Macrothink Institute™

Issues in Economics and Business
ISSN 2377-2301
2024, Vol. 10, No. 1

The Impact of Information and Communications Technology on Life Expectancy: The Case of Saudi Arabia

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Received: April 7, 2024 Accepted: May 29, 2024 Published: June 18, 2024

doi:10.5296/ieb.v10i1.21993 URL: https://doi.org/10.5296/ieb.v10i1.21993

Abstract

The impact of Information Communications Technology (ICT) spending on health indicators is a concern for policymakers in the environment of continuously increasing health spending in all countries. The article in discussion centers around the theme of "The Impact of Information and Communication Technology on Life Expectancy in Saudi Arabia" delving into the relationship between technology expenditures and health indicators. in Saudi Arabia over the period (1998-2022) using the Autoregressive Distributed Lag (ARDL) method. The results show that spending on ICT sector is positively correlated with specific health indicators, namely, the average life expectancy. These findings guide the contribution of positive and effective impacts of spending on ICT to enhance health and provide future guidance on national health policy implications.

Keywords: ICT, life expectancy, ARDL, KSA

1. Introduction

Health is the basis of human development and is a top priority for everyone, regardless of social position. It is therefore no surprise that four of the eight Millennium Development Goals (MDGs) are directly related to health. The third goal of the Sustainable Development Goals (SDGs, United Nations, 2015) is to safeguard healthy lives for people of all ages by taking the key health priorities. Thus, health issues require further research, increased health funding, and strengthening the capacity, reducing and managing health risks.

On the other hand, in recent years, the world has undergone major changes and transformations due to the development of information and communication technology (ICT), which is having a socio-economic impact on human life. It has also become a driving force for economic growth in various countries. Despite the strong socio-economic link between advances in ICT and health outcomes, the biggest benefit technology has for aging and longevity is that it creates opportunities for people to connect with others (Holt-Lunstad, 2015). This is based on the premise that ICT spending, especially in the health sector, serves as a policy instrument for governments to affect the health sector and achieve desired results.

Furthermore, the development of new technologies will promote healthy aging and longevity by allowing individuals to live healthier. For example, technological innovations have been deployed to help people stay physically active, enabling independent living, by fall detection, smart home technology, early disease detection, and disease management. disability, maintaining connections that benefit society by reducing social isolation, and continued participation in the workforce, to name a few. To ensure reaping the benefits of technology on aging and longevity, there is a need to design technologies that are inclusive and benefit everyone.

For example, by 2040, the world is expected to have no hospitals in the traditional sense. With the incredible advances that have been made in regenerative medicine, 3D printed prosthetics, and CRISPR gene editing, it means that this technology can control human biology in ways that allow us to live a more fulfilling life. live better; Artificial intelligence has contributed greatly to changing the nature of understanding disease and how the body is examined while achieving decentralization of health care through the examination of medical robots, making it easy to diagnose diseases, and at the same time provide medicine to patients and inject them with antibiotics. and give them suggestions for an ideal healthcare system (Future Foresight Foundation, 2022).

Despite the strong socioeconomic link between advances in ICT and health outcomes, the greatest benefit that technology can bring to aging and longevity is to create opportunities for people to connect with others. connection (Holt-Lunstad, 2015). However, there is less consensus about the likely nature of this impact. This study attempts to conduct empirical research on this relationship in Saudi Arabia, especially on the impact of ICT on life expectancy. This is due to the fact that expenditure on the health sector has been given top priority for all community stakeholders.

This is based on the assumption that ICT spending, especially in the health sector, serves as a policy tool for governments to influence the health sector to achieve desired outcomes. However, this view is not supported by empirical evidence as studies have reported mixed results. Several studies have reported a significant impact of ICT spending on health outcomes (Irawan, 2015, Raghupathi, 2013, Afroz, 2020). Others argue that ICT spending has no significant impact on health outcomes (Fayissa, 2005, Filmer, 1997), which leaves a policy and research gap.

Identifying and measuring the extent to which information and communications technology contributes to improving and strengthening the health sector is extremely important for decision-makers then drawing up effective health policies. In addition, information and communications technology is considered as a powerful tool for overcoming the development divide between communities. In view of the above statements, the expected results of this study will provide guidance and directions to design and develop appropriate strategic decisions related to making the best use of ICT investments. Building on this importance and considering the potential link between ICT advances and health, this study aims to empirically examine the impact of ICT spending on enhancing life expectancy in Saudi Arabia during the years (1998-2022).

This study is structured into five segments: an introduction, theoretical background, literature review, methodology, data and model construction, empirical analysis, and conclusion with recommendations, the document unfolds its exploration.

2. Theoretical Framework and Literature Review

Health indicators, whether population (demographic) or economic, address many issues that illustrate the country's development in the health sector at all levels. Information and communication technology plays a vital role in various sectors. For example, it could eliminate the barrier of time and distance, and the circulation of information has become easier than before and can be delivered to anywhere in the world. The use of information and communication technology is no longer a luxury, but has become more of an urgent necessity that cannot be achieved. In particular, ICT is essential to ensure the cost-effectiveness of health-care services and to improve the efficiency of health systems.

2.1 Theoretical Framework

Two approaches have been applied to study the impact of IT spending on health outcomes: the first is the approach of human capital model developed by (Grossman, 2000) and the second approach is the approach of the health production function approach. Grossman (1972) postulated that people involved in health-promoting activities in their free time and extra purchased medical contributions to advance their health position. For its part, the health production function approach used the traditional model of the production function for any economics. This approach viewed the health system as a production unit with the intention of providing health care services. In this case, health was taken similar to any good produced by the health system. In both approaches, health spending is considered one of the factors to the health care, along with other equally necessary social determinants of health. This study adopted the Grossman Approach in investigating the effect of ICT expenditure on life expectancy in Saudi Arabia.

2.1.1 Life Expectancy

Life expectancy can be defined as the average number of years a newborn would be expected to live if he or she lived exposed to the sex- and age-specific mortality rates prevailing at birth in a given year and in a given country, territory, or geographic area. (Shryok, 1973). Efforts in the field of improving health services, both preventive and therapeutic, especially in the last five centuries and particularly in the wake of the Renaissance in Europe, were crowned with success and victory in eliminating many epidemics that were claiming many human lives of all ages. Inequality in life expectancy remains wide between and within countries. In 2019, the country with the lowest average life expectancy was the Central African Republic with 53 years, in Japan the average life expectancy was 30 years higher (Roser, 2019). Estimates show that in a poor, pre-modern world, the average life expectancy everywhere in the world was about 30 years. Table 1 reflects the change in life expectancy in different regions of the world from 2019 to 2050.

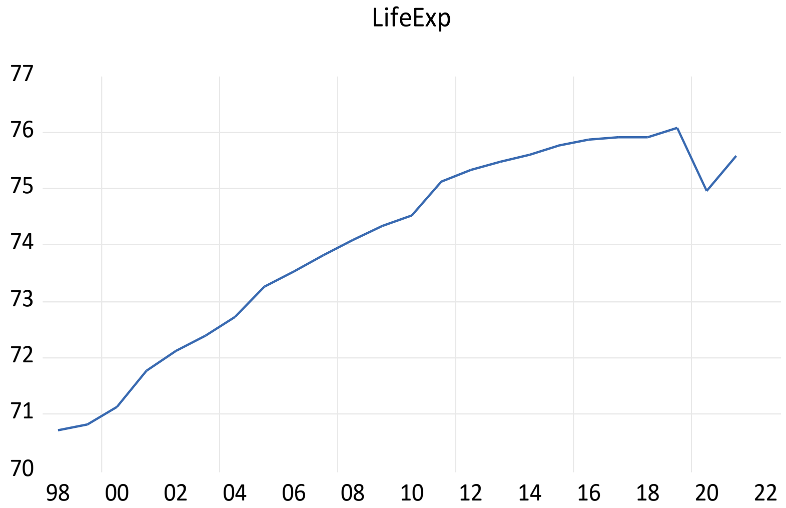
Table 1. Number of persons aged 65 years or over by geographic region, 2019 and 2050

Region	Number of persons aged 65 or over in 2019 (in millions)	Number of persons aged 65 or over in 2050 (in millions)	%change between (2019-2050)
World	702.9	1548.9	120
Sub-Saharan Africa	31.9	101.4	218
Northern Africa and West Asia	29.4	95.8	226
Central & Southern Asia	119.0	328.1	176
Eastern and South-eastern Asia	260.6	572.5	120
Latin America & the Caribbeans	65.4	144.6	156
Australia & New Zealand	4.8	8.8	84
Oceania excluding Australia & New Zealand	0.5	1.5	190
Europe & Northern America	200.4	296.2	48

For example, in 1900 the average life expectancy in the United States was 47 years. At the digital revolution in the in 1970th life expectancy increased to 70 years. According to the National Centre for Health Statistics, the average life expectancy in 2016, a year of explosive ICT development, was 78 years.

To develop and enhance the health sector, the Saudi Arabian government has adopted different initiatives to achieve ambition in the Kingdom's Vision 2030 and create a tangible positive impact on various aspects, to develop the national health system. For example, the first dimension (improving health care) of the (National Transformation) program in the Kingdom seeks to devote intensive efforts to develop the health sector to enhance this human dimension. In addition, the Saudi government has launched the "Health Sector Transformation Program" which aims to enhance and develop the health system in general and raise the quality of health care. In addition, the Program also comes as one of the programs of the Kingdom's Vision 2030 which was established for the purpose of contributing to achieving the goals of the "Vibrant Society" axis. The vision is to restructure the health sector in the Kingdom and enhance its capabilities and position as a sector effective and integrated, it places the health of all community members as its top priority.

Figure 1 displays the evolution of life expectancy at birth during (1998-2022). Data show that this index has increased continuously, which shows that the Saudi authorities are very attentive to providing the necessary funding to contribute to improving general health indicators and average life expectancy as a result. an important component of health.



Graph 1. Life Expectancy at Birth in Saudi Arabia (1998-2022)

2.1.2 Advancement in ICT

Health information technology (HIT) is information technology used in the health sector. These practices are technical practices that support the management of health information through computerized systems and the secure exchange of health information among consumers, health care providers, payers, and quality monitors (Fadahunsi, 2019).

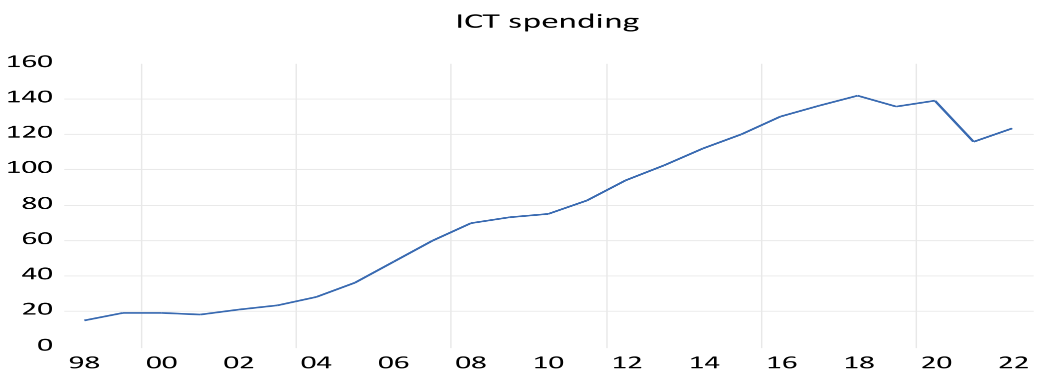
Technology can make our world fairer, more peaceful, and healthier. For example, digital achievements can support and accelerate the achievement of each of the 17 Sustainable Development Goals - from eradicating poverty to reducing maternal and child mortality, promoting sustainable agriculture, decent work, and universal literacy. But technology can also threaten privacy, reduce security, and exacerbate inequality. Also, digital technology has advanced faster than any innovation in our history, affecting nearly 50% of the population in emerging economies over the last few decades and transforming society. By improving electronic connectivity, access to finance, and access to businesses and public services, technology can be a great equalizer.

For example, in healthcare, pioneering technologies based on artificial intelligence are helping to save lives, diagnose diseases and prolong life. In education, virtual and remote learning environments have made it easier for students who would otherwise be excluded to access programs. Public services, thanks to artificial intelligence, are also becoming more accessible and accountable thanks to blockchain systems while getting rid of heavy bureaucracy. Big data can also support more responsive and precise policies and programs.

Furthermore, the World Health Organization (WHO) defined eHealth as the engagement of (ICT) services in the health sector, such as e-health, m-health, and telemedicine, as part of the widespread use of digital technology for health activities in many contexts (ITU, 2023). On the other hand, the (ITU) emphasizes the importance of reliable wireless solutions for digital health services, especially in areas where cable/fibre connectivity is not available. The consortium has a varied scope of digital health services and field programs that intended to achieve some Sustainable Development Goal 3.

The communications and information technology sector are considered one of the vital sectors with an impact on the development of all segments of society and supporting the national economy. This sector has received great attention from the Saudi government, with the aim of achieving the maximum benefit from the potential of this sector in a way that serves the citizens in his dealings and makes it easier for him. In a way that doubles the effectiveness of the performance of various government facilities, the business sector, and individuals, and contributes to advancing the wheel of development and raising the efficiency of the national economy. Creating an investment environment built on clear foundations of transparency and non-discrimination, and allowing the private sector to invest in communications and information technology activity, leading to its contribution to the gross domestic product, and adopting the adoption of electronic transactions in various fields.

During the last three decades in the Kingdom, the communications and information technology sector has witnessed a remarkable expansion, and this expansion is still continuing in a strong manner. Figure 2 shows the volume of government spending in this sector throughout the period (1998-2022).



Graph 2. Spending on ICT in Saudi Arabia (1998-2022)

2.1.3 The Impact of Spending on ICT on Life Expectancy

ICT can play different roles in the community. For example, the expansion in the ICT sector would assist in creating more employment opportunities that enable workers in making positive social and economic effects for workers and community at large. Furthermore, life expectancy is an essential measure that provides insight into the health and well-being of a population. Understanding the factors that affect life expectancy and how to calculate them is crucial in identifying areas that need improvement. The use of ICT can make a huge difference in this area. For example, ICT equipment and applications can support medical employees with ICT-supported functions to collect, record, and share information then taking effective medical decision-making. Furthermore, ICT can positively participate to reach this goal by disseminating health data to the community. Therefore, the community can benefit from ICT improvement and thereby increase their lifespan.

Since the mid of the 1990s, the Saudi government prepared the necessary requirements for the dissemination of ICT in various economic, service, and social sectors, through large spending on infrastructure, and setting comprehensive policies and incentives. It also adopted ambitious national programs to encourage the information technology industry that support the scientific research that establishes its development and support. The Kingdom made health and medical services a top priority in its Vision 2030, and therefore prepared a strategic plan for the Ministry of Health 2030, with the aim of ensuring the implementation of the health sector transformation program. The Corona pandemic demonstrated the resilience and strength of the sector, as the Kingdom received praise from the International Monetary Fund for its success in dealing with the pandemic, which revealed the fragility of the health sector in advanced economies. (https://aawsat.com. August 2023).

2.2 Literature Review

Improvement in the (ICT) plays an effective contribution in the advancement in the health sector as reflected in different previous literature. Shao (2022) argued that improvement in the ICT sector had its positive response on different health aspects of the community. The study used a fixed effects model for 141 countries over the period (2012-2016).

Afroz (2020) aims to study the link between ICT, economic progress, and health services on medical production patterns in Malaysia during the period (1993-2017), using testing techniques limits on cointegration. Research showed that improvement in the ICT sector had a positive significant effect on health improvement both in the long and short term. Arthur (2017) conducted a study the sub-Saharan African (SSA) countries to test the impact of ICT advancement on health status using the study employed the Grossman Human Capital Model. The study concluded that health spending had a significant but inelastic effect on health advancement.

Irawan (2015) aimed to study the impact of improvement on ICT on the health gap over the period (2000-2018). It also intended to reveal whether such an impact exist by gender and by African countries. The study employed the Driscoll-Kraay standard errors and feasible generalized least squares, (FGLS) and panel-corrected standard error (PCSE). The findings showed that ICTs were vital for health improvement the sample African countries. Similar conclusions were reached by Raghupathi (2013) and Sunil Mithas (2009).

Table 2 presents a summary of the most recent publications and previous studies in the research area.

Table 2. Summary of Previous Literature

Author(s)	Study area	Period	Methodology	Results
Shao (2022)	141 countries	(2012-2016)	the fixed-effect model	there was a significant relationship between ICT and the improvement of health.
Afroz (2020)	Malaysia	(1993–2017)	the bound testing technique of cointegration	The ICT affected population health significantly and positively in the long- and short-run.
Arthur (2017)	Sub-Sahara Countries	2014-2017	the Grossman Human Capital Model	The findings indicated that health expenditure has a significant but inelastic effect on health outcomes in SSA.
Irawan (2015)	Selected African countries	(2000-2018)	Driscoll-Kraay standard errors, (FGLS), and (PCSE)	ICT does act as an indispensable stimulator for Africa to significantly exceed the international health target of life expectancy at birth of 60 years.
Raghupathi (2013)	214 countries	2013	panel data approach	The findings revealed that ICT factors are positively associated with specific public health indicators.
S. Wu (2012)	Selected countries	(2000-2008).	panel data analysis	the overall improvement of ICT had a significant impact upon a country's public health delivery.
Sunil Mithas (2009)	The United States	2009	Empirical Analysis	IT investments at the country level are positively associated with higher life expectancy.

Based on the review of previous literature summarized in the table, there is few studies conducted to examine the empirical evidence on the impact of ICT spending on health indicators in Saudi Arabia. Therefore, this study intended to assess whether ICT spending has a significant impact on health indicators, specifically life expectancy, in Saudi Arabia.

Furthermore, the literature review underscores health's centrality to development, the pivotal role of technology in transcending boundaries, expediting spatial barriers, and enhancing health service efficiency globally. It argues that ICT has evolved from luxury to a necessity, vital for modern life.

3. Data, Model, and Hypothesis

3.1 Data

Methodologically, the study employs a transnational dataset for analysis, revealing that ICT expenditure positively correlates with specific health markers, notably life expectancy. It directs ICT's contribution to health strategy and provides guidance for future policy direction. The application of regression analysis, it assesses the impact of ICT on life expectancy in Arabia. Data handling and assumptions, the model specification, the empirical analysis, are demonstrated.

Section 3 presents data, methods, conceptual model, and proposed hypotheses. Data was collected from both Saudi official and the World Bank annual reports as reflected on Table 3. The study selected life expectancy at birth to reflect health indicator and chose one independent variable chosen is ICT spending, which includes public and private spending.

Table 3. Data and Variables

Data/ variables	Measurement	Source of Data
Life Expectancy at birth	Life expectancy at birth, total (years)	World Bank
Spending on ICT	Saudi Riyals	Saudi Official sources

3.2 Model

A country's health production function is a function that describes the nature of the link between specific variables and other independent variables over a span year. According to Grossman (1972), health is shaped by individuals based on their behavior, health care, and the boundaries they encounter. The study uses the Grossman (1972) model according to the description of Fayissa (2005). The health production function is defined in equation (1) as follows:

$$H=f(\text{inputs to health}) \quad 1$$

Where:

H is an individual health outcome,

and inputs that determine health, such as ICT, income, education, health care costs, and medical facilities. In this study, only ICT variable is taken into account in the model. In this analysis, the study used life expectancy as an indicator of health.

Therefore, the general model can be written as follows:

$$\text{Life expectancy}=f(ICT) \quad 2$$

The specific model is presented as follows:

$$LEBt=\beta0+\beta1LEBt\text{-}1+\beta2ICTt+\varepsilon t \quad 3$$

By transforming all variables in equation (1) into natural logarithms, the following model is intended:

$$LnLEBt=\beta0+\beta1LnLEBt\text{-}1+\beta2LnICTt+\varepsilon t \quad 4$$

Where:

ln(LEBt) represents the life expectancy at birth in Saudi Arabia;

Ln LEBt-1 represents the life expectancy at birth in Saudi Arabia in lags time

ln (LnICTt) represents spending on ICT in Saudi Arabia,

$\beta0$ is the fixed intercept, $\beta1$ & $\beta2$ represent the slope of the model (the total effect of the independent variable ICTt on the dependent variable LEBt), and εit is the error term is expected to be independent and identically dispersed. In Equations (2) to (4), the study proxy health outcomes (H) with Life Expectancy at Birth (LEB). The study estimated Equations (2) to (4) using the ARDL. The study further conducted the Chow (1960) test, the Breusch and Pagan (1980) Lagrange Multiplier test (LM), and the Hausman (1978) test to choose the appropriate model. Lastly, the study tested for heteroscedasticity using White’s (1980) test.

3.3 Hypothesis

Built on the stated equations, this study, therefore, states the following hypothesis:

H0: the spending on ICT factor has positive impact on life expectancy at birth.

4. Empirical Estimates, and Discussion

4.1 Descriptive Statistics

This section provides results and discussion. Firstly, a full summary description of the (the mean, standard deviation, minimum and maximum) of all variables. ICT has both mean and high variability compared to LEB. Furthermore, the statistics make it clear that the Jarque–Bera test for all variables used in the study is not significant, implying that all variables are chosen to have a normal distribution.

Table 4. Descriptive statistics of the variables (LEBt and ICT)

	LEBt	ICT
Mean	74.03713	75.60458
Median	74.42650	74.00000
Maximum	76.07000	142.0000
Minimum	70.71900	15.00000
Std. Dev.	1.775881	45.96575
Skewness	-0.575419	0.041315
Kurtosis	1.984041	1.511208
Jarque-Bera	2.2356601	1.223329
Probability	0.307801	0.329011
Sum	1776.891	1814.510
Sum Sq. Dev.	72.53632	48595.56
Observations	24	24

4.2 Unit Root Tests

Secondly, unit root test is checked to determine the presence of a unit root or not. The study selected the Augmented Dickey-Fuller tests to analyse the stationarity of the variables. The unit root test results are presented in Table 5 which show that all variables are stationary, both in level and in first difference. Thus, the results in Table 5 are consistent with the hypothesis that the variables are integrated at orders I (0) and I (1). All first difference coefficients of the variables are significant at the 1% level, proving that all variables are stationary in the first difference.

Table 5. Unit Root for LEBt and ICTt (At level with intercept) Augmented Dickey-Fuller Null Hypothesis: (LifeExpt, and ICT) have a unit root

Variable	Test Critical Values	t-statistics	Prob.*
D(LifeExpt)	1%	-2.23346	0.03153
	5%	-2.5632	
D(ICT)	1%	-5.325	0.02621
	5%	-5.326	

*MacKinnon (1996) one-sided p-values

4.3 Selection of Lag Order

Thirdly, this step aims to find the optimal lag order of the VAR model based on the following selection criteria : sequentially modified LR test statistics, FPE, AIC, and SIC information criteria. This process is necessary because if the wrong lag length is selected, the outcomes will be biased (Hdom and Fuinhas, 2020). Table 6 shows the results of an appropriate offset length of 2.

Table 6. Optimal Lags: VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC
0	-129.4261	NA	529.6425	11.94783	12.04702
1	-65.71261	110.0507	2.332622	6.519328	6.816885
2	-53.24680	19.26534*	1.094295*	5.749709*	6.245637*

*Includes lag order selected by the criterion

LR: serial revised LR test statistic (each at 5% level)

FPE: Final Prediction Error

AIC: Akiake Information criterion

SC: Schwarz information criterion

4.4 ARDL Estimates

Fourthly, the ARDL was used to examine the impact of ICT spending on life expectancy. The resulting correlation was:

$$LEBt=1.0398842+0.753907LEBt\text{-}1+0.005339\ln(ICT) \quad (5)$$

Equation 5 shows that expected life expectancy is positive and significant on its offset. This also reflects the existence of a positive impact of the ICT spending and life expectancy at birth. The β1 value of this model measures the elasticity of life expectancy in relation to medical spending. The data in Table 6 present the ARDL results of the analysis using Equation 1. The overall results in Table 7 show that the model has a very high R-squared explanatory power (0.968210), indicating that independence contributed more than 96% of the total variation in life expectancy in the Saudi Arabian economy across the years studied. Furthermore, the findings revealed that ICT has a positive and statistically insignificant effect on life expectancy at the 5% significance level. The per capita ICT coefficient is approximately 0.005, implying that a 1% increase in IT would increase LEB by approximately 0.005% for the Saudi Arabian economy.

Table 7. Dependent Variable (Log (HDI) using ARDL

Variable	Coefficient	Std. Error	t-statistics	Prob.*
LOG(LEBt-1)	0.753907	0.250021	3.015376	0.0068
LOG(ICTt)	0.005339	0.008111	0.658144	0.5180
C	1.0398842	1.042767	0.997195	0.3306
R-squared	0.968210	Mean Dep. Var	4.306270	
Adjusted R-squared	0.965031	S.D. Dep. Var	0.022620	
S.E. of regression	0.004230	Akaike info Criterion	-7.972189	
Sum squared residuals	0.000358	Schwarz criterion	-7.824081	
Log Likelihood		Hannan-Quin Criter.	-7.934940	
F-statistics		Durbin-Waston Stat	2.252595	
Prob(F-statistics)	0.00000			

*Note: p-values and any subsequent tests do not account for model selection

4.5 Post Estimation Test

Fifthly, this section provides post estimate tests such as heteroscedasticity, stability tests, autocorrelation test, the variance decomposition and the impulse response tests.

4.6 1Heteroscedasticity Test

Table 8 shows that the probability of the observed R-squared (0.729668) is greater than 0.05 and is therefore acceptable. Therefore, the null hypothesis of the absence of homogeneity is not rejected. In this case, the F- and χ2 (“LM”) versions of the test statistic yield the same conclusion that there is no evidence for the presence of heterogeneity because the p-value significantly exceeds count 0.05.

Table 8. Heteroscedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	0.327641	Prob. F (2,20)	0.7244
Obs*R-squared	0.729668	Prob. Chi-Square (2)	0.6943
Scaled explained SS	2.288659	Prob. Chi-Square (2)	0.3184

4.6.1 Linearity Test (Ramsey Reset Test)

It is important to know whether there is a linear relationship between the dependent variable (LEBt) and the independent variable (ICT). The null hypothesis is that the model under consideration is linear or precisely determined. The null hypothesis of linearity is rejected because the test statistics (t-statistics, f-statistics, and likelihood ratio statistics) are statistically significant. Table 9 reflects this analysis.

Table 9. Stability diagnostic: Ramsey RESET Test

	Value	df	Probability
t-statistic	2.143081	19	0.0453
F-statistic	4.592798	(1,19)	0.0453
likelihood	4.979558	1	0.0256

4.6.2 Autocorrelation Test (LM Test)

The Breusch-Godfrey LM test was conducted to test for autocorrelation. The null hypothesis is that there is no serial correlation. Table 9 shows that the observed R-squared probability is greater than 0.05 and is reasonable. Both statistics indicate that there is no serial correlation in the model. Therefore, the null hypothesis of no serially correlated residuals (i.e. autocorrelation) is not rejected). Table 10 illustrates this observation.

Table 10. Residuals diagnostic: Serial Correlation (Breusch-Godfrey Serial Correlation LM Test)

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.767685	Prob. F (2,18)	0.4832
Obs*R-squared	1.785952	Prob. Chi-Square (2)	0.4094

4.7 The Dynamic Response Analysis

Further research is needed using both impulse response functions and ARDL-based variance decomposition, as well as 10-period results, to study the dynamic effects of model responses to specific shocks as well as the impact lies between the three variables.

4.7.1 The Variance Decompositions

The term "variance decomposition" refers to the breakdown of mean square error into the individual contributions of each variable. This technique can be used to examine how each variable's update affects the other variables and to show the relative effects. Table 11 shows that the variance in the LEBt projections is not accurate, and that part of it may be due to arbitrary innovation shocks to ICT, including itself. The study's findings suggest that there are two co-integration relationships existing between the two variables. ICT has a favourable effect in the long run. These results suggest that the two variables have a long-term mutually beneficial relationship. Future studies on the subject are recommended by the study, and they should take additional variables into account that could have an impact.

Table 11. Variance Decomposition of Log(LEBt):

Period	S.E.	Log(LEBt)	Log(ICT)
1	0.004147	100.0000	0.000000
2	0.004828	99.63114	0.368858
3	0.005757	99.63114	0.401441
4	0.006389	99.62550	0.374499
5	0.006920	99.67964	0.320358
6	0.007302	99.70715	0.292854
7	0.007582	99.71409	0.285906
8	0.007782	99.71465	0.285346
9	0.007927	99.71648	0.283520
10	0.008036	99.72046	0.279535

4.7.2 The Impulse Response Analysis

The impulse response analysis of ARDL is shown in Fig. 3. The effect of D(ICT.) on D(LEBt,) is shown in the first row. These details are shown in Figure 3: First, it is found that a positive shock has a significant impact after considering the impact of an IT shock. After a positive shock, LEBt. The decline rapidly reaches a nadir in the second period, then slowly increases to a peak in the sixth and seventh periods, then stabilizes. This shows that the positive shock of HPI has a significant impact on the index's upward momentum. Second, D(LCPI) has a negative impact on D(LEBt), reaching the lowest impact in the second period, then increasing rapidly in the third period, decreasing again in the fourth period, and stabilizing in the ninth period. Finally, D(Lifeexp)) has a small impact on D(ICT) in the first period, reaches its maximum influence in the third period, and stabilizes after the ninth period.

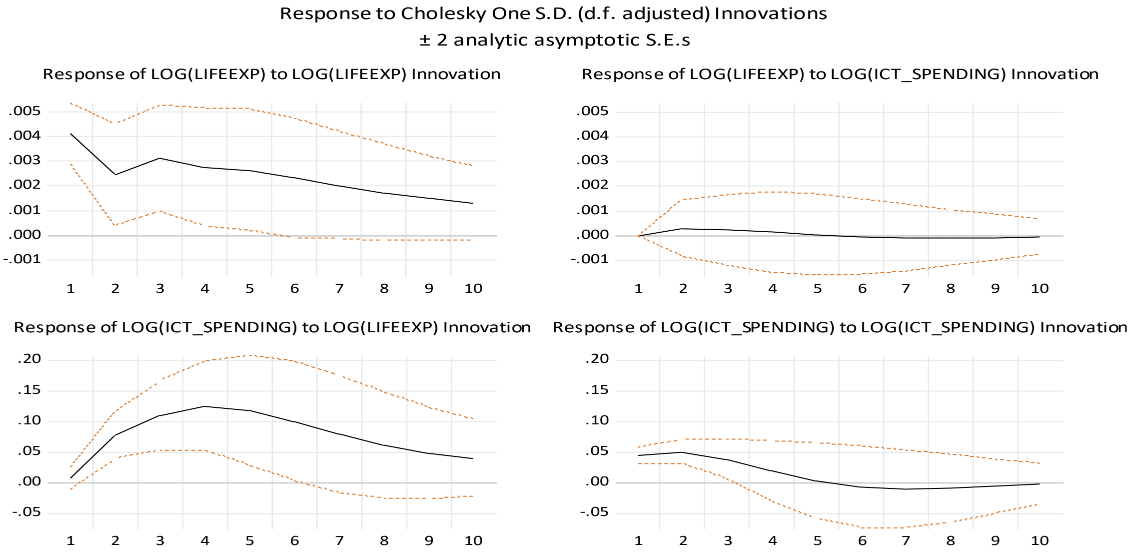


Figure 3. Impulse response function

Generally, the discussion segment synthesizes the findings and concludes, emphasizing the positive correlation between ICT and expectancy, offering empirical evidence for policymakers. The document highlights the significance of ICT in enhancing life expectancy and directs policymakers, offering practical guidance for strategic formulation.

5. Conclusion

To develop the health sector, the Saudi Arabian government has adopted different initiatives to achieve ambition in the Kingdom's Vision 2030 and create a tangible positive impact on the national health system. Those initiatives include the first dimension (improving health care) of the (National Transformation) program and the "Health Sector Transformation Program". Similarly, Saudi Arabia has given continuous support to the information and technological sector. For example, it established, the ICT Sector Strategy 2019-2023 which intended at building a well-developed digital infrastructure that contributes to achieving the required digital transformation and thus supporting the directions of the Kingdom’s Vision 2030 and building a digital society. This study has attempted to investigate the impact of spending in the ICT sector on health indicators, namely, life expectancy at birth in Saudi Arabia during the period (1998-2022). The results show that spending on information and communication technology components is positively correlated with specific health indicators, mainly average life expectancy. These findings guide the contribution of positive and effective impacts of spending on ICT to enhance health and provide future guidance on national health policy implications.

Acknowledgments

Not applicable.

Authors contributions

Not applicable.

Funding

Not applicable.

Competing interests

Not applicable.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Macrothink Institute.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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