period t−1.

$DLESP_{t-2}$: the first difference of the logarithm of life expectancy at period t−2.

U_{1t} : the error term of the first equation of the model at period t.

5. Results

The construction of the VAR model in this study is based on the following steps:

- Stationarity test of the time series
- Determination of the number of lags
- Granger causality test
- Estimation of the study model
- Model evaluation
- Estimation of impulse response functions
- Variance analysis of the study model

5.1. Stationarity Test of the Time Series

The table presents the results of the stationarity tests for the time series dlcons and dlesp under different models (Intercept, Trend and Intercept, and None).

Table 1: Results of the ADF Test After the First Difference

Variabl	Mode	Level	Decision
dlcons	Interce	0.0116	I(0)
	Trend and Intercept	0.0078	I(0)
	Non	0.0702	I(0)
dlesp	Interce	0.0000	I(0)
	Trend and Intercept	0.0000	I(0)
	Non	0.0000	I(0)

For the variable dlesp, the p-values are all equal to 0.0000, which allows for the rejection of the null hypothesis of a unit root in all models. This indicates that dlesp is stationary at level I(0) in all three specifications tested (Intercept, Trend and Intercept, and None). Regarding dlcons, the results vary slightly depending on the model used. The p-values for the Intercept (0.0116) and Trend and Intercept (0.0078) models are both below the 5% threshold, leading to the conclusion that the series is stationary at level I(0) in these configurations. However, for the None model, the p-value (0.0702) exceeds 5%, suggesting that the null hypothesis of non-stationarity cannot be rejected at this confidence level. This implies that dlcons\text{dlcons}dlcons might exhibit a trend or seasonal structure that requires special attention in the model. In summary, dlesp is stationary at level I(0) in all models tested. On the other hand, dlcons is stationary in models with a constant or trend but may require further differencing or adjustment in the model without a constant or trend. These results highlight the importance of choosing an appropriate specification for the econometric analysis to be conducted.

5.2. Determination of the Number of Lags

Before estimating the VAR model, it is important to determine the number of lags in order to avoid the problem of autocorrelation of errors, which can negatively affect the quality of the estimated model. Table 2 presents the number of lags based on several criteria.

Table 2: Determination of the Number of Lags Based on Various Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	167.7207	NA	3.44e-07	-9.206703	-9.118730	-9.175998
1	182.7746	27.59890*	1.86e-07*	-9.820811*	-9.556891*	-9.728696*
2	183.9331	1.995167	2.19e-07	-9.662949	-9.223083	-9.509424
3	187.1067	5.113014	2.31e-07	-9.617038	-9.001225	-9.402103
4	191.7288	6.933136	2.25e-07	-9.651598	-8.859839	-9.375253

This table presents the results of the various statistical criteria used to determine the optimal lag order in our VAR model, which includes the two endogenous variables. It appears that selecting a lag of 1 is appropriate, as confirmed by the LR, FPE, AIC, SC, and HQ criteria.

5.3. Granger Causality Test

The results of the Granger causality test are presented in the following table:

Table 3: Granger Causality Test

Dependent variable : DLCONS			
Excluded	Chi-sq	df	Prob.
DLESP	0.65046	1	0.4201
All	0.65046	1	0.4201
Dependent variable : DLESP			
Excluded	Chi-sq	df	Prob.
DLCONS	0.49637	1	0.4845
All	0.49637	1	0.4845

The results of the Granger causality test indicate that there is no significant causality between the variables DLCONS (household consumption) and DLESP (life expectancy) in either direction. Specifically, the p-value of 0.4201 for DLESP(−1) suggests that there is no significant causal relationship between past life expectancy and household consumption, implying that variations in life expectancy do not impact consumption in

the short term. Similarly, the p-value of 0.4845 for DLCONS(−1) shows that there is no significant causality from household consumption to life expectancy, indicating that changes in household consumption do not directly affect life expectancy according to the Granger criterion for the period studied.

5.4. Results of the VAR Model Estimation

The model is estimated based on the results from the determination of the number of lags (one lag) and the Granger causality test. The results of the model estimation are summarized in Table 4.

The VAR model was estimated using the results from the stationarity tests and the Granger causality test. The results of the model estimation are summarized in the following table :

Tableau (4) : Les résultats de l'estimation du modèle

Variable	Constant	DLCONS(-1)	DLESP(-1)
DLCONS	0.064386	0.495341	-0.008747
t-statistic	3.00846	3.40641	-0.49637
DLESP	0.005368	-0.846731	0.023335
t-statistic	2.06952	-0.65046	0.14792
R-squared	0.246407		
Adj. R-squared	0.204541		
F-statistic	5.885575		

The estimated equations of the VAR model are as follows:

Equation (1): DLCONS

$$DLCONS_t = 0.064386 + 0.495341 DLCONS_{t-1} - 0.008747 DLESP_{t-1} + u_1$$

Equation (2) : DLESP

$$DLESP_t = 0.005368 - 0.846731 \cdot DLCONS_{t-1} + 0.023335 DLESP_{t-1} + u_2$$

The equation for DLCONS shows that the coefficient of DLCONS(−1) is significant (t-statistic = 3.40641), indicating that household consumption positively depends on its own lagged value. In contrast, the coefficient of DLESP(−1) is not significant (t-statistic = -0.49637), suggesting that past life expectancy does not have a direct effect on household consumption. As for the equation for DLESP, the coefficient of DLCONS(−1) is insignificant (t-statistic = -0.65046), indicating that past consumption does not directly affect life expectancy, while the coefficient of DLESP(−1) is weak (t-statistic = 0.14792), suggesting a weak relationship between current and past life expectancy.

Moreover, the low R2R^2R2 value for the DLESP equation (0.246407) and the low F-statistic (5.885575) show that this model poorly explains the variations in life expectancy, unlike the DLCONS equation, where the model shows stronger statistical significance.

5.5. Model Evaluation

The model of the study will be evaluated by testing the normality of the residual distribution, checking for the absence of autocorrelation in the errors, and testing the stability of the VAR model.

5.5.1. Jarque-Bera Test of Residual Normality

Table (5): Jarque-Bera Test of Residual Normality

Component	Jarque-Bera	df	Prob.
1	72.02634	2	0.0000
2	140.9817	2	0.0000
Joint	213.0081	4	0.0000

The results of the Jarque-Bera tests for each component, as well as for the overall test, indicate that the residuals of the model do not follow a normal distribution. This suggests that it would be pertinent to reconsider the model or apply transformations in order to improve the normality of the residuals.

5.5.2. LM Test for the Absence of Autocorrelation in Errors

Table (6): LM Test for the Absence of Autocorrelation in Errors

Lags	LM-Stat	Prob
1	4.105669	0.3919
2	0.881575	0.9272
3	6.293599	0.1783
4	1.294914	0.8622
5	5.448513	0.2443
6	5.311719	0.2568
7	1.617512	0.8056
8	3.186071	0.5272
9	2.283470	0.6838
10	1.356704	0.8517
11	1.934762	0.7478
12	0.796718	0.9389

The results of the LM test for residual autocorrelation, presented in the table, show that the p-value is greater than the 5% critical threshold for all lags, leading to the failure to reject the null hypothesis of no autocorrelation. Therefore, the results suggest that the VAR model does not suffer from a systematic autocorrelation issue.

5.5.3. Stationarity Test

The results of the stationarity test are presented in Figure (2):

Figure (2): Stationarity Test

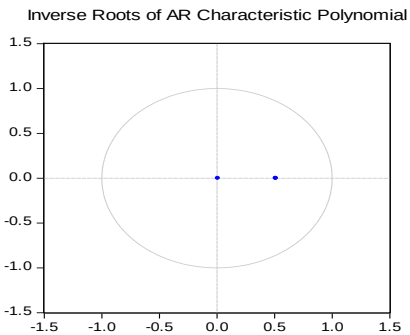


Figure (2) indicates that all the inverse roots of the characteristic polynomial of the VAR lie within the unit circle. This condition confirms that the estimated model satisfies the stability criterion and that the results derived from the VAR analysis are econometrically valid.

5.6. Estimation of Impulse Response Functions

The impulse response functions of the model are presented in the following figure:

Figure (3): Impulse Response Functions

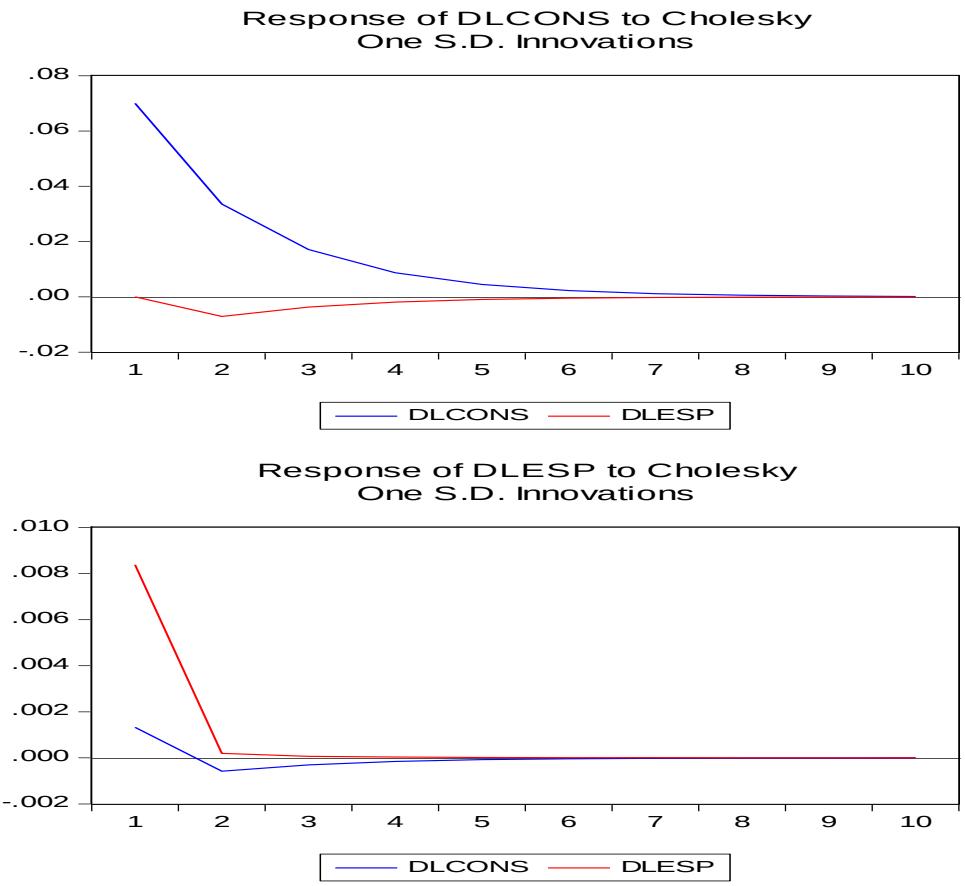


Figure shows that the response of DLCONS to a shock in DLESP is significantly positive from the first period, peaking at around 0.06,

suggesting an immediate impact of improvements in life expectancy on consumption. However, this effect is temporary and quickly stabilizes at zero starting from period 3, remaining constant until period 10. On the other hand, the response of DLESP to a shock in DLCONS is relatively weak and insignificant throughout the periods, indicating that the effect of household consumption on life expectancy is negligible, if not delayed.

Furthermore, the curve representing the response of DLCONS to a shock in DLESP in the lower part of the figure shows a sharp initial decline in the first period, suggesting that the immediate impact of life expectancy on consumption could be negative, although this effect is also very temporary and stabilizes around zero starting from period 3. Finally, the red curve shows a sharp immediate increase in DLESP in the first period following a shock in consumption, but this effect quickly dissipates and returns to a value close to zero from period 3, suggesting that the impact of consumption on life expectancy is limited and not significant in the long term.

5.7. Variance Decomposition Analysis of the Model

Table (7) presents the variance decomposition analysis for certain periods. It highlights the source of variations in household consumption when a random shock in life expectancy occurs over a ten-year forecasting horizon.

Table (7): Variance Decomposition Analysis

Variance Decomposition of DLCONS:			
Period	S.E.	DLCONS	DLESP
1	0.070009	100.0000	0.000000
2	0.077960	99.17146	0.828545
3	0.079901	98.99903	1.000968
4	0.080400	98.95675	1.043252
5	0.080529	98.94590	1.054103
6	0.080563	98.94308	1.056919
7	0.080572	98.94235	1.057653
8	0.080574	98.94216	1.057844
9	0.080574	98.94211	1.057894
10	0.080575	98.94209	1.057907

Variance Decomposition of DLESP:			
Period	S.E.	DLCONS	DLESP
1	0.008484	2.428987	97.57101
2	0.008507	2.883710	97.11629
3	0.008512	3.009952	96.99005
4	0.008514	3.042836	96.95716
5	0.008514	3.051404	96.94860
6	0.008514	3.053637	96.94636
7	0.008514	3.054219	96.94578
8	0.008514	3.054371	96.94563
9	0.008514	3.054410	96.94559
10	0.008514	3.054421	96.94558

From the table, it can be deduced that at the beginning of the period, the variance decomposition of DLCONS shows that 100% of the variance is explained by DLCONS itself, suggesting that household consumption is independent of life expectancy. Starting from period 2, approximately 1 to 2% of the variance in DLCONS begins to be explained by DLESP, but this contribution remains marginal, reaching only 1.0579% by period 10, while 98.9421% of the variance in DLCONS continues to be explained by factors internal to DLCONS.

As for DLESP, at the start of the period, most of the variance (97.571%) is explained by itself, with only 2.4289% attributed to DLCONS, indicating that life expectancy is mainly influenced by its own dynamics. Throughout the periods, the variance of DLESP remains predominantly explained by internal factors of DLESP, with a small contribution from DLCONS, which reaches only 3.0544% by period 10, highlighting that household consumption has a very weak effect on life expectancy in the long term.

6. Conclusion

This study aimed to analyze the dynamic interaction between life expectancy and household consumption in Algeria, using a VAR model for the period 1984-2024. The results indicate that the relationship between these two variables remains generally weak and econometrically insignificant. The Granger causality test reveals the absence of significant

causality in both directions. This can be explained by the fact that these two variables evolve independently. Household consumption appears to be more influenced by immediate economic factors, such as price fluctuations and government policies, rather than by improvements in life expectancy. Furthermore, household behaviors may not directly respond to changes in life expectancy, especially in an unstable economic context.

The estimation of the VAR model also confirms that household consumption primarily depends on its own past dynamics, while life expectancy is weakly influenced by consumption. The impulse response functions show immediate but temporary effects, which dissipate quickly after a few periods. Additionally, the variance decomposition shows that each variable is primarily explained by its own shocks.

These results suggest that, in the Algerian context, the interaction between life expectancy and household consumption is limited and does not constitute a strong, sustained, or statistically significant relationship. The improvement in life expectancy seems to be more influenced by structural factors such as the healthcare system, social conditions, education, the environment, and public policies, rather than by changes in household consumption. Likewise, household consumption appears to be mainly determined by its own internal dynamics, as well as other economic variables.

Compared to previous studies, such as those by Messaïli and Kaïd Tlilane (2020), Kafando (2021), Achchab and Bennaceur (2021), and Es-Salmani et al. (2023), the results of this study show significant divergences. These works generally acknowledge the importance of the interaction between health and economic development, although they rely on different variables and methodologies. For instance, Messaïli and Kaïd Tlilane highlight a significant relationship between health and economic growth in Algeria, while this study concludes that there is a weak and econometrically insignificant relationship between life expectancy and household consumption. Similarly, Kafando (2021) shows that human capital, including health, has a direct effect on income and poverty, which aligns with the idea that health factors can influence economic behavior. However, this study does not confirm the existence of a direct or causal link between life expectancy and household consumption. Regarding Achchab and Bennaceur (2021) and Es-Salmani et al. (2023), their results

suggest stronger relationships between health, healthcare expenditures, and economic or social indicators, particularly poverty. These conclusions contrast with the findings of this study, which show that the health-consumption relationship remains limited in the Algerian context. These divergences may be explained by differences in context, variables used, and econometric methods employed, particularly the use of the VAR model, which highlights less pronounced dynamic interactions than those observed in some previous studies.

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