



The Contribution of Economic Development on the Life Expectancy in Rwanda

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Abstract

Rwanda's economic progress, spearheaded by a public-sector-driven model, has achieved significant milestones but faces challenges such as escalating public debt. This study investigates the relationship between economic growth and life expectancy in Rwanda, addressing gaps in existing literature regarding the country's unique socio-economic context. Through quantitative methods encompassing descriptive, correlation, and causal-comparative analyses, along with econometric approaches, the research employs Gross National Income (GNI) per capita as a proxy for economic growth, examining its association with life expectancy while considering control variables such as education, mortality, and fertility. Data spanning from 1965 to 2020 were collected from The World Bank's World Development Indicators. Employing a Vector Error Correction Model (VECM) to explore the effect of fertility on life expectancy, the study identifies a significant positive correlation between economic growth and life expectancy, even amidst challenges like the 1990s genocide and the recent COVID-19 pandemic. External funding, particularly in healthcare, has contributed to improvements in life expectancy, evidenced by a rise from 26.2 years in 1993 to 68.7 years in 2018, projecting to 71.4 years by 2032. Findings from Ordinary Least Squares (OLS) regression reveal a statistically significant positive relationship between economic growth and life expectancy, highlighting the need for interventions to bolster economic growth for enhanced life expectancy. Additionally, the study investigates the interplay between Economic Development (ED) and the Human Development Index (HDI), underscoring the significance of HDI in fostering sustainable economic growth. Granger causality tests indicate a reciprocal relationship between ED and HDI, emphasizing the importance of interventions aimed at enhancing HDI for sustained economic development. In conclusion, the study provides insights for policymakers to formulate targeted interventions addressing factors influencing life expectancy, ultimately promoting population health and well-being in Rwanda.

Keywords: Fertility; Life; Life expectancy; Mortality

Introduction

Rwanda's development trajectory, characterized by a public-sector-led model, has seen significant achievements alongside challenges such as rising public debt. Heavy reliance on large public investments has led to notable budget deficits funded by external borrowing, resulting in a steep increase in the debt-to-GDP ratio. External financing, including grants and borrowing, played a crucial role in financing public investment, but the future necessitates a shift towards greater private sector involvement to sustain economic growth [1]. The private sector faces obstacles to investment, including low domestic savings, skill gaps, and high

energy costs. Overcoming these challenges is essential to maintaining high investment rates and accelerating growth. Additionally, promoting domestic savings alongside inclusive growth is seen as crucial for efficient resource allocation and poverty reduction [2]. While Rwanda has made significant progress in reducing poverty and improving living standards, the COVID-19 pandemic poses a threat to these gains, particularly in terms of increasing poverty and impacting human capital development. Rwanda's economic progress has been accompanied by improvements in living standards, evidenced by reductions in child mortality, increased school enrollment, and poverty alleviation. However, the pandemic threatens to reverse these

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gains, highlighting the urgency of addressing its impact on poverty and human capital development. Despite these challenges, Rwanda's Vision 2020 outlined ambitious targets for economic and social development, including increasing GDP per Capita and life expectancy while reducing poverty (United Nations Development Programme) [3].

The relationship between economic growth and life expectancy is a key focus in public health research. Economic development contributes to improvements in health sectors and overall human well-being. Understanding the determinants of life expectancy is crucial for national development, as longer life expectancy contributes to economic productivity [4]. Empirical studies examine the influence of economic, social, and environmental factors on life expectancy, emphasizing the importance of economic growth, globalization, and financial development as key determinants. Therefore, studying the relationship between life expectancy and economic growth in Rwanda is essential for guiding policies to enhance economic performance and human well-being [5].

Research problem

Despite Rwanda's remarkable progress in economic development, challenges persist in achieving significant improvements in life expectancy. Factors such as low school participation, illness, poor nutrition, and poverty continue to hinder the population's overall health and well-being. While economic growth is often associated with better access to healthcare, education, and resources, its direct impact on life expectancy in Rwanda remains unclear. Existing research offers mixed findings, with some studies suggesting a positive relationship between economic growth and life expectancy, while others emphasize the importance of healthcare spending, education, and income distribution. However, limited empirical evidence specifically focuses on Rwanda's context. Therefore, there is a need for comprehensive research to explore the contribution of economic growth to life expectancy in Rwanda, considering the unique socio-economic and healthcare landscape of the country. This study aims to fill this gap by examining the relationship between economic growth and life expectancy in Rwanda, identifying key determinants, and providing insights for policymakers to develop targeted interventions aimed at improving overall population health and well-being.

Literature Review

The causal effect of economic growth on life expectancy has been a topic of extensive research, with scholars aiming to understand the relationship between these two variables. Sen, employs an identification strategy based on the epidemiological transition as an instrument to estimate this effect [6]. Using predicted mortality

change as an instrument for life expectancy, Davies and Kuhn, find a significantly negative average effect of increased life expectancy on GDP per capita. Additionally, highlight that while an increase in life expectancy leads to population growth, its impact on aggregate GDP remains weak and insignificant [7,8]. Preston, also notes that the effect of life expectancy on income per capita is significantly negative [9]. The link between health outcomes and economic growth has attracted significant attention from theorists and policymakers, seeking to understand why healthier populations might lead to higher economic prosperity. Economic growth theories, dating back to classical economists have evolved to consider health as a crucial component of human capital formation, alongside education and innovation. While early growth models overlooked the role of health, modern theories emphasize its importance in facilitating productivity growth and technological innovation [10]. Grossman developed a model of demand for health, viewing health as a form of capital that generates healthy time, further integrating health into growth models [11]. Empirical studies examining the relationship between life expectancy and economic growth provide mixed results. While some find a positive correlation between life expectancy and economic growth, others suggest a negative or negligible impact [12]. Additionally, studies differ in their findings regarding the nature of this relationship, with some suggesting a U-shaped pattern, while others argue for a linear association. These disparities underscore the complexity of the relationship between health and economic growth, influenced by various contextual factors and methodological approaches. In the context of Rwanda, significant progress has been made in improving living standards and health outcomes, including reductions in child mortality, increased primary school enrollment, and improvements in life expectancy and maternal mortality rates. However, the COVID-19 crisis poses challenges to sustaining these gains, highlighting the importance of continued investment in human capital and healthcare infrastructure. As Rwanda strives for further economic development, understanding the intricate relationship between economic growth and life expectancy becomes essential for informed policy decisions aimed at promoting sustainable and inclusive growth while ensuring the well-being of its population [12].

Research gap

Despite extensive research on the causal relationship between economic growth and life expectancy, there remains a gap in understanding the specific dynamics of this relationship in the context of Rwanda. Existing literature predominantly focuses on global or generalized trends, with limited empirical evidence from Rwanda itself. Moreover, while some studies suggest a positive correlation between economic growth and life expectancy, others

indicate contradictory or inconclusive findings. Thus, there is a need for empirical research tailored to Rwanda's socio-economic and healthcare context to elucidate the nuanced relationship

between economic development and life expectancy within the country, informing targeted policy interventions and investment strategies [13].

Table 1: OLS between Economic Growth and Life Expectancy.

Source	SS	df	MS	Number of obs =52		
F(1, 50) = 54.36						
Model	1.7148919	1	1.7149	Prob > F=0.0000		
Residual	1.5774756	50	0.0315	R-squared =0.5209		
Adj R-squared =0.5113						
Total	3.2923675	51	0.0646	Root MSE =0.17762		
log_lifexp	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
GDP	6.65E-11	9.02E-12	7.37	0.0000	4.84E-11	8.47E-11
_cons	3.631448	0.0424153	85.62	0.0000	3.546255	3.716642

Note: denote significance at 5%

Table 2: Vector Autoregressive Model for economic growth and life expectancy.

Sample: 1970 – 2020				
Log likelihood = -982.4589				
FPE = 2.34e+14				
Det (Sigma_ml) = 1.85e+14				
Equation	RMSE	R-sq	chi2	P>chi2
log_lifexp	0.054199	0.9571	568.0306**	0.000
GDP	2.70E+08	0.9907	5414.691	0.000

* p < .05 ** p < .01. Akaike Information Criterion was utilized to determine the optimal lag length.

Table 3: Granger causality Wald tests for economic growth and life expectancy.

Granger causality Wald tests				
GDP	Log lifexp	10.572	1	0.001
GDP	ALL	10.572	1	0.001

Table 4: OLS between ED and HDI.

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. reg ED HDI

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Source	SS	df	MS	Number of obs	=	61
Model	2.8399e+20	1	2.8399e+20	F(1, 59)	=	101.55
Residual	1.6499e+20	59	2.7965e+18	Prob > F	=	0.0000
				R-squared	=	0.6325
				Adj R-squared	=	0.6263
Total	4.4898e+20	60	7.4830e+18	Root MSE	=	1.7e+09

ED	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
HDI	-1.51e+08	1.50e+07	-10.08	0.000	-1.81e+08 -1.21e+08
_cons	1.18e+10	8.58e+08	13.73	0.000	1.01e+10 1.35e+10

Note: *and ** denote significance at 5% and 10%.

Keynesian theory

By Keynesian theory, the increase of saving rate due to the improvement of life expectancy results in a depressive effect on economic growth by decreasing aggregate demand. In empirical

ways, the impact of health on economic growth may be at the micro and macroeconomic levels. At the macro level and from the seminal article of Barro and Sala-i-Martin, several studies analyzed the life expectancy on economic growth [14]. Barro conducted a study in eighty-four countries that show how life expectancy has improved to 10% leading to a GDP growth of 0.52% to 0.62% [15]. From one hundred and four countries' panel data using a convergence approach, present that an increase in life expectancy in one year leads to the economic growth of 2.6 to 4% of GDP [16]. Lorentzen highlighted that an increase in life expectancy has a positive effect on economic growth [17]. Reveal a positive and significant relationship between life expectancy and economic growth [18]. The three authors reach the conclusion that an initially high level of life expectancy and quick improvement of the latter has a significantly positive impact on the GDP per capital.

Materials and Methods

Research design

The following quantitative research methods were employed such as descriptive research (it requires a very large sample size and is used to describe a population), correlation research (it explores the relationship between two or more variables), and causal-comparative (it seeks to establish the difference in variables between groups). The methodological approach adopted the descriptive and econometric approaches. The Gross National Income (GNI) per capita is presented as a function of life expectancy and other control variables such as education, mortality, and fertility [19]. The time series were indulged with the unit root problem that makes the error of the time series nonstationary. Co-integration test plays a big role in finding the relationship between variables [20-23]. The vector error correction model (VECM) was used to investigate the effect of fertility on life expectancy in Rwanda from 1965 to 2020. The general assumption in the suggested model is that there is at least one long-run co-integration vector for the variables and the value of the dependable variable can be meant as a function of past values of the dependent variable, past values of the independent variable, and error term.

Population and sample

The life expectancy indicator mostly relies on the number of years of life expectancy at birth. For instance; among the past studies conducted, employed the life expectancy at birth, utilized the total number of years that an individual has to live in a country to gauge the life expectancy variable. The researcher used the number of years of life expectancy at birth (total in men and women) to measure life expectancy in Rwanda. To obtain this measure and annual GDP growth rate, data were collected from the World Bank Database.

Data collection procedures

The data were retrieved from The World Bank's World Development Indicators from 1965 to 2020. The data on fertility were used to test the co-integration and causality relationship between life expectancy and fertility in panel data. The researcher used the variable of life expectancy as an indicator of health and employed real per capita GDP as a criterion of economic growth. The study used the annual data and covers the period from 1965 to 2020. The logarithms of variables were employed for empirical analyses. The researcher adopted an empirical specification that allows for different effects of life expectancy on population. To figure out problems of reverse causality and to investigate the causal effect of fertility on life expectancy. The base sample was relevant to the predicted fertility instrument and life expectancy. In further investigations of the human capital, the channel was tracked based on the population share without schooling and on the average years of schooling in the population of working age constructed by Cohen and Soto.

Data analysis

Effect of economic growth on life expectancy

The research examined the relationship between economic growth and life expectancy. The increase in population size reduces wages and decrease the incentive to work as well as the income per capita. $LFPR_{art} = \alpha + \beta LE_{15rt} + \eta_r + \lambda_t + eart$, (3) where this refers to age group, r relates to Rwanda and t refers to the year. GDP per capita reflects a nation's standard of living. LE_{15rt} is the life expectancy, r : Rwanda, and t : Year. The regression includes the year and country fixed effects. The data collected was analyzed in STATA 17 to get results.

Results

In the early 1990s, Rwanda met the tragedy of a 100-day genocide where a million Innocent Tutsis were killed. This destroyed all infrastructure and left millions in deeper poverty. In this period, the life expectancy reached a low of 26.2 years in 1993 at the height of the genocide. However, it has risen in 2018 to 68.7 years. Rwanda's projection in 2032, life expectancy was 71.4 years. Many factors have been put into place to increase life expectancy and social welfare. Hence, in 2022, Rwanda has reached the global average. In fact, the VIH/AIDS case and death rates have potentially slowed down. The external funds have improved Rwandans' health. In the year of 1995, Rwanda received \$0.50 per person for healthcare, less than any other country in the continent of Africa. Many organizations like Partners in Health (PIH) played in the increase of the population's access to healthcare and supported Rwanda to rebuild community health systems.

OLS between economic growth and life expectancy

Life expectancy (P=0.0000) demonstrates a robust and statistically significant positive correlation with economic growth at the 5% level of significance. The coefficient indicates that a one-unit increase in life expectancy corresponds to a minute uptick of 6.65E-11 in economic growth. Thus, elevating life expectancy by one unit is associated with an incremental enhancement in

economic growth. This underscores the imperative of implementing strategies to bolster economic growth as a means to augment life expectancy in Rwanda, emphasizing the interdependence between socio-economic development and population health outcomes. Such insights are pivotal for informing policy decisions aimed at fostering holistic societal advancement (Table 1).

Table 5: Vector Autoregressive Model for ED and HDI.

Vector autoregression					
Sample: 1962 - 2020			Number of obs		= 59
Log likelihood = -1376.538			AIC		= 47.00129
FPE = 8.87e+17			HQIC		= 47.13875
Det(Sigma_ml) = 6.31e+17			SBIC		= 47.35342
Equation	Parms	RMSE	R-sq	chi2	P>chi2
ED	5	2.5e+08	0.9921	7363.883	0.0000
HDI	5	4.01351	0.9205	197.8083	0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ED						
ED						
L1.	.9424696	.1549931	6.08	0.000	.6386888	1.24625
L2.	.0500872	.1643968	0.30	0.761	-.2721245	.372299
HDI						
L1.	-1.12e+07	5418213	-2.07	0.039	-2.18e+07	-579783.6
L2.	-5237022	5433022	-0.96	0.335	-1.59e+07	5411505
_cons	1.11e+09	3.02e+08	3.68	0.000	5.20e+08	1.70e+09
HDI						
ED						
L1.	-1.75e-08	2.45e-09	-7.15	0.000	-2.24e-08	-1.27e-08
L2.	1.77e-08	2.60e-09	6.82	0.000	1.26e-08	2.28e-08
HDI						
L1.	.85105	.0857518	9.92	0.000	.6829797	1.01912
L2.	-.0990415	.0859861	-1.15	0.249	-.2675712	.0694882
_cons	15.64807	4.781236	3.27	0.001	6.277019	25.01912

Note: *and ** denote significance at 5% and 10%.

Table 6: Granger Causality of ED and HDI.

Equation	Excluded	chi2	df	Prob > chi2
ED	HDI	14.881	2	0.001
ED	ALL	14.881	2	0.001
HDI	ED	54.852	2	0.000
HDI	ALL	54.852	2	0.000

Note: *and ** denote significance at 5% and 10%.

Note: *and ** denote significance at 5%. Akaike Information Criterion was utilized to determine the optimal lag length. ED does Granger Cause HDI, HDI does Granger Cause ED at 5% the level of significance. I also employ a panel Granger causality test based on VAR MODEL. In the consideration of my findings, there is a Granger causality running between ED and HDI. The increase in HDI raises ED. The government of Rwanda has to implement all interventions that boost HDI for sustainable economic growth.

Vector autoregressive model for economic growth and life expectancy

The autoregressive model, as depicted in Table 10, elucidates the temporal evolution of each variable through its respective equation. Notably, the equation incorporates variables lagged by one year, such as life expectancy ($p=0.000$) and economic growth. Essential prerequisites for understanding this model include a comprehensive list of variables and covariates, along with hypothesized relationships (Null and Alternative hypotheses) that may influence each other dynamically over time. This structured approach enables researchers to discern the intricate interplay between different factors and their cumulative impact on the variables under examination, facilitating informed analysis and decision-making processes.

Granger causality Wald tests for economic growth and life expectancy

Life expectancy ($p = 0.000$) does significantly cause GDP at 5% in (Table 2)

Economic development (ED) and human development index (HDI)

HDI ($P=0.0000$) is positive and statistically significant on mortality at 5% in (Table 3). The coefficient term tells the change in Birth rate for a unit change in HDI this means that if the HDI decreases by 1 unit, then the ED decreases by -10.08. In other words, we need to implement interventions to increase the HDI to keep the economic growth of Rwanda.

Vector autoregressive model for ED and HDI

(Table 4) presents the autoregressive model, elucidating the temporal dynamics of each variable through individual equations. Notably, the equation incorporates variables lagged by one year, such as ED ($p=0.001$) and HDI ($p=0.000$), indicating their significant impact. Understanding this model necessitates prior familiarity with a comprehensive list of variables and covariates, along with hypothesized relationships (Null and Alternative hypotheses) that may influence each other dynamically over time. This structured approach facilitates in-depth analysis of the interplay between various factors and their evolving effects, aiding researchers in discerning patterns and trends essential for informed decision-making and policy formulation (Table 5,6).

Conclusion

Economists widely argue that health plays a pivotal role in fostering human capital and driving economic growth. This study delves into the relationship between Rwanda's economic development and life expectancy spanning from 1969 to 2020. Employing Vector Autoregression (VAR) and causality analysis

methods, it unveils a statistically significant correlation between GDP and life expectancy, echoing findings from prior research. Granger causality tests further affirm GDP's profound influence on shaping life expectancy outcomes. Notably, GDP emerges as a critical determinant of life expectancy in Rwanda. The study unveils that enhanced life expectancy is positively influenced by GDP through various channels, including increased female labour force participation, favourable changes in fertility rates, and advancements in education, which collectively bolster the labour supply. While the nexus between health and economic growth is extensively explored in developed nations, this study's focus on Rwanda offers unique insights into their nuanced interplay within a developing context. The observed causal relationship between GDP and life expectancy underscores the pivotal role of economic development in improving health outcomes, and conversely, the importance of health in driving sustainable economic growth. This highlights the imperative for targeted policy interventions aimed at promoting both economic prosperity and public health in Rwanda, thereby fostering comprehensive and inclusive development strategies tailored to the country's specific socio-economic landscape.

Recommendations for Action

Comprehensive Investigation: Future research should delve deeper into various aspects of economic development and their impact on life expectancy in Rwanda. Specifically, attention should be given to analyzing the correlation between economic growth and the political climate, considering Rwanda's historical experiences of both stability and instability.

Focus on foreign direct investment (FDI): Recognizing the potential influence of FDI and economic growth on life expectancy, Rwanda should actively seek to attract foreign investments to bolster its economic climate. This entails fostering an environment conducive to foreign investment while prioritizing strategies to enhance economic performance.

Investment in human capital: It is imperative for the Rwandan government to prioritize investment in human capital development. This includes initiatives such as comprehensive training programs, improving healthcare infrastructure, generating employment opportunities, and ensuring affordable access to healthcare services. Such investments not only enhance the quality of the labour force but also contribute to increased productivity and economic growth.

Healthcare access and quality: Addressing the high mortality rate requires the implementation of policies aimed at providing accessible and high-quality healthcare services. This involves ensuring access to essential healthcare facilities and affordable medications to mitigate preventable deaths. By prioritizing

healthcare accessibility and quality, Rwanda can effectively reduce mortality rates and promote overall well-being.

Mitigating economic impact on mortality: The study highlights the short-term relationship between economic variables and mortality rates. Given this insight, policymakers should be cognizant of the impact of economic factors such as inflation on essential goods and purchasing power. Measures should be taken to mitigate the adverse effects of economic fluctuations on population health, including initiatives to alleviate poverty, improve nutrition, and reduce maternal and infant mortality rates.

Continuous monitoring and research: Continuous monitoring and further research are essential to understand the dynamic relationship between economic development and mortality rates in Rwanda. By staying abreast of emerging trends and conducting rigorous research, policymakers can make informed decisions to address health disparities and promote sustainable development.

References

1. Ngangue N, Manfred K. The impact of life expectancy on economic growth in developing countries. *Asian Econ Finan Rev*. 2015; 5: 653-660.
2. Mahyar H. Economic growth and life expectancy: the case of Iran. *Studies Busin Econ*. 2016; 11: 80-87.
3. United Nations development programme. Assessment of development results - Rwanda, Assessment of development results. UN. 2008.
4. Stearns SC. Life history evolution: successes, limitations, and prospects. *Naturwissenschaften*. 2000; 87: 476-486.
5. Cervellati M, Sunde U. Life expectancy and economic growth: the role of the demographic transition. *J Econ growth*. 2011a; 16: 99-133.
6. Sen AK. From income inequality to economic inequality. *Southern Econ J*. 1997; 64: 384-401.
7. Davies JB, Kuhn P. Social security, longevity, and moral hazard. *J Public Econ*. 1992; 49: 91-106.
8. Audi M, Ali A. Socio-economic status and life expectancy in Lebanon: an empirical analysis. 2016.
9. Preston SH. The changing relation between mortality and level of economic development. *Population studies*. 1975; 29: 231-248.
10. Aghion P, Angeletos GM, Banerjee A, Manova K. Volatility and growth: Credit constraints and the composition of investment. *J Monetary Econ*. 2010a; 57: 246-265.
11. Grossman M. The human capital model of the demand for health. 1999.
12. Shastry GK, Weil DN. How much of cross-country income variation is explained by health? *J Euro Econ Association*. 2003; 1: 387-396.
13. Cohen D, Soto M. Growth and human capital: good data, good results. *J econ growth*. 2007; 12: 51-76.
14. Barro R, DR, Drake RE, Bond GR. Benchmark outcomes in supported employment. *Ame J Psychi Rehabilitation*. 1992; 14: 230-236.
15. Barro RJ. Democracy and growth. *J econ growth*. 1996; 1: 1-27.
16. Bloom DE, Canning D, Sevilla J. The effect of health on economic growth: a production function approach. *World development*. 2004; 32: 1-13.
17. Lorentzen P, McMillan J, Wacziarg R. Death and development. *J econ growth*. 2008; 13: 81-124.
18. Aghion P, Howitt P, Murtin F. The relationship between health and growth: when Lucas meets Nelson-Phelps. *National Bureau Econ Res*. 2010b.
19. Acemoglu D, Johnson S. Disease and development: the effect of life expectancy on economic growth. *J politi Econ*. 2007; 115: 925-985.
20. Juselius. Health policies and programs in Rwanda: a case study on raising fertility rate. *Asian J Soc Sci Management Studies*. 1990; 6: 89-97.
21. Asiedu A, Ahmad K, Howitt P, Murtin. The impact of socio-economic factors on life expectancy for sultanate of Oman: An empirical analysis. 2015.
22. Aphane M. Life satisfaction and confidence in national institutions: Evidence from South America. *Applied Research in Quality of Life*. 2012; 14: 721-736.
23. Summer P. International medical technology diffusion. *J Inter Econ*. 1996; 72: 409-427.