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Time-series analysis of the health outcomes-financial development nexus: Evidence from South Africa

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Abstract

This study contributes to the literature by investigating the health and financial development nexus in South Africa. The 'health is wealth' debate was again exemplified by the outbreak of the COVID-19 pandemic, thereby raising awareness of the inescapable links between poor health and diverse threats to global socioeconomic prosperity. Thus, the influencing factors of health have continued to be studied. Accounting for structural breaks, the study estimates annual time series data sourced from the World Development Indicators within the autoregressive distributed lag error correction model (ARDL-ECM). The regression outcomes show that financial development has differential impacts on health outcomes. In particular, financial development proxied by domestic credit to the private sector has a negative effect on life expectancy at birth while reducing child mortality, thereby fostering better child health outcomes. This research engages health policy strategists on the right policy mix to achieve better health outcomes. While the financial development drive is ongoing, efforts should be intensified to improve socioeconomic determinants of health, and policy strategies aimed at solving national priority health challenges should be logically pursued.

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1. Introduction

The influential role of health in macroeconomic performance was first brought to the fore by the extensive debate of 'health is wealth' literature, which argues that health is a significant hallmark of a nation's economic growth (Aghion, Howitt, & Murtin, 2010; Bloom & Canning, 2008; Bloom, Canning, Kotschy, Prettner, & Schünemann, 2022; Grossman, 1972). Bloom et al. (2022) and Bloom and Canning (2008) argued that health is an indispensable element of an economy, contributing to the growth trajectory by increasing labor market participation, enhancing labor productivity through improved physical and mental capacities, and incentivizing lower fertility and investment in human and physical capital. The health is wealth argument has indeed been exemplified by notable events in recent times, the most important of which is the increasing recognition of the marked role of health in achieving inclusive and sustainable growth, as evidenced by the inclusion of health-specific goals in global development plans: the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs). Aside from SDG 3 being health-specific, the achievement of many SDGs is linked to progress in health SDG (WHO, 2017). In addition, health care financing has been ubiquitous on the agenda of bilateral and multilateral agencies (Odoch, Senkubuge, & Hongoro, 2021; OECD,

2019a). More importantly, the outbreak of the COVID-19 pandemic has again drawn the attention of the world to the significance of human health for economic health. In particular, the pandemic revealed the inescapable linkages between poor health and diverse threats to global socioeconomic prosperity such as hunger, poverty, illiteracy, unemployment, and inequality (OECD Trade & Agricultural Directorate, 2022; Sánchez, 2021).

Although the cross-country discrepancies in health outcomes have long been hinged on diverse factors such as a country's level of income (Salahuddin, Vink, Ralph, & Gow, 2020), public health expenditure (Akintunde & Olaniran, 2022; Or, 2000), institutions (Ajide, Dauda, & Alimi, 2023), and literacy level, (Raghupathi & Raghupathi, 2020), a strand of the literature pioneered in the work of Claessens and Feijen (2006) recently emerged on the relevance of the level of financial development for a nation's health outcomes. Following the overwhelming documented evidence on the import of financial development for the economic lives of countries, the financial development-health outcomes literature hinges on four major channels, namely the income growth effect, infrastructure development effect, education effect, and risk management effect (Chireshe & Ocran, 2020), as pathways through which financial development improves health outcomes.

Based on evidence on the finance-led growth hypothesis, finance-induced growth in turn generates increased investment, employment, and higher productivity, thus leading to income growth (King & Levine, 1993; Levine, 1997). With higher income, households are able to afford better health care services, nutritious food, and quality housing, which are critical for better health outcomes. Also, by mitigating liquidity constraints and idiosyncratic risk through efficient stock markets and financial intermediaries, financial systems provide finance for the development of infrastructure (Levine, 1997) such as hospitals, electricity, clean energy, water and sanitation, which have been found beneficial to improved health outcomes (Ajide et al., 2023). The education effect argument pivots on the influential studies of Becker (1962) and Mushkin (1962), which similarly corroborate the income growth effect. A well-developed financial system constitutes a key source of finance for investment in human capital in the form of education which is expected to yield future returns in the form of better employment and income (Thierry & Emmanuel, 2022). Raghupathi and Raghupathi (2020) and Shahid et al. (2022) argued for the pertinent role of education in providing knowledge on factors such as hygiene, nutrition, vaccination, and even birth control, all of which have an important bearing on improvement in health. Lastly, the risk management effect emphasizes the role of financial development in health improvement by providing financial services, including credit in times of emergencies, savings opportunities, and insurance which serves as mitigations against future risks, including health risks (Chireshe & Ocran, 2020).

Most of the research on health and financial development has concentrated on developing nations because of the dual challenges of inadequate health outcomes and an undeveloped financial system. This study departs from existing studies in two major ways; to make contributions to the growing strand of literature. First, unlike a large proportion of the prior studies, which pooled cross-country data to estimate panel regressions, we performed a time series analysis of the relationship choosing South Africa as our study context. While Chireshe and Ocran (2020);Shahbaz, Shafiullah, and Mahalik (2019), and Donou-Adonsou (2022) included South Africa in their study samples on the relationship, between the level of financial development and health outcomes in sub-Saharan Africa (SSA), the studies are, however, pervaded with the challenge of the heterogeneity of pooled countries. Countries vary in socioeconomic structures, which are often obscured in cross-country analysis involving pooled data thereby producing limited inference (Haque, Pesaran, & Sharma, 1999).

South Africa has the most developed and sophisticated financial system on the continent of Africa, with an excellent global rating. In spite of the global-wide impact of COVID-19, South African domestic credit to the private sector as a share of Gross Domestic Product (GDP) was 111.2% in 2020, while it was 91.02%, 32.2%, and 27.1% in Morocco, Kenya, and Egypt, respectively and as slow as 12.2% in Nigeria. Among the BRICS[1]countries, it was 70% in Brazil and 54.7% and 59.7%, respectively, in India and Russia in the same period. Although, due to recorded progress in health, most health indicators in South Africa are above the regional averages but below the global standards. While global life expectancy was 73.2 years in 2022, it was 64.9 years in South Africa and 60 years in SSA (World Bank, 2023). Moreover, the country's burden of the global "Big Three" infectious diseases (BTID)–HIV/AIDS, tuberculosis, and malaria has been extreme, and the impact on health has been significant (Le Roux et al., 2020; WHO, 2018). In addition to a high prevalence rate of 14%, globally, the number of people living with HIV/AIDS (PLWA) in 2022 was highest in South Africa, with the number (7.5 million) being higher than the second (Mozambique, 2.2 million), third (India, 2.1 million), and fourth (Nigeria, 1.9 million) ranks put together (World Bank, 2023). On the other hand, however, tremendous improvement in child health has led to a sharp decline in infant mortality, falling from a high of 47.7/1000 live births in 2000 to 24.3/1000 live births in 2022, below both the global and SSA averages, which were 26.8 and 50 per 1000 live births, respectively, in the same period (World Bank, 2023).

[1]BRICS is the acronym created by Goldman Sach (2001) to represent Brazil, Russia, India, China and South Africa.

Second, owing to certain peculiarities of the South African economy and global events capable of introducing structural breaks into our model, we account for structural breaks in our model. In spite of the inherent potential of the global financial crisis and the COVID-19 pandemic to introduce shocks into the financial development trend, the issue of structural breaks has been ignored in past studies. Although Shahbaz et al. (2019) considered South Africa alongside 15 other sub-Saharan African countries in their time series analyses of the effect of certain macroeconomic variables, including financial development, on life expectancy, the study, however, failed to account for structural break in their analyses. Aside from the consideration for political transition in 1994 and the incessant boycotts and sanctions preceding the period of transition, Namibia was part of South Africa until 1990, and also, given the focus of our study on financial development, the financial crisis of 2008 is another major factor to consider. All these important events are capable of introducing structural breaks into our models. As pointed out by Perron (1997) as well as Casini and Perron (2018), failure to account for structural breaks in time series analyses could yield biased estimates and misleading policy inferences. Lastly, we used a mix of health outcomes in our analysis, accounting for overall health as well as child health. To the best of our knowledge, this is the first attempt to pay attention to the above-mentioned nexus in estimating the financial development-health outcome nexus, particularly for South Africa.

The rest of the paper is couched as follows: a review of empirical literature is presented in the next section, followed by methodology, findings and conclusion.

2. Review of Related Literature

The relationship between health outcomes and financial development did not gain the attention of empirical investigators until recently. This assertion is based on the contemporaneity and small but growing size of the existing studies. The choice of health indicator has mostly been life expectancy, which, according to the World Bank definition, measures the number of years a newborn baby would live if patterns of mortality prevailing at the time of its birth were to stay the same throughout its life. Financial development, on the other hand, is mostly represented by measures of financial depth, usually the ratio of financial sector liabilities to GDP and bank credit to the private sector.

The earliest empirical investigation of the financial development-health outcomes nexus was in the work of Claessens and Feijen (2006), which assessed the effect of financial development on four themes of the MDGs, including health. The author reported evidence on finance-led health effect. In a follow-up study on the role of financial development in achieving the MDGs. Rosner (2011) corroborates the stance that an improved financial sector promotes health and wellbeing. The results indicated that bank loans had a lower health premium than financial depth as determined by banks' saving liabilities. A reversed pattern of the relationship was, however, found by Shafiei, Nonejad, Zare, and Haghighat (2020). Specifically, the authors' analysis based on panel of developing countries showed that while bank credit raises life expectancy, banks' saving liabilities have a reducing effect on life expectancy. The documented positive association between financial development and health conditions was similarly upheld in a recent study by Gorgij and Shahraki (2022) for a panel of Middle East and North African (MENA) countries.

The role of finance in achieving health outcome goals was also uncovered in samples of time-series analyses. Prasad, Karan, Jayawardena, and Alam (2020) tested the nexus in a time series analysis of the Fijian economy. The cointegration analysis affirmed that development in the financial sector leads to an additional year in population life expectancy. In another time-series analysis of drivers of health, Rahman and Alam (2022) established a positive linkage between financial development and improved health status in Australia Shahbaz et al. (2019), in a comprehensive country study of sixteen selected SSA countries, likewise showed that financial development accounts for an additional year in life expectancy in all the investigated countries except Gabon and Togo. A similar multi-country time series analysis was conducted by Shi, Wang, and Altuntaş (2022) for three selected large Asian economies, namely China, India, and Japan. The research outcomes based on the ARDL estimator showed that the long-run positive effect of financial development on the life expectancy proxy of health outcomes is only significant for China, while the effect is only positive and significant for China and India in the short run.

In country-specific analyses, Alam, Shahbaz, and Paramati (2016) and Akintunde and Olaniran (2022) explored the contribution of development in the financial sector to changes in health outcomes in India and Nigeria, respectively. While Alam and his colleagues found that improvement in the financial sector promotes health outcomes in India, Akintunde and colleagues argued that the relationship is measure-specific in Nigeria. In specific terms, the authors found that only broad money supply raises life expectancy in Nigeria and not bank credit. In a turn of events, Wang et al. (2020) contend that financial development failed to foster better health in Pakistan, as indicated by the negative elasticity coefficient of the financial development proxy.

While a larger proportion of the prior studies focused on the influence of financial development on health outcomes, a smaller thread of research has focused on the reverse relationship. Testing whether better health outcomes contribute to growth in the financial sector of high-income countries, Kuloğlu and Ecevit (2017) showed that better health outcomes cause financial development. In the same vein, Donou-Adonsou (2022) examined the effect of health outcomes on financial development in sub-Saharan African countries. The

generalized method of moments GMM estimated elasticity coefficients showed that improved health indicated by higher life expectancy and lower infant mortality led to financial sector development in the sub-region.

3. Methodology

3.1. Data Source and Description

For the study's objective, we collected annual time series data sourced from the World Development Indicator database of the World Bank between 1981 and 2020. The choice of scope is believed to be long enough to allow for the achievement of the study's objective of estimating the long-run relationship between the variables of interest. For robust analysis, we adopted two measures of the dependent variables to allow for assessment of the relationship in terms of overall and child health. To this end, health outcomes were proxied by life expectancy at birth (LEX) and infant mortality (INFMOR). On the other hand, the principal explanatory variable, financial development was proxied by financial depth measured by domestic credit to the private sector (DCPS).

Moreover, in order to estimate a health production model void of misspecification error, we took clues from empirical evidence to choose as control variables macroeconomic indicators, which have been identified as significant predictors of health. While our choice of control variables is motivated by prior studies and data availability, we also took into consideration our study context. For both models, we incorporated the level of economic growth measured by Gross Domestic Product growth rate (GDPG) and secondary school enrolment. The wealth is health" argument has been extensively debated in the literature with a near consensus that a country's level of economic development is a significant predictor of its health wellbeing both at micro and macro levels (Or, 2000). Secondary school enrolment (SCH_S) is used to account for literacy level, which has likewise been identified as a key driver of better health (Raghupathi & Raghupathi, 2020). With increased public spending on education in South Africa, school enrolment has been impressive, thus improving literacy in the country. In particular, the share of the population with secondary education rose from 73% in 2008 to 82% in 2018 (OECD, 2019b).

Also, owing to the implication of the burden of disease on morbidity, mortality, and longevity, the human immunodeficiency virus (HIV) is incorporated to account for the burden of infectious disease. Our choice of the epidemic is logical in that South Africa ranks fifth globally in HIV/prevalence rate and has the largest number of people living with the epidemic in the world. Thus, the epidemic has the potential to determine health outcomes in the country. Data on urban proportion of total population (URBP) was employed to account for the degree of urbanization in the model. The health effects of urbanization are established in the literature (Brueckner, 2019; Jemiluyi, 2021) and the rate of urbanization has been rising in South Africa, with about two-third of the population residing in urban centers in 2021 (UN-Habitat, 2023). For the child health model, in addition to income and literacy level, we adopted two other significant drivers of child health in the country, namely immunization (IMMU) and adolescent pregnancy (ADOL) (Barnighausen, Bloom, Canning, & O'Brien, 2008; Noori, Proctor, Efevbera, & Oron, 2022).

3.2. Technique of Estimation

Time series data possess certain attributes that are critical for the selection of appropriate methods of analysis. Important among such attributes is the autoregressive nature of time series, which dictates that the current values of a series may be correlated with its past values. In addition, the order of integration of the series of interest and existence of the cointegrating relationships among the variables are also crucial in determining a suitable methodological framework for a time series analysis.

3.2.1. Stationarity (Unit Root) Test

Failure to uncover the stationarity properties of series of interest prior to estimation may lead to the problem of spurious regression, in which the regression results will suggest the existence of significant relationships among the model's variables when, in the real sense, the variables are uncorrelated. Inferences based on the outcomes of such regressions will be misleading (Pesaran, Shin, & Smith, 2001). Thus, we assessed the unit root property of the series. While conventional unit root tests such as Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) are often used in time series studies, these methods have been criticized on the ground that they are inefficient in handling series with structural breaks (Perron, 1989). Given certain peculiarities of the South African economy cited in the introductory section that are capable of introducing structural breaks into our models and the consequences of ignoring them in our econometric analysis, we tested for the effects of structural changes in our data. Since our break points were known before, we chose the Chow breakpoint test of Chow (1960). Based on the reported F-statistics and the associated levels of significance, we failed not to reject the null of no structural break at all the tested periods, thereby implying the presence of a structural break. Therefore, we chose the unit root with break test as offered by E Views 12 statistical package, which followed the framework of Perron (1989) and Zivot and Andrews (2002). The results for the unit root tests are presented in Table 1.

The results show that break points occurred for all the variables at different periods. For DCPS, the structural change occurred in 2008 during the global financial crisis. This is expected, given the impact of the

crisis on the global financial sector. The data showed that in this period, domestic credit to the private sector as share of GDP fell from 171. 4% in 2007 to 160.6% in 2008. The break point in GDPG in 2019 could be due to the slump in economic activities owing to the impact of the COVID-19 pandemic. Furthermore, the results showed that break points occurred in the data for both measures of health (LEX and INFMOR) in 2001 and 2002, respectively, while for HIV, they took place in 1989 and 1990. In all, the reported t-statistics and the associated probability value revealed that the null hypothesis of unit root was rejected for all the series either at level or at first difference. Specifically, all series, except LEX, DCPS, SCH_S, and URBP are stationary at level. Thus, the variables are a combination of both I (0) and I(1) series.

Table 1. Unit root with structural break.

Variables	At level I(0)	Break year	At 1st difference I(1)	Break year
LEX	3.325	2002	5.120***	2001
INFMOR	6.137***	2007	-----	-----
DCPS	3.327	1991	9.840***	2008
GDPG	4.511**	2019	-----	-----
HIV	5.453***	1989	-----	-----
ADOL	6.775***	1987	-----	-----
IMMU	2.703	2010	9.432***	1994
SCH_S	3.842	1992	6.480***	2014
URBP	3.834	1994	5.699***	1986

Note: *** and ** represent 1% and 5% level of significance respectively.
The absolute values of the t-statistics were reported for all the series.

3.2.2. Cointegration (Bound) Test

Following the confirmation of the stationarity attributes of our variables, we proceeded to test for the existence of cointegration among the variables. The cointegration test examines co-movement among the series over a long period, thus establishing a long-run relationship (Pesaran et al., 2001). For this purpose, we chose the bound cointegration test of Pesaran et al. (2001),which has been adjudged advantageous over other cointegration tests such as Engle-Granger and Johansen cointegration tests owing to its efficiency in testing for cointegration among I(0) or I(1) variables and even combinations of both orders of integration. Therefore, since our model is a mix of I(0) and I(1) variables, it is certain that we adopt the bound test.

With the null hypothesis that there is no cointegration among the regression variables, the bound cointegration test is based on F-statistics. Decisions on the existence of cointegration or otherwise are made by comparing the F-statistics with the associated lower I(0) and upper I(1) critical values. The results of the bound cointegration test for our adopted series are reported in Table 2. For the two models, the null hypothesis of no cointegration among the series was rejected as the reported F-statistics are greater than the upper bound critical values at 1% and 5% levels of significance for the overall and child health models, respectively.

Table 2. Bound cointegration test.

Overall health model: LEX, DCPS, GDPG, SCH_S, HIV, URBP			**Child health model: INFMOR, DCPS, GDPG, SCH_S, IMMU, ADOL**	
F-statistics	14.16		4.40	
K	5		5	
Critical bound values				
Level of significance	Lower bound (I(0))	Upper bound (I(1))	Lower bound (I(0))	Upper bound (I(1))
10%	2.26	3.35	2.26	3.35
5%	2.62	3.79	2.62	3.79
2.5%	2.96	4.18	2.96	4.18
1%	3.41	4.68	3.41	4.68

3.2.3. Autoregressive Distributed Lag Error Correction (ARDL-ECM) Approach.

Consequent upon confirmation that the series are combinations of I(0) and I(1) variables and the cointegration test indicates the existence of a long-run relationship among the series, the Autoregressive Distributed Lag Error Correction (ARDL-ECM) framework of Pesaran et al. (2001) was chosen for the empirical analysis. ARDL has been adjudged efficient in econometric analyses concerned with making inferences from past data. In fact, ARDL provides a robust framework for the analyses involving distributed lagged changes, i.e., changes in an economic variable that are capable of causing changes in other economic variables beyond the current period (Pesaran et al., 2001; Shrestha & Bhatta, 2018). Moreover, its ability to extract long-run relationships from short-run dynamics has also made it appealing for estimating long-run relationships in dynamic single-equation regressions (Harris & Sollis, 2003).

Aside from its flexibility and efficiency in a small sample size, the ARDL-ECM has also been found optimal and more feasible in cointegrating regressions relative to other cointegrating estimators (Pesaran et al., 2001). As opposed to other methods in the family of parametric single-equation cointegration estimators, ARDL model has the capacity to mitigate the second-order asymptotic effects of cointegration. Hence, it performs better in terms of estimation accuracy and sound statistical inferences even in the presence of endogenous variables (Harris & Sollis, 2003).

Following the establishment of structural breaks within the underlying variables, we took this into account in estimating the health production model. Since ARDL-ECM does not factor in the issue of a potential structural break into the system, a dummy variable was incorporated into the model to account for breakpoints in the series. Thus, we followed the modelling style of Bist and Bista (2018), and the empirical model specification is stated thus;

$$HEALTH_t = HEALTH_{t-1} + FINDEV_t + CTRL_t + \varepsilon_t \quad (1)$$

Where HEALTH and FINDEV represent the measures of health outcome and financial development respectively. CTRL represent a vector of the chosen control variables earlier defined.

The unrestricted error correction model of Equation 1 takes the form:

$$HEALTH_t = \partial_0 + \sum_{i=1}^{m} \emptyset_i \Delta HEALTH_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta FINDEV_{t-i} + \sum_{i=0}^{o} \varphi_i \Delta CTRL_{t-i} + \eta_1 HEALTH_{t-1} + \eta_2 FINDEV_{t-1} + \eta_3 CTRL_{t-1} + \eta_4 Dv + \varepsilon_t \quad (2)$$

Δ represents the short-run, thus, ϕ_i, γ_i, and $\psi_i$represent the coefficients of the short-run dynamics while $\eta_1, \eta_2 and \eta_3$ account for the long-run relationships. $Dv$is the dummy variable representing the structural break in the system while the error term at time t is captured as ε_t.

Owing to confirmation of cointegration among the variables, we run an error correction model as suggested by Pesaran et al. (2001).

$$HEALTH_t = \partial_0 + \sum_{i=1}^{m} \emptyset_i \Delta HEALTH_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta FINDEV_{t-i} + \sum_{i=0}^{o} \varphi_i \Delta CTRL_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (3)$$

ECT_{t-1} is the error correction term whose coefficient λ measures the speed of adjustment of the model towards equilibrium.

4. ARDL-ECM Estimation Results and Discussion

The estimated results for two ARDL models (3,4,1,1,1,2) and (4,3,1,3,3,1) are presented in Table 3. In model 1, in which health outcome is represented by infant mortality, the short-run coefficient of FINDEV proxied by DCPS is negative in the immediate period, implying a reducing effect of FINDEV on infant mortality. However, the effect is statistically insignificant. On the contrary, at lags 1 to 3, the coefficients are positive and statistically significant, suggesting a worsening effect of FINDEV on health outcomes by raising death among infants. This is contrary to the argument that FINDEV fosters health through multiple links suggested in the health-finance literature. However, the long-run elasticity coefficient of DCPS shows that development in the financial sector has an improving effect on health outcomes. The statistically significant coefficient suggests that a percentage increase in financial credit will lower the rate of mortality among infants in South Africa by 1.6%. The child health advantage of financial development may be linked to the role of financial development in promoting gender inclusion. While there is still much to be achieved, efforts are in top gear in South Africa to address the issue of gender inequality in finance as more women are being financially included (Financial Sector Conduct Authority (FSCA), 2021).

Hence, with more women having access to financial products, they are able to smooth their income and reduce their vulnerability to shocks, which could result in economic instability. Financially empowered and independent women would be able to make adequate provision for their children's nutrition, housing, and medical care (Abreha & Zereyesus, 2021). In addition, they are able to seek antenatal and postnatal care in standard health facilities with trained personnel's, thereby reducing the risk of antenatal and postnatal complications that could result in mother, foetus, or infant death (Abreha & Zereyesus, 2021; Alinsato, Alakonon, & Bassongui, 2022). Furthermore, with the financial sector supporting the growth of the South African economy, government is able to make huge investments, in infrastructure, including those that are health-oriented, such as health facilities and sanitation systems (Lefatsa, Sibanda, & Garidzirai, 2021; Shahbaz et al., 2019).

Aside from the results being in consonance with the assertion that improvement in the financial system fosters better health conditions, as found by the pioneering research of Claessens and Feijen (2006) and afterwards corroborated by Rosner (2011); Alam et al. (2016), and Rahman and Alam (2022) they are also consistent with findings in the South African literature. While the finance-led growth hypothesis has been supported on one hand (Ehigiamusoe, 2018), the wealth is health argument has also been confirmed in the literature (Salahuddin et al., 2020). Given the South African economy, the financial-led improvement in health outcomes makes sense. Being an important engine of growth, financial development does not only lead to an increase in national income (Ehigiamusoe, 2018), but also raises per capita income through employment and entrepreneurial opportunities (Ajide & Ojeyinka, 2022). As income rises, parents, particularly women, prioritize the welfare of their children, making adequate and quality provision for their children in terms of nutrition, housing, and medical care.

Table 3. ARDL-ECM results.

Variables	Child health (Infant mortality)		Overall health (Life expectancy)	
	Coefficients	Std. error	Coefficients	Std. error
Short-run estimates				
Δ(DCPS)	-0.005	0.009	-0.014**	0.007
Δ(DCPS(-1))	0.060**	0.017	0.026***	0.009
Δ(DCPS(-2))	0.032**	0.015	0.007	0.006
Δ(DCPS(-3))	0.024**	0.009	------	------
Δ(GDPG)	0.072**	0.033	0.062**	0.024
Δ(SCH_S)	0.065**-----	0.024	0.021	0.016
Δ(SCH_S(-1))	-----	-----	-0.131***	0.024
Δ(SCH_S(-2))	-----	-----	-0.081***	0.022
Δ(IMMU)	-0.035**	0.015	------	------
Δ(ADOL)	0.094	0.121	------	------
Δ(ADOL(-1))	-0.168	0.131	------	------
Δ(HIV)	-----	-----	-0.098	0.139
Δ(HIV(-1))	-----	-----	1.089***	0.339
Δ(HIV(-2))	-----	-----	-0.350	0.238
Δ(URBPG)	-----	-----	0.637	0.480
DV	0.036	0.344	-1.965***	0.566
ECT(-1)	-0.059***	0.009	-0.501***	0.047
Long-run estimates				
DCPS	-1.616**	0.669	-0.140***	0.017
GDPG	1.206*	0.637	0.125**	0.047
SCH_S	1.100	0.655	0.407***	0.032
IMMU	-1.121**	0.439	-----	-----
ADOL	-1.608**	0.763	-----	-----
HIV	-----	------	-0.121*	0.061
URBPG	------	-----	1.272	0.982

Note: ***, ** and * represent statistical significance at 1%, 5% and 10% levels of significance. Variables acronyms are as described in data description.

For overall health, represented by life expectancy, the short-run coefficients are mixed, negative in the current period and positive at lags 1 and 2. Moreover, the coefficients are only significant in the current period and at lag 1. Nonetheless, the long-run coefficient of DCPS shows that an increase in bank lending exerts a negative influence on life expectancy. This is consistent with the short-run relationship in the current period. This finding does not only fail to support the rising argument that development in a country's financial system has the potential to promote population health; it is also quite surprising given the stellar financial sector in South Africa (Akinboade & Makina, 2006; World Bank, 2018). Thus, it is expected that following the popular income effect, financial development would spur growth enablers such as industrialization, entrepreneurship, and foreign investment, thereby raising income through increased employment and consequently fostering better health (Donou-Adonsou, 2022; Shi et al., 2022).

However, there's a chance that the outcomes were the product of specific contextual factors. For example, while development in the financial sector could have led to a rise in the nation's per capita income, the increase in income could likewise spur people to engage in lifestyles that are detrimental to healthy living. For instance, rising income tends to promote ostentatious living characterized by an unhealthy diet and alcoholic consumption, which have been associated with an increasing prevalence rate of non-communicable chronic diseases such as obesity and diabetes (Alaba & Chola, 2014). Moreover, cultural and religious beliefs may not encourage people to seek medical care in the event of illness, in spite of rising income. Bosire, Cele, Potelwa, Cho, and Mendenhall (2022) found a heavy reliance on traditional medicine and spiritual treatment plans among South Africans. While the negative influence is in variance with popular opinion, it aligns with the findings of Wang et al. (2020) for Pakistan and part of the findings of Shafiei et al. (2020) and Akintunde and Olaniran (2022) for developing countries and Nigeria, respectively. Shafiei et al. (2020) showed that only bank credit raises life expectancy, while banks saving liabilities have a reducing effect on life expectancy. A reversed assertion was made by Akintunde and Olaniran (2022), who found that only a broad money supply raises life expectancy in Nigeria while credit to the private sector an inhibit increase in life expectancy.

As for other correlates, a percentage rise in economic growth raises life expectancy by 0.06 years in the short-run, while its short run coefficients in the child model show that infant mortality increases with growing income. In both instances, the coefficients are statistically distinguishable from zero. The results are the same in the long run, corroborating the health advantage for life expectancy and health penalty for child health. While the effect on overall health status supports the wealth is health argument (Salahuddin et al., 2020), the child health effect contradicts the stance. Contrary to the established multidimensional linkages of education to better health, the school enrolment short run coefficient suggests that education has an insignificant

worsening effect on child health in the immediate period. According to the life expectancy model, life expectancy increases in the present and decreases at lags 1 and 2. The short run increasing effect is not statistically distinguishable from zero, while the reducing effect is. The negative influence obtained on child health persists in the long run, while it reverses in the case of overall health. The life expectancy model showed that improvement in literacy rate augments health by increasing life expectancy. This resonates with the findings of Raghupathi and Raghupathi (2020), which assert that higher education attainment is associated with better health outcomes and accounts for cross-country variation in health outcomes between developing countries and developed countries with better educational outcomes.

The direction of the relationship between HIV prevalence rate and life expectancy is mixed in the short run. Although it is negative in the current period in line with the consensus in the literature, the coefficient is not significant. In both lags 1 and 2 the coefficients are significant and suggest that rather than HIV exacerbating health conditions, it promotes better health by lengthening life expectancy. However, in the long run, HIV prevalence is negatively correlated to life expectancy, with a percentage increase in the prevalence rate lessening life expectancy by 0.12. The conclusions on the health impact of HIV and acquired immunodeficiency syndrome (AIDS) have been mixed in South Africa. While a number of studies have argued that antiretroviral therapy (ART) has recorded tremendous progress in reducing AIDS-related deaths, and thereby enhancing survival rates (Doan, Shin, & Mehta, 2022), evidence of the deleterious health effect of HIV likewise abounds in the literature (Le Roux et al., 2020; Mba, 2007). South Africa has the world's largest antiretroviral programme. It runs an efficient antiretroviral therapy, including the use of multiple drugs known as highly active antiretroviral therapy (HAART) (UNAIDS, 2020). Meanwhile, the results indicate that urbanization enhances health in the short run, but the coefficient lacks statistical significance. The long-run result is not different from the short run, as the result similarly suggests a non-significant increase in life expectancy in the long run.

For the child health predictors, immunization has a statistically significant negative relationship with infant mortality in the short run, while adolescent pregnancy is positively but insignificantly related to infant mortality. These findings imply that immunization fosters better child health by reducing infant mortality, while adolescent pregnancy raises infant mortality. In the long run, both indicators have beneficial effect on health outcomes, reducing the mortality rate among infants. The beneficial benefit of immunization corroborates the argument that immunization programs reduce mortality among children by offering protection against diseases (Barnighausen et al., 2008). The health advantage effect of adolescent pregnancy contradicts argument that early childbearing in teenagers is associated with a higher risk of child health odds (Le Roux et al., 2020). Moreover, the model error correction term (ECM (-1)), which measures the speed of adjustment towards equilibrium, is correctly signed and statistically significant.

4.1. Post Estimation Diagnostic Tests

To affirm the robustness and consistency of our study's outcomes, the ARDL-ECM models were subjected to post-estimation tests. To be more specific, we checked our models for serial correlation and heteroscedasticity to make sure that the error terms were not linked to the regressors and that the error term variance stayed the same. Using the Breusch-Godfrey LM test and Breusch-Pagan-Godfrey heteroscedasticity test, we failed to reject the null hypotheses of no serial autocorrelation and homoscedasticity of the error term variance, respectively, for both regressions. The results for the diagnostic tests are presented in Table 4.

Table 4. Diagnostic tests.

Tests	Child health model (Infant mortality)	Overall health (Life expectancy)
Breusch-Godfrey serial correlation LM test	1.473 (0.257)	3.785 (0.034)
Heteroscedasticity test: Breusch-Pagan-Godfrey	1.255 (0.315)	1.184 (0.370)
Ramsey RESET test	0.610 (0.549)	0.911 (0.377)
Jarque-Berra normality test	0.377 (0.828)	0.493 (0.782)

Note: Probability values are reported in parentheses alongside the F-statistics.

Furthermore, the absence of an econometric limitation on misspecification was affirmed by the Ramsey reset test. Lastly, we assessed the stability of the estimated parameters for each model using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ). All the models were confirmed stable as the lines are within the 5% critical boundaries as presented in the Appendixes. Figure 1 and 2 exhibit the CUSUM and CUSUMSQ tests, respectively, for the infant mortality regression model. In both cases, the lines lie within the 5% critical boundaries, confirming the stability of the ARDL model (Bahmani-Oskooee & Ng, 2002). In the same vein, the results of the CUSUM and CUSUMSQ tests for the life expectancy model are presented in Figures 3 and 4, respectively. The stability of the estimated model is likewise affirmed by the graph lines.

5. Conclusion

In this study, we sought to investigate the effect of financial development on health outcomes in South Africa using a four-decade dataset spanning from 1981 to 2020. The study contributed to the extant literature in at least two ways. To the best of our knowledge, this is the first attempt to verify the relationship in our country of study, South Africa. Moreover, owing to the peculiarities of our study context, the study considered the issue of structural breakage and accounted for it in the estimated model. The structural break test confirmed the presence of shocks in our model during the study period. Moreover, the regression outcomes of the ARDL-ECM estimator show that financial development as measured by domestic credit to the private sector has differential impacts on health outcomes represented by life expectancy and infant mortality in South Africa. In particular, the regression results show that financial development worsens the overall health proxy of life expectancy and improves child health outcomes measured by infant mortality. This research engages policymakers, especially strategists in the health sector, on the right policy mix to achieve better health outcomes. While the financial development and inclusion drives are ongoing, efforts should be intensified to improve socioeconomic determinants of health, including income, literacy level, and immunization programs. Moreover, policy strategies aimed at fostering better health outcomes by solving national priority health challenges, in particular the HIV/AIDS epidemic and health-risk behaviour, should be logically pursued.

Further contribution to the literature could contemplate time-series analysis of other economies. In addition, the relationship could be assessed within the framework of a comparative analysis of sub-regional or national economies.

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Appendixes

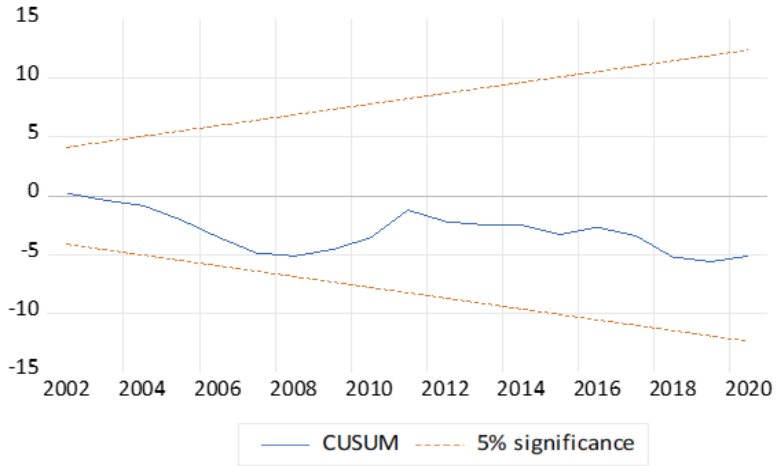

Figure 1. Infant mortality model: CUSUM test.

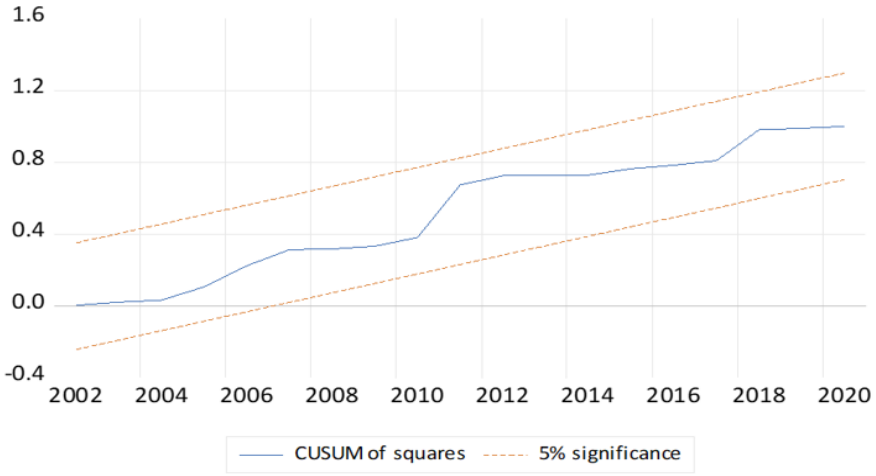

Figure 2. Infant mortality model CUSUM of square test.

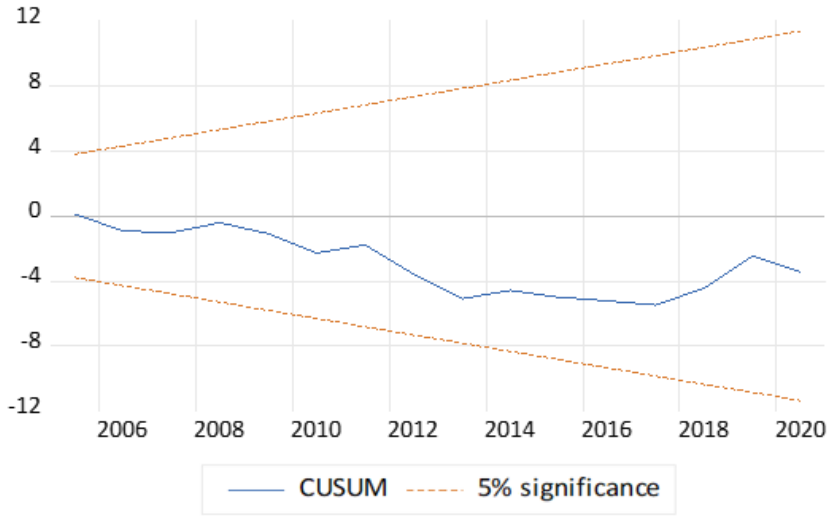

Figure 3. Life expectancy model: CUSUM test.

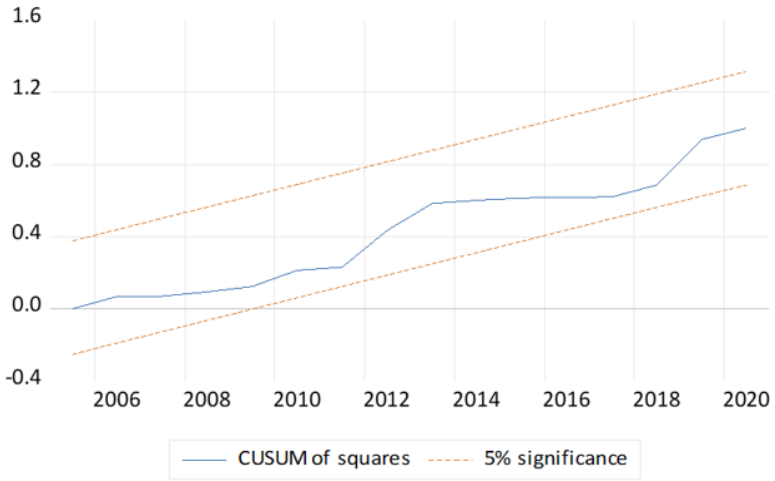

Figure 4. Life expectancy model: CUSUM of square test.