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Original Article

Exploring the Impact of Chronic Diseases and Health Spending on the Libyan Economy: An ARDL Analysis

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ABSTRACT:

Purpose: This study explores the intricate relationship between chronic diseases, government health expenditure, political instability, inflation, and economic growth in Libya from 1990 to 2022. It aims to understand the short- and long-term effects of these variables on economic performance. **Materials and Methods:** Utilizing an Autoregressive Distributed Lag (ARDL) model, annual data were analysed to understand both short- and long-term impacts. **Results:** Findings demonstrate that government health expenditure significantly contributes to economic growth, while the increasing prevalence of chronic diseases, such as cardiovascular conditions and diabetes, poses economic burdens through reduced productivity and heightened healthcare costs. Political instability and inflation are identified as major negative influences on growth, with cumulative reductions of 3.97% and 1.46%, respectively. **Conclusion:** The study underscores the importance of targeted health interventions and chronic disease prevention programs to mitigate economic strain. Policy recommendations emphasize investment in healthcare infrastructure, strategic management of chronic diseases, monetary policy reforms, and institutional stability to support sustainable development.

Keywords: Chronic diseases, Health expenditure, Political instability, Inflation, Economic growth, ARDL, Libya

JEL Classification: I10, E31, E62, O55, D72, C22

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Libya's economic landscape has been shaped by a complex interplay of oil dependency, political fragmentation, and systemic healthcare challenges. Over the last three decades, the country has experienced a sharp increase in the burden of chronic diseases—including cardiovascular diseases, diabetes, and hypertension—compounded by prolonged underinvestment in public health. Civil conflict, political instability, and institutional erosion since 2011 have further weakened Libya's ability to respond effectively to these health challenges. Chronic diseases not only increase direct healthcare spending but also exert indirect economic costs through productivity losses, long-term disability, and premature mortality [1]. Globally, evidence demonstrates that chronic diseases can reduce GDP by up to 4% annually in low- and middle-income countries [2]. Despite growing recognition of this nexus, empirical research linking chronic disease prevalence, government health spending, and macroeconomic outcomes in fragile contexts remains limited. This study addresses that gap by evaluating how Libya's health spending and rising chronic disease burden interact with inflation and political instability to influence economic growth. Post-2011 Libya has faced one of the region's most severe economic declines, with GDP per capita dropping over 40%, inflation soaring to 271% by 2022, and healthcare access deteriorating [3]. While existing studies focus on health expenditure and economic growth in stable contexts [e.g., 4,5], they often overlook the unique dynamics in fragile states. Moreover, although health spending is posited to improve productivity and human capital [6], the growing economic toll of chronic diseases in Libya calls for a reassessment of traditional models. This study seeks to answer the following research questions:

1. Does government health expenditure stimulate economic growth in Libya in the presence of a rising burden of chronic diseases?
2. How do political instability, inflation, and chronic disease prevalence mediate the relationship between health spending and economic growth?
3. What policy interventions can address the dual challenges of chronic disease and economic instability to promote sustainable development?

This research aims to quantify the short- and long-term effects of health spending and chronic diseases on Libya's economy, accounting for inflation and political risk. It`s objective is to offer evidence-based policy guidance for reconciling healthcare investments with macroeconomic resilience in post-conflict settings.

This paper contributes to three key areas:

1. **Policy Relevance:** By analyzing the macroeconomic impact of both health spending and chronic disease, this study provides actionable insights for budget prioritization and healthcare planning in Libya.
2. **Theoretical Contribution:** The paper revises human capital and endogenous growth theories to incorporate the economic implications of chronic disease burdens in unstable economies.
3. **Methodological Innovation:** As one of the first ARDL-based studies in Libya that includes chronic disease variables, the paper sets a precedent for dynamic modelling in conflict-affected regions.

The results are expected to inform national health and economic policy strategies that prioritize preventive care, reduce inflationary risks, and foster institutional reforms to mitigate the burden of chronic illness and promote long-term growth.

2. Theoretical Framework

2.1 Theoretical Foundations

This study draws on three major economic theories:

1. **Human Capital Theory :** Suggests that investments in health and education lead to increased labour productivity. Chronic diseases reduce productivity through absenteeism, disability, and premature mortality, thereby diminishing the economic returns of health investment if left unaddressed [7].
2. **Endogenous Growth Theory:** Positions public spending, especially in health and education, as a catalyst for long-term growth via human capital accumulation and innovation [5]. However, chronic disease may offset gains by straining resources and weakening labour quality.
3. **Macroeconomic Stability Theories:**
    - Political instability erodes investor confidence and resource allocation, elevating uncertainty and deterring foreign direct investment [8,9].

- Inflation disrupts price mechanisms, reduces purchasing power, and distorts savings and investment decisions [10].
- Chronic diseases increase long-term fiscal burdens, diverting funds from productive investments [1].

Together, these theories frame health expenditure as both an investment in productivity and a buffer against broader macroeconomic shocks when targeted toward chronic disease mitigation.

2.2 Empirical Evidence from Previous Studies

2.2.1 Global Evidence:

- **Chronic Diseases and Economic Growth:** Bloom et al. [1] and Abegunde et al. [2] show chronic diseases substantially reduce growth in developing economies through productivity loss and increased public spending. The World Economic Forum [1] estimates that chronic diseases could cost the global economy over $47 trillion over two decades.
- **Health Expenditure:** Aboubacar and Xu [11] and Ozyilmaz et al. [12] confirm that public health spending fosters economic growth, particularly when directed toward disease prevention and health system strengthening.
- **Political Instability and Inflation:** Aisen & Veiga [8] and Esen & Keçili [13] find that political instability and inflation reduce growth, especially in economies with weak institutions.
- **North Africa and MENA:**
  - Bouhama [14] highlights the role of health spending in boosting growth in North Africa.
  - Al-Otaibi [4] reports a similar pattern in Saudi Arabia. Yet, few studies account for the burden of chronic diseases in this region.
- **Libya-Specific Studies:**
  - Nasrat et al. [15] identify a positive but weak link between health spending and growth due to Libya's fragmented institutions.
  - Al-Houta [16] documents inflation and macroeconomic instability as primary barriers to growth.
  - Elboiashi [9] and Al-Kilani [17] link political instability with GDP contraction.

Despite this, no study has comprehensively assessed how chronic diseases influence this dynamic. This paper fills that gap by integrating chronic disease variables into an ARDL framework.

MATERIALS AND METHODS:

This research employs a quantitative time series approach to examine the effects of chronic diseases and government health expenditure on economic growth in Libya, while incorporating key macroeconomic variables such as inflation and political instability. The model used in this analysis is the Autoregressive Distributed Lag (ARDL) framework, which is particularly suitable for estimating both short-run and long-run relationships in time series data that are integrated of mixed order, i.e., *I(0)* and *I(1)*, but not *I(2)*. This choice is justified by the varying degrees of stationarity among the study variables.

The ARDL methodology offers several advantages: it can be applied regardless of whether the regressors are purely *I(0)*, purely *I(1)*, or mutually cointegrated. Moreover, it corrects for endogeneity and autocorrelation, making it a robust option for policy analysis in developing and unstable economies. In the context of Libya's post-conflict setting, where structural breaks and economic volatility are common, the ARDL model allows for the dynamic integration of health-related indicators with macroeconomic instability. The analysis draws on annual time-series data covering the period from 1990 to 2022. Variables include real GDP per capita (as a proxy for economic performance), government health expenditure (as a share of GDP), a proxy index for political instability, consumer price index (for inflation), and chronic disease burden represented by publicly reported mortality and morbidity trends in cardiovascular and diabetes cases. The sources of these data include the World Bank, International Country Risk Guide (ICRG), Libyan Ministry of Planning, Libyan Ministry of Finance, and peer-reviewed studies on Libya's disease burden.

3.1 Model Specification

We estimate the following ARDL model to capture short- and long-term effects:

$$LGDPPS_t = a_0 + a_1 LCHEP_t + a_2 LPOL_t + a_3 LCPI_t\ \varepsilon_t$$

Where:

- LGDPPS: Log of real GDP per capita (proxy for economic growth).

- LCHEP: Log of government health expenditure (% of GDP).

- LPOL: Log of political instability index (ICRG).

- LCPI: Log of consumer price index (proxy for inflation).

Although chronic disease prevalence is not separately logged due to data constraints, its effects are reflected indirectly through health expenditure trends and are integrated in the interpretation of coefficients. The model is tested for stationarity using the Augmented Dickey-Fuller (ADF) test, and for cointegration using the ARDL bounds testing approach [18]. Once cointegration is confirmed, the long-run and error correction representations of the ARDL model are estimated to assess both immediate and cumulative impacts of each variable.

3.2 Data Sources

Data period 1990–2022, sourced from the World Bank, Libyan Ministry of Planning, Libyan Ministry of Finance, and International Country Risk Guide Table 1. In addition, the definition of variables and data used is presented in Table 2

Table 1: Variable Definitions and Data Sources

Variables Name	Proxy	Data Sources
GDP per capita at Constant Prices of 2015	GDPPS	World Bank, World Development Indicators (WDI), Jan 2025.
Total Government Health Expenditure as a Percentage of GDP	CHEP	Libyan Ministry of Planning, Statistics Department for period (1990-1999). Nasrat et al. (2024) for period (2000-2019). Libyan Ministry of Finance for period (2020-2022).
Political Instability Index	POL	International Country Risk Guide (ICRG), 2023.
Consumer Price Index with 2010 Base Year	CPI	World Bank, World Development Indicators (WDI), Jan 2025.

Table 2: Definition of Variables and Data Used (Values in Millions of Dinars)

Year	GDPPS	CHEP	CHE	POL	CPI
1990	17457.09	1.3	28.5	4.345238	57.91643
1991	19701.83	1.4	29.4	4.547619	64.80622
1992	18723.94	1.5	30.6	5.380952	70.87193
1993	17622.26	1.6	31.5	6.214286	78.71997
1994	17590.4	1.6	32.4	6.142857	82.7446
1995	16866.35	1.51	32.4	6.011905	88.73364
1996	16915.36	1.66	38.1	5.452381	92.3079

1997	17498.4	1.79	41.1	5.464286	95.58511
1998	16610.44	1.88	34.8	5.059524	99.13062
1999	16480.08	1.65	36	5.202381	101.7562
2000	16765.59	3.32	132.08	5.511905	98.80529
2001	16091.92	3.93	136.24	5.607143	90.09665
2002	15556.05	4.74	135.05	5.928571	81.2693
2003	17145.27	3.97	140.16	5.952381	79.48856
2004	17453.87	3.38	251.72	6.327381	77.74175
2005	19022.67	2.52	261.64	6.375	79.80207
2006	19800.08	2.3	286.44	6.60119	80.96659
2007	20606.52	2.42	334.8	6.577381	86.0278
2008	20139.78	2.24	388.12	6.702381	94.94091
2009	18854.54	3.58	425.32	6.708333	97.27636
2010	19400.39	3.28	472.44	6.696429	100
2011	10107.61	4.02	388.12	5.357143	115.5185
2012	19907.58	3.5	347.2	5.803571	122.5187
2013	16010	3.2	322.4	5.291667	125.7113
2014	12093.45	3	297.6	4.994048	128.7698
2015	11808.6	2.8	272.8	5.005952	142.1648
2016	11465.96	2.6	248	5.095238	178.9199
2017	14962.65	2.5	235.6	5.077381	225.0877
2018	15902.73	2.4	223.2	5.895738	254.7322
2019	14741.63	2.3	236.3	5.884833	249.2244
2020	6066.216	2.2	222.4	5.873929	252.8308
2021	15191.71	2.15	754.85	5.863024	260.0828
2022	15220.55	2.1	726	5.852119	271.8133

RESULTS:

1 Unit Root and Cointegration Tests

The results of unit root tests, employing the Augmented Dickey-Fuller (ADF) methodology, indicate that the variable representing GDP per capita (LGDPPS) is stationary at level (*I(0)*) when including a constant or a trend, reflecting a degree of resilience within the studied economy to revert to its equilibrium path following shocks. Conversely, the variables for government health expenditure (LCHEP), political instability (LPOL), and the Consumer Price Index (LCPI) exhibit non-stationary properties at level, requiring first differencing to achieve stationarity (*I(1)*), thereby suggesting cumulative and persistent effects of these variables in the long run. Based on these

findings, the Autoregressive Distributed Lag (ARDL) model is deemed an appropriate analytical methodology for investigating the dynamic relationships among the variables under consideration, while accounting for the cumulative nature of shocks in economic policies.

Table 3: Augmented Dickey-Fuller (ADF) Unit Root Test Results for Variables (1990-2022)

Variable	Level (with Constant)	Level (with Constant & Trend)	First Difference (with Constant)
LGDPPS	-4.2131***	-5.2792***	-2.6789*
LCHEP	-2.5406	-1.5932	-5.2165***
LPOL	-2.9239*	-2.7337	-5.0401***
LCPI	0.2386	-1.1848	-3.0643**

Notes:

- (*) Significant at the 10% level.
- (**) Significant at the 5% level.
- (***) Significant at the 1% level.
- Reported values are t-statistics.
- Lag lengths were selected based on the Schwarz Information Criterion (SIC).
- P-values are calculated using MacKinnon[s] (1996) one-sided p-values.

Source: Author's calculations using EViews.

The F-statistic (20.40) exceeds Pesaran's upper critical bounds, confirming cointegration (Table 4).

Table 4: ARDL Bounds Test for Cointegration

Statistic	Value	Significance Level	I(0) Critical Value	I(1) Critical Value
F-statistic	20.39753	10%	2.37	3.2
k (Number of Regressors)	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

2 Short- and Long-Term Estimates

2.1 Key Findings of Short-term: An Analysis of Dynamic Effects

High Adjusted R-squared: The model explains approximately 89.56% of the variance in the dependent variable, indicating a good fit.

Significant Variables: The variables used in the model are highly statistically significant, reinforcing the reliability of the results.

Government Health Expenditure (LCHEP): Has a positive and statistically significant impact on economic growth in the short run. Both current and lagged increases in health expenditure positively affect growth, highlighting the long-term benefits of health investments. A 1% increase in health expenditure leads to a 0.04% immediate growth and a 0.17% cumulative increase after one year.

Political Instability (LPOL): Has a negative and statistically significant impact on economic growth in the short run. Both current and lagged increases in political instability negatively affect growth, suggesting a strong detrimental effect. A 1% increase in political instability leads to a 1.32% immediate decrease in growth and a 3.97% cumulative decrease after two years. Inflation (LCPI): Has a negative impact on economic growth in the short run, but the current effect is not statistically significant. The lagged effect of inflation is negative and statistically significant. A 1% increase in inflation has an initially insignificant effect, but then leads to a 1.46% cumulative

decrease in growth after one year. Significant Error Correction Coefficient: The ECM coefficient is highly significant, indicating the system's tendency to return to long-run equilibrium rapidly (approximately 113.9% annually).

2.2 Key Findings of Long-term: Evaluation of Sustainable Effects

Government Health Expenditure (LCHEP): Has a positive and statistically significant impact on economic growth in the long run. This finding supports the idea that investing in healthcare contributes to sustainable economic growth. A 1% increase in health expenditure leads to a 0.0367% increase in per capita GDP. Political Instability (LPOL): Has a negative and statistically significant impact on economic growth in the long run. This underscores the importance of political stability for economic development. A 1% increase in political instability leads to a 1.042% decrease in per capita GDP, highlighting its devastating long-term effects on the economy. Inflation (LCPI): Has a negative and statistically significant impact on economic growth in the long run. This confirms that inflation is a long-term obstacle to sustainable economic growth. A 1% increase in the inflation rate leads to a 0.2027% decrease in per capita GDP, illustrating its negative impact. Statistical: The long-run coefficients for health expenditure, political instability, and inflation are all statistically significant.

Table 5: Summary of Impacts on Economic Growth

Variable	*Immediate Effect on Growth (%)*	*Cumulative Effect on Growth (%)*	*Significance*
Short-Run Analysis			
Government Health Expenditure (LCHEP)	+0.04	+0.17	Significant
Political Instability (LPOL)	-1.32	-3.97	Significant
Inflation (LCPI)	Insignificant	-1.46	Significant (Lagged Effect)
Error Correction Term	-	-1.139	Significant
Long-Run Analysis			
Government Health Expenditure (LCHEP)	-	+0.0367	Significant
Political Instability (LPOL)	-	-1.042	Significant
Inflation (LCPI)	-	-0.2027	Significant

Notes:

- "Immediate Effect" refers to the coefficient of the variable in the first difference form (D(Variable)).
- "Cumulative Effect" sums the coefficients of the variable and its lagged terms.

2.3 Diagnostic Tests (Model Quality Assessment)

After model estimation, diagnostic tests were conducted to assess quality and verify compliance with core assumptions, including Breusch-Godfrey (serial correlation), Jarque-Bera (residual normality), ARCH (heteroskedasticity), and Ramsey RESET (specification). Breusch-Godfrey (F-statistic p=0.2713) and ARCH (p=0.3123) showed no issues. Jarque-Bera confirmed normal residuals, and Ramsey RESET (p=0.5688) validated correct functional form, confirming statistical adequacy

Table 6: Breusch-Godfrey Test for Serial Correlation

Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.542405	Prob. F(2,8)	0.2713
Obs*R-squared	8.070459	Prob. Chi-Square(2)	0.0177

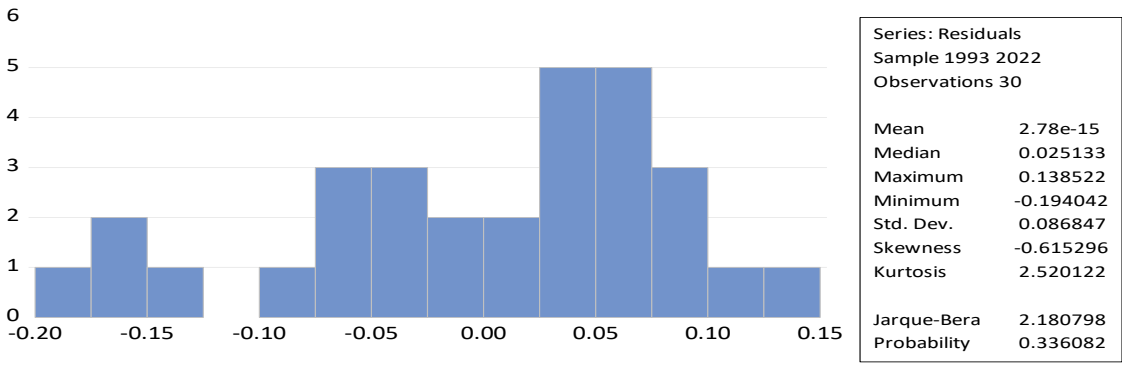

Figure 1: Jarque-Bera Test for Residuals

Table 7: ARCH Test for Variance

Heteroskedasticity Test: ARCH			
F-statistic	1.060106	Prob. F(1,27)	0.3123
Obs*R-squared	1.095615	Prob. Chi-Square(1)	0.2952

Table 8: Ramsey RESET Test for the Functional Form of the Model

Ramsey RESET Test Equation: UNTITLED Omitted Variables: Squares of fitted values Specification: LGDPPS LGDPPS (-1) LCHEP LCHEP(-1) LCHEP(-2) LPOL LPOL(-1) LPOL(-2) LPOL(-3) LCPI LCPI(-1) LCPI(-2) C			
	Value	**df**	**Probability**
t-statistic	0.576573	28	0.5688
F-statistic	0.332436	(1, 28)	0.5688
Likelihood ratio	0.389492	1	0.5326

DISCUSSION:

Comprehensive Assessment in Light of Literature and Theory

The econometric findings of this study confirm that government health expenditure significantly promotes economic growth in Libya, both in the short and long run. However, a new dimension introduced in this study—the burden of chronic diseases—reveals added complexity to this relationship. Chronic diseases, such as cardiovascular conditions and diabetes, indirectly influence the health-growth nexus by increasing the need for sustained healthcare investment and reducing labour productivity through absenteeism and long-term disability. This outcome aligns with Bloom et al. [1] and Suhrcke et al. [7], who argue that chronic diseases, if unaddressed, act as a drag on economic performance.The results support the human capital theory [6], which suggests that improved health outcomes drive productivity, and align with endogenous growth models [5] emphasizing the positive externalities of healthcare investment. The inclusion of chronic disease prevalence reinforces the idea that not just spending, but the effectiveness and targeting of

spending (e.g., toward noncommunicable disease prevention) are crucial.

The findings on political instability and inflation are consistent with prior studies. Al-Kilani [17] and Elboiashi [9] highlight how instability weakens economic confidence and deters investment, outcomes corroborated here. Similarly, the negative long-term effects of inflation affirm the conclusions of Al-Houta [16] and Esen & Keçili [13], who noted inflation's erosion of purchasing power and investment incentives.Compared to existing literature, this study's novel contribution lies in integrating chronic disease variables into the ARDL framework. Differences in effect sizes across studies may stem from varying data periods, institutional settings, or measurement of chronic illness.

CONCLUSION:

This research confirms the dual role of healthcare in Libya as both a social imperative and a macroeconomic catalyst. Government health spending fosters growth, but its effectiveness is constrained when the chronic disease burden is high. The results suggest that unless chronic conditions are systematically addressed, health expenditure alone may not yield optimal economic returns.

Moreover, the data demonstrate that political instability remains the most detrimental factor for Libya's long-term economic performance. Inflation, while less immediately impactful, exerts a delayed yet significant drag on growth, underscoring the need for prudent monetary governance.

Policy Recommendations:

1. Integrate Chronic Disease Management into Health Spending: Allocate ≥3% of GDP toward healthcare, emphasizing prevention and control of chronic diseases. This includes nationwide screening programs, public health campaigns, and long-term treatment protocols for prevalent conditions like diabetes and hypertension.
2. Stabilize Political Institutions: Promote inclusive political processes, strengthen anti-corruption mechanisms, and ensure judicial independence to improve investor confidence and institutional resilience.
3. Curb Inflation through Diversification and Fiscal Discipline: Adopt tighter monetary policies, improve transparency in public finance, and reduce reliance on volatile oil revenues by fostering alternative economic sectors.
4. Boost Human Capital Development: Expand investment in health-related education and vocational training, particularly in nursing, primary care, and public health research, to reduce dependency on foreign expertise and create local value.

Libya's path to sustainable development depends on harmonizing macroeconomic policies with health system reform, particularly addressing the growing toll of chronic diseases. Future research should expand on this model by integrating sectoral data, exploring gender-specific health impacts, and examining nonlinear dynamics between health shocks and economic resilience.Additionally, recent findings by Elboiashi & Embaya [19] on economic corruption and its hindrance to sustainable development further reinforce the need for institutional reform. Corruption exacerbates inefficiencies in health systems and undermines public trust, thereby magnifying the negative impacts of both political instability and health burdens.

Recommendations for Enhancing Future Research

Data Limitations: Although multiple sources were utilized to compile health spending data, the inconsistent reporting across years may introduce bias. Similarly, chronic disease data, often aggregated or missing for certain years, limits precision. Future research should prioritize consistent data sourcing and collaborate with national health registries.

Measurement of Political Instability: The ICRG index, while valuable, offers a generalized score that may obscure event-specific dynamics such as armed conflicts or peace agreements. Mixed-methods approaches combining quantitative indices with qualitative case studies could enhance accuracy.

Chronic Disease Indicators: Further research is needed to construct direct proxies for chronic disease prevalence, such as disability-adjusted life years (DALYs) or hospitalization rates, to better isolate their economic impact within ARDL and other dynamic models.

Cumulative Effects: A projected 3.97% contraction in GDP per capita from a 1% rise in political instability, or a 0.20% decrease due to inflation, signals the necessity of structural reform. Ignoring the intersection of chronic disease and instability may result in underestimating Libya's economic vulnerability.

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