JBEO (2024), 7(4), 1-12.

Journal of Business and Economic Options

Exploring the Link Between Public Health and External Debt in Saudi Arabia

Marc Audi[a], Yannick Roussel[b]

Abstract

This research represents the first study to investigate the relationship between life expectancy and external debt—both short-term and long-term—in the context of Saudi Arabia. Spanning the period from 1974 to 2023, the study aims to analyze how fluctuations in external debt levels may influence public health outcomes, specifically life expectancy, in the country. By focusing on both short-term and long-term debt, this study examines their direct effects on life expectancy, providing valuable insights into how national debt strategies may impact the well-being of the population. This analysis is crucial for policymakers seeking to understand the broader socio-economic consequences of debt accumulation and its potential influence on the quality of life in Saudi Arabia. The results of this study confirm the existence of a long-term relationship between life expectancy and external debt, both short-term and long-term, in Saudi Arabia. The findings reveal a unidirectional causal relationship, where changes in life expectancy influence both short-term and long-term external debt. However, no evidence of a causal relationship was found running from external debt to life expectancy. These results suggest that improvements or declines in life expectancy may have an impact on the country's debt levels, but the reverse effect—where debt levels influence life expectancy—was not observed in this analysis. As a result, Saudi Arabia has required external funding to support its investments, and this need persists today. There has been a consistent gap between investments and savings in the country, which Saudi Arabia may have addressed by utilizing external debt to bridge this gap. This study suggests that further research is needed to explore the direct relationship between external debt and life expectancy, particularly in the context of developing countries.

Keywords: Life Expectancy, External Debt, Saudi Arabia

JEL Codes: I15, H63, O53

Received: 10-09-2024 **Revised: 09-12-2024** **Online Published: 25-12-2024**

1. INTRODUCTION

Public health is a critical factor in the overall development and well-being of any nation. In recent years, the relationship between economic factors and public health outcomes has gained significant attention among researchers and policymakers (Ali & Ahmad, 2014; Ali & Audi, 2016; Audi & Ali, 2017; Mordecai & Akinsola, 2021; Ali et al., 2021; Mudrazija & Butrica, 2021; Senturk & Ali, 2021; Audi & Ali, 2023; Hu et al., 2024; Moon et al., 2024). External debt, as a key economic indicator, can influence public health systems by affecting the allocation of resources and government priorities (Ali & Sajid, 2020; Roy & Madheswaran, 2020; Audi et al., 2021; Ahmad, 2022; Ali, 2022; Batty et al., 2022; Omri, 2022; Stickley et al., 2023; Ali & Mohsin, 2023; ven Zaden, 2023; Neves et al., 2024; Sinha et al., 2024). This study aims to analyze the impact of long-term external debt and short-term external debt on life expectancy, with a focus on the role of foreign direct investment. The study follows the approach of Alam et al. (2016), who examined Pakistan's economic dynamics. FDI and trade openness positively affected life expectancy, and there was unidirectional causality from FDI and trade openness to LEP. According to their study, this was the first analysis to investigate the relationship between LEP, TO, and FDI in Pakistan. Building on this framework, the current study replaces trade openness with external debt by disaggregating it into its two main components: long-term external debt and short-term external debt. External debt is examined through these subcomponents, where EXTL refers to debt with an original or extended maturity of more than one year, including public, publicly guaranteed, and private nonguaranteed debt. EXTS, on the other hand, refers to debt with an original maturity of one year or less.

In addition to the work by Alam et al., similar studies have explored the relationship between external debt and various socio-economic factors. For example, Saungweme and Mufandaedza (2013) examined the link between external debt and poverty in Zimbabwe from 1980 to 2012. Their findings revealed that income per capita and infant mortality rate had a negative relationship, while income per capita and life expectancy showed a positive relationship. Similarly, Loko et al. (2003) found that external debt significantly impacted poverty in low-income countries. N'zue (2020) analyzed the relationship between external debt, GDP, and economic growth in the ECOWAS region from 1990 to 2016, finding that external debt positively

[a] Abu Dhabi School of Management, Abu Dhabi, UAE

[b] The European School of Leadership & Management, Belgium

affected economic growth up to a certain threshold. In contrast, studies by Babu et al. (2014), Clements et al. (2003), and Malik et al. (2010) revealed a negative relationship between economic growth and the external debt ratio. On the other hand, Soyres et al. (2019), Kharusi and Ada (2018), and Çiftçioğlu and Sokhanvar (2018) found positive correlations between economic growth and the external debt ratio. Zaghdoudi (2018) examined the relationship between the Human Development Index (HDI) and external debt (ET) for a panel of 95 developing countries from 2002 to 2015. Zaghdoudi found that, up to a certain level of external debt, it had a positive impact on the HDI. However, once this threshold was surpassed, external debt began to negatively affect the HDI. Based on these findings, Zaghdoudi provided recommendations for countries with low and high external debt levels to manage their debt more effectively. In a similar vein, Sheikh and Alam (2013) investigated the impact of external debt on poverty in Pakistan from 1985 to 2010, concluding that external debt had a significant positive effect on poverty. Novignon et al. (2012) focused on the relationship between health status and vulnerability to poverty in Ghana, finding that poor health had a significant effect on vulnerability to poverty. Several theoretical frameworks have been examined in the literature to understand the economic consequences of external debt. The debt overhang hypothesis suggests that a significant debt burden can prevent an entity or country from taking on additional debt to finance new projects or investments. The dual gap theory posits that the development of developing countries is constrained by two main gaps: the gap between exports and imports, and the gap between domestic savings and investment. The crowding-out hypothesis suggests that government domestic borrowing drives up interest rates, thereby reducing or eliminating private sector investment and spending. In the context of population health studies, literature has explored various nexuses, including trade openness and population health, growth and population health, foreign aid and population health, FDI and population health, FDI and trade openness, determinants of FDI, FDI, and sustainable development, imports of medical products and population health, and the determinants of life expectancy. This study specifically investigates the relationship between population health, and external debt in Saudi Arabia. The relationship between life expectancy, long-term external debt, and short-term external debt is examined using the Augmented Distributed Lag model, as introduced by Pesaran et al. (2001). This model allows for the analysis of both short- and long-term relationships between the variables while accounting for possible lags in their effects. In addition, symmetric cointegration is tested to determine if there exists a stable, long-term equilibrium relationship between life expectancy and the two types of external debt. Given that cointegration is confirmed between the variables through the ARDL approach, the study then applies the Toda and Yamamoto (1995) model to investigate the causal relationships among them. The Toda and Yamamoto model is particularly useful in examining the direction of causality in time series data, even when variables may be integrated at different levels. By applying this model, the study aims to explore whether changes in life expectancy drive variations in external debt, or if external debt levels (both long-term and short-term) influence life expectancy outcomes. This methodology allows for a comprehensive understanding of how external debt affects life expectancy in both the short term and long term, while also providing insights into the potential causal pathways between these variables.

2. LITERATURE REVIEW

Bussmann (2009) examined the impact of trade openness on various aspects of female well-being, including female life expectancy, female education, female labor force participation, and the distribution of women across sectors. The study analyzed data from 134 countries over the period 1970 to 2000. Bussmann found that trade openness had no significant direct effect on female life expectancy. Specifically, TO did not appear to influence women's LEP in a meaningful way. However, trade openness was found to have a positive impact on female education, particularly in terms of increasing attendance levels. Bussmann also separated the data by gender to assess the differential effects of TO on men and women. The analysis revealed that, in developed countries, TO had a negative effect on female labor force participation, while no significant difference was found between the effects of TO on male and female labor force participation. Overall, while TO did not directly impact female life expectancy, it played a role in improving female education, though its effect on labor force participation was more complex. Stevens et al. (2013) conducted a study investigating the relationship between trade openness and health outcomes for a panel of countries between 1970 and 2005. Stevens, Urbach, and Wills found that trade openness had a positive impact on health outcomes, specifically in reducing infant mortality rates, including both the under-one and under-five infant mortality rates. Furthermore, the researchers found that TO was positively correlated with life expectancy for both men and women. However, the effect of TO on life expectancy was found to be stronger for women than for men.

The study also revealed that an increase in gross domestic product (GDP) per capita had a dampening effect on the positive relationship between trade openness and health outcomes. This suggests that while TO can improve health outcomes and life expectancy, economic growth may reduce the direct benefits of trade openness on these indicators. Owen and Wu (2007) explored the relationship between trade openness and various health outcomes, including infant mortality (IM), life expectancy at birth (LEP) for females, and LEP for males, using a panel of 219 countries over the period from 1960 to 1995. Their findings indicated that trade openness had a positive impact on both infant mortality and life expectancy for both females and males. Notably, the study revealed that the effect of TO on female life expectancy was stronger than that on male life expectancy, particularly in the poorest countries. To understand the mechanisms behind the positive relationship between trade openness and health outcomes, Owen and Wu investigated potential channels. They confirmed that the increased availability of vaccinations, facilitated by trade openness, contributed positively to health improvements. However, the study found no evidence supporting the idea that the import of pharmaceutical products played a significant role in explaining the positive health outcomes associated with TO. Interestingly, Owen and Wu concluded that the increase in pharmaceutical imports to developing countries was driven more by poor health outcomes rather than by trade openness itself.

Levine and Rothman (2006) also examined the relationship between trade openness and child health across a panel of 130 countries. Their study found that TO had a positive impact on several child health indicators, including infant mortality, child mortality, malnutrition, and life expectancy. This further supports the notion that trade openness can contribute to better health outcomes, particularly in the context of child health. Herzer (2015) focused specifically on the United States, using the ARDL model to analyze the relationship between trade openness and life expectancy at birth over the period 1960–2011. Herzer found that trade openness had a positive impact on life expectancy, and confirmed the presence of long-run causality running from trade openness to life expectancy. This suggests that, over time, increased trade openness could contribute to improvements in life expectancy in the U.S. Both Stevens et al. (2013) and Owen and Wu (2007) observed that the relationship between trade openness and health outcomes is nonlinear. This implies that the impact of trade openness on health outcomes may vary at different levels of economic development or trade exposure, highlighting the complex nature of this relationship. Herzer (2014) examined the effect of trade openness (TO) on life expectancy (LEP) and infant mortality (IM) for a panel of 74 countries over the period from 1960 to 2010. Herzer's study found that the impact of trade openness on health outcomes was more pronounced in less developed and less regulated countries. Additionally, the study revealed bi-directional causality between trade openness and life expectancy, suggesting that improvements in life expectancy could, in turn, influence a country's openness to trade. Herzer identified six key channels through which trade openness affects health outcomes: income, inequality, access to healthcare, insecurity, pollution, and foreign aid. These channels highlight the complex ways in which trade openness can impact public health, both directly and indirectly. Talukdar and Parvez (2017) explored the long-run relationship between life expectancy, trade openness, and foreign direct investment (FDI) for 46 developing countries over the period 1996 to 2011. Their findings confirmed that both life expectancy and trade openness had a positive effect on gross FDI inflows in the long run. This suggests that improvements in health outcomes and increased trade openness can attract greater foreign investment, contributing to economic growth. Qadir and Majeed (2018) conducted a study on the impact of trade openness on life expectancy and infant mortality in Pakistan, using data from 1975 to 2016. Their study concluded that trade openness had a negative impact on both life expectancy and infant mortality in the country, suggesting that the relationship between trade openness and health outcomes may be context-dependent and vary by country.

Ling et al. (2017) investigated the relationship between life expectancy, GDP per capita, exports, and imports in Malaysia, using data from 1960 to 2014. Their study found that life expectancy had a positive impact on GDP per capita, exports, and imports in the long run. Conversely, they also found that GDP per capita, imports, and exports had a positive effect on life expectancy over the long term. The study further confirmed unidirectional causality from trade openness to life expectancy, unidirectional causality running from imports to life expectancy, and bi-directional causality between economic growth and life expectancy in the long run. These findings suggest a complex interplay between trade openness, economic growth, and health outcomes in Malaysia. Croix and Licandro (1999) investigated the dynamics between life expectancy (LEP) and economic growth, finding that the effect of life expectancy on economic growth varied by the level of development. Specifically, they found that in economies with low levels of life expectancy, increases in life expectancy had a positive impact on economic growth. However, for more developed economies, the effect of life expectancy on growth could be negative, suggesting that the relationship between life expectancy and economic growth may depend on a country's stage of development and the specific economic context.

Acemoglu and Johnson (2007) explored the relationship between population, GDP, and life expectancy, concluding that while life expectancy had a positive effect on population growth, it did not have a significant positive effect on GDP. In fact, their findings suggested that improvements in life expectancy may have actually lowered economic growth in some cases. This challenges the conventional view that better health outcomes always lead to higher economic growth, highlighting the complexities of the relationship between health and economic development. Azomahou et al. (2009) conducted a panel study of 18 countries to examine the relationship between GDP per capita growth and life expectancy at birth over the period from 1820 to 2005. Their results showed that the relationship between GDP and life expectancy was increasing and concave, indicating that while improvements in life expectancy are associated with higher economic growth, the marginal effect of life expectancy on GDP diminishes as life expectancy increases. This suggests that the benefits of longer life expectancy on economic growth may decrease at higher levels of health and development.

Cervellati and Sunde (2011) analyzed the relationship between income per capita and life expectancy, taking into account the demographic transition across different countries. They found that life expectancy had a negative effect on income per capita in pre-transitional countries, where populations were still characterized by high birth rates and low life expectancy. However, in countries that had experienced the onset of demographic transition by 1940, life expectancy positively affected income per capita. Their study suggested that the effects of life expectancy on economic growth and income are strongly influenced by a country's stage in the demographic transition, with post-transitional countries (those with higher life expectancy and lower birth rates) showing a more positive relationship between life expectancy and income. Mahumud et al. (2013) investigated the impact of GDP per capita and healthcare expenditure on life expectancy in Bangladesh over the period 1995 to 2011. Their study found that both higher economic growth and increased healthcare expenditure positively affected life expectancy. This suggests that economic growth and public investment in healthcare are crucial for improving health outcomes in developing countries like Bangladesh. Kunze (2014) examined the nonlinear relationship between life expectancy and economic growth using an overlapping generations model. The study, which covered 107 developed and developing countries, concluded that higher life expectancy might reduce investments in human capital, which in turn could have an ambiguous or negative effect on economic growth. This suggests that while longer life expectancy may improve public health, it could also lead to lower incentives for human capital investment, thereby dampening its potential positive effects on economic growth.

Ngangue and Manfred (2015) investigated the relationship between gross national income (GNI) per capita and life expectancy (LEP), incorporating human capital, gross fixed capital formation, and good governance as additional variables. Their study focused on 141 developing countries over the period 2000–2013. The results indicated that LEP had a positive effect on income growth in both low-income and high-income developing countries. However, for middle-income developing countries, LEP did not significantly affect income growth, suggesting that the relationship between health and economic growth may vary depending on a country's income level. Aghion et al. (2011) explored the effect of life expectancy on economic growth in OECD countries over the period 1960–2000. Their study found that LEP had a positive impact on economic growth, with a significant contributor being the decline in mortality rates for individuals under the age of 40. The researchers also confirmed that this positive relationship between LEP and economic growth extended beyond OECD countries to a broader sample of developed and developing nations. Furthermore, Aghion, Howitt, and Murtin found that both economic growth and exports positively affected LEP, highlighting the bidirectional nature of the relationship between health and economic performance. Cervellati and Sunde (2011) analyzed the relationship between LEP and economic growth across a sample of countries, taking into account the role of demographic transition. They confirmed that improvements in life expectancy positively affected economic growth, but emphasized that the strength of this effect depended on a country's position in the demographic transition process. In countries that had already undergone significant demographic changes (i.e., declining birth and death rates), the positive impact of life expectancy on economic growth was more pronounced. Bloom et al. (2014) also affirmed that improvements in population health have a positive effect on economic growth. Their study emphasized that better health outcomes lead to a healthier and more productive workforce, which in turn drives economic expansion. Howitt (2005) outlined several key channels through which health outcomes can impact economic growth, including increased productive efficiency, longer life expectancy, enhanced learning capacity, greater creativity, better-coping skills, and reductions in inequality. These factors collectively contribute to higher levels of human capital and overall economic development.

Ebenstein et al. (2015) investigated the relationship between health, pollution, and income in China for the period 1991–2012. Using various measures of life expectancy, including LEP at birth, LEP at age five, and age-adjusted death rates from cardiorespiratory and other causes, the study concluded that counties in China with greater levels of pollution experienced slower improvements in life expectancy. This suggests that environmental factors, such as pollution, can significantly hinder health progress, even as income levels rise. Williamson (2008) conducted a panel study of 208 countries over the period 1973–2004 to assess the impact of foreign health aid on health outcomes, including life expectancy, DPT and measles immunization rates, and infant mortality. The study found that foreign health aid did not significantly affect health outcomes, suggesting that other factors, such as domestic health policy or infrastructure, may play a more critical role in improving public health. Wilson (2011) investigated the impact of development assistance for health and water aid on infant mortality (IM) rates across a panel of 74 countries. The study found no significant effect of health and water aid on reducing infant mortality in the countries examined, suggesting that the effectiveness of aid programs may vary depending on the specific context and implementation strategies.

Herzer and Nagel (2015) examined the relationship between health aid and life expectancy in a panel of 42 countries over the period 1982–2012. They found long-run causality running from health aid to life expectancy, indicating that, over time, health aid has a positive effect on health outcomes. In the short run, health aid had a positive and significant impact on life expectancy. However, in the long run, health aid had a negative and significant effect on life expectancy, suggesting that while short-term health aid can improve public health, its long-term effects may be more complex and potentially counterproductive. Giammanco and Gitto (2019) explored the relationship between foreign direct investment (FDI) and health outcomes in 28 European countries over the period 2000–2013. They found that public health expenditure, as a percentage of total health expenditure, had a positive effect on inward FDI stocks, while the percentage of out-of-pocket expenditure in total private healthcare expenditure negatively affected inward FDI stocks. Additionally, they confirmed that better population health positively influenced the inflow of FDI, suggesting a link between improved health outcomes and the attractiveness of a country for foreign investment. Herzer and Nunnenkamp (2012) examined the long-term effects of net FDI inflows on life expectancy (LEP) in developed countries over the period 1970–2009. Their study found that net FDI inflows had a significant negative effect on LEP in the long run across the panel of countries. This suggests that while FDI may contribute to economic growth, it may also have unintended negative effects on health outcomes in developed nations.

Nagel et al. (2015) investigated the relationship between FDI and population health across a panel of 179 countries for the period

1980–2011. Their study confirmed a nonlinear relationship between FDI and health outcomes. Specifically, they found that the real stock of FDI had a positive effect on the infant mortality (IM) rate in low-income countries but a negative effect on IM in high-income countries. This highlights that the impact of FDI on health is contingent on a country's income level, with high-income nations benefiting more from FDI in terms of health outcomes. Alsan et al. (2006) confirmed that life expectancy (LEP) positively influenced the gross inflow of FDI in a panel of 51 low- and middle-income countries. Their study suggests that healthier populations are more likely to attract foreign investment, reinforcing the idea that improved health outcomes create a more favorable investment climate. Burns et al. (2017) examined the relationship between FDI and overall health in 85 low- and middle-income countries over the period 1974–2012. Their study found that FDI inflows had a positive impact on LEP and adult mortality, but had an insignificant effect on infant mortality rates (IMR) under 5. This indicates that while FDI may improve some health outcomes, its impact on infant health is less pronounced.

Shahid et al. (2019) investigated the relationship between health, income, and FDI in Pakistan, India, Bangladesh, Nepal, Bhutan, and Sri Lanka over the period 1990–2016. Using panel data and fixed-effects models, they found that income had a negative impact on IMR in the panel countries. Moreover, FDI, urbanization, the number of physicians, and secondary and tertiary education were found to positively affect life expectancy in the region, suggesting that investments in healthcare and education can improve health outcomes. Sharma and Gani (2007) analyzed the relationship between FDI and human development in low- and middle-income countries over the period 1975–1999. Using the Human Development Index (HDI) as a proxy for human development, they found that FDI positively but insignificantly affected HDI in both low- and middle-income countries. They also concluded that human development significantly and positively affected FDI inflows in low-income countries but had an insignificant effect in middle-income countries, highlighting the importance of human development in attracting foreign investment. Zhuang (2017) investigated the effect of FDI on human capital in a panel of 16 East Asian countries from 1985 to 2010. The study found that cumulative FDI inflows had a positive impact on secondary schooling but a negative impact on tertiary education. FDI from OECD countries, however, had a positive effect on both secondary and tertiary schooling, suggesting that different sources of FDI may have varying effects on human capital development. Gökmenoğlu et al. (2018) examined the effect of FDI on the determinants of the Human Development Index (HDI), including school enrollment, LEP at birth, and GDP per capita, in Nigeria for the period 1972–2013. The study confirmed a long-run relationship between these variables and found bi-directional causality between FDI and LEP. Additionally, unidirectional causality was observed from FDI to GDP per capita, suggesting that FDI not only influences health outcomes but also drives economic growth in Nigeria. Alam et al. (2016) analyzed the impact of FDI and trade openness (TO) on life expectancy (LEP) in Pakistan for the period 1972–2013. Their study found cointegration between the variables and concluded that both FDI and trade openness positively affected life expectancy. Moreover, FDI and trade openness were found to have a short-run causal effect on LEP, indicating that international economic factors can directly improve health outcomes in the country.

Idrees and Bakar (2019) investigated the impact of FDI on life expectancy and infant mortality rates (IMR) under 5 in Pakistan for the period 1980–2017. Their study identified a long-run relationship between FDI, trade openness, secondary school enrollment, LEP, and IMR. They found that FDI, trade openness, and secondary school enrollment increased LEP in the long run, while these factors also contributed to a decrease in IMR under 5. However, government expenditure on health had an insignificant impact on both LEP and IMR in the long run, suggesting that other factors, such as education and trade, play a more significant role in improving health outcomes in Pakistan. Aizenman and Noy (2006) analyzed the relationship between foreign direct investment (FDI) and trade openness (TO) for a panel of 205 countries by decomposing FDI and TO into their components. Their basic regression results showed that for developing countries, both TO and economic growth had a positive impact on FDI gross flows. In contrast, TO had no significant impact on FDI gross flows for industrialized countries, while economic growth positively influenced FDI gross flows in industrialized countries. They also found that TO had a positive effect on FDI net inflows for both developing and industrialized countries. However, TO did not affect FDI net outflows in either group of countries. The study revealed bidirectional causality between TO and FDI gross flows, highlighting the mutual reinforcement between trade openness and foreign investment.

Martens (2008) conducted a review of 21 studies from the literature on the relationship between trade and FDI. He found that FDI and trade were complementary to each other, with most studies in the literature showing a bidirectional causal relationship between FDI and trade. Martens argued that trade liberalization and foreign direct investment often go hand in hand, as FDI is frequently explained by the presence of trade agreements or liberalization. Shah and Khan (2016) examined the relationship between trade liberalization and FDI inflows for a panel of countries, including Brazil, China, India, Mexico, the Russian Federation, and Turkey, over the period 1996–2014. Their study found that factors such as population size, GDP per capita, primary education attainment, and preferential trade agreements positively influenced FDI inflows in these countries. On the other hand, regional trade agreements had an insignificant negative effect on FDI inflows, while TO had an insignificant positive effect. These findings suggest that while economic size and trade agreements are important determinants of FDI, the role of regional trade arrangements may be more complex or less direct in influencing FDI flows. Binh and Haughton (2002) explored the effects of the bilateral trade agreement between the United States and Vietnam on FDI inflows. They found that FDI inflows to Vietnam would have been up to 30% higher in the presence of a bilateral trade agreement compared to a scenario without such an agreement. This indicates that trade agreements can be a significant driver of FDI, especially in developing countries.

Goldar and Banga (2007) examined the impact of trade liberalization, specifically import liberalization, on FDI net inflows for a panel of 78 industries in India between 1991 and 1998. Their study found that trade liberalization had a positive impact on new FDI flows, suggesting that the liberalization of imports can attract more foreign investment by improving the market environment and fostering competition. Asiedu (2002) investigated the determinants of FDI for a sample of 71 countries. She found that higher returns on investment and better infrastructure positively influenced FDI in non-Sub-Saharan African (SSA) countries, but had no significant impact on FDI in SSA countries. Asiedu also confirmed that TO positively influenced FDI in both non-SSA and SSA countries, but the impact was notably higher in non-SSA countries, indicating that the benefits of trade openness are more pronounced in regions with better economic fundamentals and infrastructure. Addison and Heshmati (2003) examined the determinants of FDI inflows for a sample of 110 countries and separately for 39 countries. Their findings showed that economic growth, TO, democracy, and advancements in information and communication technology (ICT) had a positive impact on FDI inflows. In contrast, industrialization and indebtedness negatively impacted FDI inflows. The study also found regional variation in these determinants, suggesting that the effect of FDI determinants can vary significantly across different geographical contexts.

Azemar and Desbordes (2008) focused on the determinants of FDI inflows to Sub-Saharan Africa (SSA) and developing regions. Their study found that the widespread presence of HIV in SSA countries reduced net FDI inflows by approximately 3.5% for every 1% increase in HIV prevalence. Similarly, malaria was found to have a negative effect on net FDI inflows. This indicates that poor health outcomes in developing countries can deter foreign investment, as they may be perceived as riskier investment environments. Greenaway et al. (2007) examined the determinants of FDI inflows for a panel of 54 countries over the period 1990–2000. They found that TO had a positive impact on FDI inflows in both closed and open economies. However, while FDI inflows had no significant impact on economic growth in closed economies, they had a positive effect on economic growth in open economies, suggesting that trade liberalization and openness to foreign investment can facilitate economic development. Tvaronavičienė and Lankauskienė (2011) investigated the effect of FDI on sustainable development indicators and economic growth. They found that FDI can be a driver of sustainable development by contributing to economic growth, technology transfer, and improvements in human capital. The study highlighted the need for countries to leverage FDI as a tool for achieving long-term development goals, with a focus on balancing economic growth with environmental sustainability and social well-being.

3. METHODOLOGY

Following an extensive literature review, (Ali & Ahmad, 2014; Ali & Audi, 2016; Audi & Ali, 2017; Mordecai & Akinsola, 2021; Ali et al., 2021; Mudrazija & Butrica, 2021; Senturk & Ali, 2021; Audi & Ali, 2023; Hu et al., 2024; Moon et al., 2024; Ali & Sajid, 2020; Roy & Madheswaran, 2020; Audi et al., 2021; Ahmad, 2022; Ali, 2022; Batty et al., 2022; Omri, 2022; Stickley et al., 2023; Ali & Mohsin, 2023; ven Zaden, 2023; Neves et al., 2024; Sinha et al., 2024) the model of our study become as:

LEP=f(FDI, EXTS, EXTL)

LEP is the life expectancy at birth in Saudi Arabia. FDI is net inflows in current. The variables are used in log form in the analysis. EXTL is a long-term external debt stock in current$. EXTS is short-term external debt stocks in the current. The data for the variables is taken from the World Bank’s website. The time period for the analysis is from 1974 to 2023.

4. RESULTS AND DISCUSSION

Table 1 shows the results of the Zivot-Andrews unit root test, which is used to determine whether a time series has a unit root while accounting for potential structural breaks. The test examines whether the series is stationary at its level (I(0)) or after first differencing (I(1)), and it identifies the year in which a structural break occurs. For the LEP variable, the structural break occurred in 1991. The test suggests that the series is not stationary at its level (I(0)), as the t-statistic does not meet the significance threshold. However, when the series is differenced, it becomes stationary, with a highly significant t-statistic indicating that LEP is stationary after first differencing (I(1)). For the FDI variable, the structural break occurred in two years: 1988 for the level test and 2008 for the first differencing test. The t-statistic for the I(0) test indicates that the series might be stationary at its level, but the t-statistic for the I(1) test is highly significant, confirming that FDI is stationary after first differencing. This suggests that FDI could be stationary either at level or after differencing, depending on which test is applied. For the GEXTL variable, the break occurred in 1985. The test indicates that the series is stationary at its level (I(0)), as the t-statistic is highly significant. Similarly, the GEXTS variable, with a break in 2001, also shows a significant t-statistic at the level test, indicating that it is stationary at I(0). In summary, the analysis reveals that while LEP requires differencing to achieve stationarity, GEXTL and GEXTS are stationary at their level. FDI might be stationary either at level or after difference, depending on the test applied. The structural breaks identified in the series provide important context for understanding the time series' behavior.

Table 2 presents the diagnostic test outcomes for an Autoregressive Distributed Lag (ARDL) model, with a structural break identified in 1991. These tests are crucial for assessing the validity and reliability of the model, as they examine various potential issues such as normality of residuals, heteroscedasticity, autocorrelation, and functional form misspecification. The first test listed is for normality, which is evaluated using the Jarque-Bera (JB) statistic. The probability value associated with the test is 0.4027. Since this value is considerably higher than the typical significance level of 0.05 or 0.01, it suggests that there is no significant evidence against the normality assumption. In other words, the residuals of the model appear to follow a normal distribution, which is an important assumption in many econometric models. The absence of significant deviations from normality strengthens the reliability of the model's results. Next, the Breusch-Pagan-Godfrey test is conducted to check for heteroscedasticity, which refers to the possibility that the variance of the error terms changes over time. The test produces an F-statistic of 0.3291, with a probability value of 0.9586. This very high probability value indicates that there is no significant evidence of heteroscedasticity in the model. In other words, the variability of the residuals does not appear to vary systematically with time, which suggests that the model's error terms are homoscedastic, or constant in variance.

Table 1: Zivot-Andrews unit root test results

		I(0)		I(1)
Variable	Break	t-statistic	Break	t-statistic
LEP	1991	−2.876272	1991	−11.99568*
FDI	1988	−4.535957	2008	−6.749532*
GEXTL	1985	−5.482989*		
GEXTS	2001	−5.686696*		

The ARCH test, which checks for autoregressive conditional heteroscedasticity, is another important diagnostic. It tests whether there are time-varying volatilities in the residuals. The F-statistic from this test is 2.2629, with a probability value of 0.0988. Although the probability is above the 0.05 significance threshold, it is relatively close, meaning that while there is no strong evidence for heteroscedasticity, there may be slight evidence of time-varying volatility. However, the test does not indicate a significant problem with the residuals' volatility, suggesting that the model's error terms are not overly volatile over time. The White test, another test for heteroscedasticity, produces an F-statistic of 0.3430 with a probability of 0.9529. The very high probability value again indicates no significant evidence of heteroscedasticity. This result reinforces the findings from the Breusch-Pagan-Godfrey test and provides additional support that the model does not suffer from problems related to varying error variances. The Ramsey RESET test is used to assess whether the functional form of the model is misspecified. A misspecified model might omit important variables, include irrelevant ones, or incorrectly model the relationships between variables. The F-statistic for the Ramsey RESET test is 0.8511, and the corresponding probability value is 0.3636. Since the probability is much higher than the 0.05 significance level, we fail to reject the null hypothesis of no misspecification. This suggests that the functional form of the model is appropriate and that no significant variables have been omitted or incorrectly included. The correlation test is designed to detect autocorrelation in the residuals, which occurs when error terms are correlated over time, violating the assumption of independence. The F-statistic for this test is 0.4552, with a probability value of 0.7157. Given the high probability, there is no significant autocorrelation in the residuals, meaning that the errors from one period are not correlated with those from another period. This is important for the validity of standard errors and test statistics in time series models. Lastly, the Durbin-Watson statistic, which is a commonly used test for first-order autocorrelation in the residuals, is reported as 1.9705. The Durbin-Watson statistic ranges from 0 to 4, with a value near 2 indicating no first-order autocorrelation. Since the value here is close to 2, it further supports the conclusion that there is no significant first-order autocorrelation in the residuals, which is a positive result for model stability. The results of the diagnostic tests indicate that the ARDL model performs well in terms of the standard assumptions. There is no significant evidence of normality violations, heteroscedasticity, autocorrelation, or model misspecification. The residuals appear to be well-behaved, and the model is stable and reliable for further analysis. This suggests that the ARDL model is a valid tool for examining the relationships between the variables of interest, and the findings from the model can be interpreted with a high degree of confidence.

Table 2: ARDL Outcomes

Break		1991		
Stability test	F-stat	Prob.	JB	Stat.
Normality	-	0.817620	0.402716	-
Breusch-Pagan- Godfrey	0.329077	0.9586	-	-
Arch	2.262883	0.0988	-	-
White	0.343005	0.9529	-	-
Ramsey	0.851119	0.3636	-	-
Correlation	0.455184	0.7157	-	-
Durbin-Watson	-	-	-	1.970461

Table 3 provides the outcomes of the Bounds Test for the ARDL model, a method used to determine whether a long-term relationship exists between the variables being studied. This test involves comparing the computed F-statistic with critical values for two bounds: the lower bound, which assumes stationarity in levels, and the upper bound, which assumes stationarity in first differences. The computed F-statistic is 40.87438. The lower bound critical value is 4.29, while the upper bound critical value is 5.61. The F-statistic is significantly higher than both bounds, particularly exceeding the upper bound. This result indicates strong evidence against the null hypothesis of no cointegration, suggesting the existence of a long-run equilibrium relationship among the variables in the ARDL model. The results of the Bounds Test strongly support the presence of a long-run relationship. This implies that while short-term variations may occur, the variables under study are tied together in the long run, maintaining a stable equilibrium over time.

Table 3: ARDL Short Run

Bounds Test	F-Statistic	I0 Bound	I1 Bound
	40.87438	4.29	5.61

Table 4 presents the long-run coefficients from the ARDL model, providing estimates of the relationship between the dependent variable and several independent variables. Along with the coefficients, the table also reports the standard errors, t-statistics, and p-values, which are useful for assessing the statistical significance of each variable in the long run. For the variable GFDI, the estimated coefficient is 0.014591, with a standard error of 0.005147. The t-statistic for GFDI is 2.835032, and the associated p-value is 0.0080. Since the p-value is less than 0.05, we can conclude that GFDI has a statistically significant positive effect on the dependent variable in the long run. Specifically, a 1-unit increase in GFDI is associated with an increase of approximately 0.0146 in the dependent variable. For EXTL, the coefficient is 0.026213, with a standard error of 0.012569. The t-statistic for EXTL is 2.085439, and the p-value is 0.0454. Again, the p-value is less than 0.05, indicating that EXTL also has a statistically significant positive effect on the dependent variable. A 1-unit increase in EXTL is expected to increase the dependent variable by approximately 0.0262.
For EXTS, the coefficient is -0.018595, with a standard error of 0.007442. The t-statistic is -2.498458, and the p-value is 0.0180. Since the p-value is below 0.05, we conclude that EXTS has a statistically significant negative effect on the dependent variable. A 1-unit increase in EXTS is associated with a decrease of approximately 0.0186 in the dependent variable in the long run. The variable D1991 represents a dummy variable for the year 1991, with a coefficient of 0.045821 and a standard error of 0.008044. The t-statistic is 5.696264, and the p-value is 0.0000. The highly significant p-value suggests that 1991 had a substantial and significant impact on the dependent variable, with a positive effect of about 0.0458. Finally, the constant term (C) has a coefficient of 3.810115, with a standard error of 0.408154. The t-statistic is 9.334999, and the p-value is 0.0000, indicating that the constant term is highly significant. This represents the long-run value of the dependent variable when all the independent variables are set to zero. The results show that GFDI, EXTL, EXTS, and D1991 all have statistically significant relationships with the dependent variable. GFDI and EXTL have positive long-run effects, while EXTS has a negative effect. The year 1991 appears to have had a significant influence on the dependent variable, and the constant term represents the baseline value of the dependent variable when all other variables are held constant.

Table 4: ARDL Long Run

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFDI	0.014591	0.005147	2.835032	0.0080
EXTL	0.026213	0.012569	2.085439	0.0454
EXTS	−0.018595	0.007442	−2.498458	0.0180
D1991	0.045821	0.008044	5.696264	0.0000
C	3.810115	0.408154	9.334999	0.0000

Table 5 presents the short-run coefficients from the ARDL model, which indicate the immediate impact of changes in the independent variables on the dependent variable in the short term. Alongside the coefficients, standard errors, t-statistics, and p-values are also provided to assess the statistical significance of each variable. The coefficient for D GLEP(-1) is 1.751800, with a standard error of 0.040658. The t-statistic is 43.085915, and the p-value is 0.0000. This very low p-value indicates that D GLEP(-1) (the lagged first difference of GLEP) has a highly significant positive effect on the dependent variable. The coefficient suggests that a one-unit increase in the change of GLEP in the previous period is associated with an increase of 1.7518 in the dependent variable in the current period. For D GLEP(-2), the coefficient is -0.839186, with a standard error of 0.044369. The t-statistic is -18.913586, and the p-value is 0.0000. Since the p-value is highly significant and the coefficient is negative, this indicates that the previous period's change in GLEP (lagged by two periods) has a significant negative impact on the dependent variable. Specifically, a one-unit increase in the change of GLEP two periods ago is associated with a decrease of 0.8392 in the dependent variable in the current period.
The coefficient for D GFDI is 0.000032, with a standard error of 0.000015. The t-statistic is 2.215757, and the p-value is 0.0342, which is significant at the 5% level. This result indicates that D GFDI (the first difference of GFDI) has a positive effect on the dependent variable, though the effect is relatively small (0.000032). A one-unit increase in the change in GFDI is associated with a small increase in the dependent variable. For D EXTL, the coefficient is 0.000113, with a standard error of 0.000075. The t-statistic is 1.520009, and the p-value is 0.1386, which is above the 0.05 significance level. This suggests that D EXTL (the first difference of EXTL) does not have a statistically significant effect on the dependent variable in the

short run. The positive coefficient indicates a potential positive relationship, but it is not strong enough to reject the null hypothesis of no effect. For D GEXTS, the coefficient is -0.000017, with a standard error of 0.000032. The t-statistic is -0.527006, and the p-value is 0.6019, which is much higher than 0.05, indicating that D GEXTS does not have a significant impact on the dependent variable. The coefficient is negative, but the effect is not statistically significant in the short run. The coefficient for D 1991, the dummy variable for the year 1991, is 0.000198, with a standard error of 0.000038. The t-statistic is 5.186882, and the p-value is 0.0000. This result suggests that the year 1991 had a significant positive impact on the dependent variable. A one-unit increase in the change in the dummy variable for 1991 is associated with an increase of 0.000198 in the dependent variable, which is statistically significant.
Finally, the CointEq(-1) term represents the error correction term from the cointegrating equation. The coefficient is -0.004323, with a standard error of 0.000928. The t-statistic is -4.656594, and the p-value is 0.0001. The negative and statistically significant coefficient suggests that the system corrects for any disequilibrium between the variables. Specifically, the dependent variable adjusts by approximately 0.0043 units for every unit deviation from the long-run equilibrium. The results show that several variables have significant short-run effects on the dependent variable. D GLEP(-1) and D GLEP(-2) are both highly significant, with D GLEP(-1) having a positive effect and D GLEP(-2) having a negative effect. D GFDI also has a positive short-run effect, while D EXTL and D GEXTS are not statistically significant. The year 1991 has a significant positive impact on the dependent variable, and the error correction term indicates a significant adjustment toward long-run equilibrium.

Table 5: ARDL Short Run

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D GLEP(-1)	1.751800	0.040658	43.085915	0.0000
D GLEP(-2))	−0.839186	0.044369	−18.913586	0.0000
D GFDI	0.000032	0.000015	2.215757	0.0342
D EXTL)	0.000113	0.000075	1.520009	0.1386
D GEXTS	−0.000017	0.000032	−0.527006	0.6019
D 1991)	0.000198	0.000038	5.186882	0.0000
CointEq(−1)	−0.004323	0.000928	−4.656594	0.0001

5. CONCLUSIONS

This study explores the relationships between life expectancy (LEP), short-term external debt (EXTS), and long-term external debt (EXTL) in Saudi Arabia for the period 1974–2023, with a focus on foreign direct investment (FDI) as a mediating factor. The findings reveal several significant relationships. First, there is a positive and substantial impact of long-term external debt (EXTL) on life expectancy (LEP) in Saudi Arabia. This suggests that increases in long-term external debt may contribute to improvements in life expectancy, potentially through funding healthcare and social infrastructure that benefit public health outcomes. Similarly, short-term external debt (EXTS) also has a positive and significant impact on life expectancy in the country. This finding implies that short-term borrowings, which might be used for urgent healthcare needs or fiscal adjustments, can also play a role in improving life expectancy by financing immediate health-related expenditures. However, despite the positive associations between both forms of external debt and life expectancy, the study finds no causal relationship running from EXTL to LEP. This indicates that while there is a correlation between long-term external debt and life expectancy, long-term borrowing does not appear to directly drive improvements in public health outcomes in a causal sense. Similarly, no causal relationship is found between short-term external debt and life expectancy, suggesting that short-term debt may influence other economic variables, such as fiscal balances or economic growth, but does not directly impact life expectancy. On the other hand, the study identifies unidirectional causality running from life expectancy to both forms of external debt. Specifically, improvements in life expectancy appear to lead to greater demand for long-term external debt. This may reflect the need for sustained financial resources to support an aging population and expanding healthcare needs. The same pattern is observed with short-term external debt, where improvements in life expectancy seem to influence short-term debt decisions. This suggests that rising life expectancy may prompt the government to seek additional fiscal resources in the short term to meet public health and welfare demands. In conclusion, while the study finds a positive impact of both long-term and short-term external debt on life expectancy in Saudi Arabia, it also reveals that life expectancy itself is a driving force behind external debt decisions. The study underscores the role of public health outcomes in shaping national debt strategies, with life expectancy influencing both short-term and long-term borrowing decisions, rather than external debt directly affecting health outcomes. The primary contribution of this study lies in its unique approach to analyzing the impact of external debt (ET) on life expectancy (LEP) by breaking down external debt into its components—long-term external debt (EXTL) and short-term external debt (EXTS). This approach distinguishes the study from the majority of existing literature, which typically focuses on the relationship between economic growth and life expectancy, without a detailed examination of the specific components of external debt. While some studies have explored the effect of external debt on poverty or human development indices, there has been limited research directly addressing the impact of external debt on life expectancy, particularly in the context of Saudi Arabia. Over the past two decades, Saudi

Arabia has undertaken significant efforts to modernize and expand its infrastructure to accommodate its growing population. This rapid development has created a gap between investments and savings, necessitating the need for external funding. As a result, the country has increasingly relied on external debt to finance these investments. The findings of this study suggest that external debt, in both its short-term and long-term forms, plays a role in supporting public health outcomes, as reflected in the positive relationship with life expectancy. Given these findings, this study recommends further research into the relationship between external debt and life expectancy, particularly in the context of developing countries. Understanding how external debt influences health outcomes could help policymakers in other nations navigate the complexities of borrowing to support both economic development and public health goals. This area of study is crucial for developing countries that face similar challenges in balancing infrastructure development, economic growth, and public health needs.

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