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The Short-Run and Long-Run Dynamics of Savings, Capital Formation, and Growth in Saudi Arabia: An ARDL Approach

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Abstract: An Autoregressive Distributed Lag (ARDL) model is employed to analyse data spanning 1970 to 2021 to examine the relationship between Saudi Arabian savings, capital accumulation, and economic growth. According to the long-term cointegration analysis, savings do not affect long-term economic growth significantly, but capital formation does. Moreover, according to the Error Correction Model (ECM-ARDL), savings negatively affect short-term economic growth, whereas capital development has a positive and statistically significant effect on economic growth in the third and fourth periods. These findings align with existing literature in the field, marking this study as the first to explore these dynamics specifically within the context of Saudi Arabia. The study recommends that the Saudi government increase the investment rate to stimulate economic growth and reduce dependence on volatile oil revenues. Financial sector reforms are also needed to enhance real income and, at the same time, channel savings into productive investments for economic growth. It is also important for the economic growth and investment that will ensure long-term prosperity.

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Introduction

The literature review primarily focuses on the relationship between capital accumulation, economic growth, and savings, as explored by key studies in the field (Abdallah & Aziz, 2021; Abu, 2010; Adeleke, 2014; Bakare, 2011; Jouini, 2016; Lucas, 1988; Mohan, 2006; Romer, 1986; Saltz, 1999). Saudi Arabia, as a major global economic actor and key player in the oil market, has initiated extensive economic and financial reforms in response to evolving economic conditions and its Vision 2030 agenda. Recent measures, such as the introduction of a value-added tax (VAT), are anticipated to strengthen financial stability and further decrease the country's dependency on oil income. These initiatives are intended to foster a more resilient and diversified economic structure (Khan, 2020).
Saudi Arabia's substantial savings rate has significantly contributed to the country's economic development. Since the 1990s, the savings rate in Saudi Arabia has consistently exceeded 20% of GDP, peaking at 28.2% in 2014. This high savings rate can be attributed to factors such as a substantial government surplus, relatively high-income levels, and a strong savings culture. Conclusively, because of higher investment in education, infrastructure, and much more vital sectors that have improved economic growth by increasing the pay as well as provide more employment opportunities and living standards for most of the citizens. The encouraging relation that Saudi Arabian high saving rate and economic growth is indicative that higher savings will increase the economic activities by channeling to productive investment thus, contributing to GDP growth. This is in tandem with the general observation that countries with higher saving rates normally grow faster in terms of GDP as opposed to those with lower saving rates. In the context of Saudi Arabia, savings, capital formation, and economic growth are closely interconnected. Savings represent the portion of income not consumed but reserved for future use, while capital formation involves the strategic investment of savings into long-term assets, such as machinery, factories, and infrastructure, which are critical for enhancing an economy's productive capacity. It has been observed that the capital accumulation process, either in the form of physical capital, such as machinery and structure, or financial capital, has played a very instrumental role in stimulating growth in Saudi Arabia. A country with much investment in its infrastructure, such as roads, airports, and seaports, plus energy resources like oil and gas production and renewable energy (Al-Muttar et al., 2022; Algarini, 2020; Ballester et al., 2023; Sarkar, Bakka, & Rao, 2023). These investments have been instrumental in diversifying the Saudi economy, generating employment opportunities, and attracting significant foreign investment. By directing resources into various sectors beyond oil, these initiatives have promoted economic development and strengthened the country's industrial base. However, against all these development factors of Saudi Arabia, the country's economy remains too dependent on oil exports, which makes it naturally vulnerable to fluctuations in world oil prices. Thus, abrupt crises are a certain threat to economic stability, which indicates contradiction to an urgent need for independence from oil and building such an economic structure that should be resistant to exogenous and other shocks and uncertainties.
The Saudi government has implemented various economic reforms to increase private sector employment and attract foreign investment. These efforts have been successful in stimulating investment and driving economic growth. The economic growth of Saudi Arabia is closely linked to its capacity to improve the efficiency of manufacturing and the distribution of goods. According to Alrasheedy & Alaidarous (2019), savings are required to improve the capital accumulation and hence the growth rate. However, evidence suggests that Saudi households allocate a considerable portion of their income to consumption, averaging $89.98 billion between 1968 and 2019, and peaking at $308.75 billion in 2019. This figure surpasses the world average of $306.35 billion across 148 countries in 2019, as reported by Global Economy (2021). Furthermore, the study by Sellami, Bentafat, & Rahmane (2020) establishes a clear correlation between savings and GDP growth, indicating that an increase in the savings rate leads to higher GDP growth, and vice versa. Savings, capital formation, and economic growth have been in a highly interrelated and studied relationship in Saudi Arabia. Capital formation and economic growth in the country have been highly influenced by a high rate of saving. The World Bank estimates that the Saudi saving rate has been more than 20% of GDP since the 1990s, reaching as high as 28.2% in 2014. Several factors have driven this high savings rate, including the substantial surplus in the government's budget, relatively high-income levels, and a generally solid saving culture by the population. The enablement of high savings in Saudi Arabia has, however, allowed considerable investment in certain sectors that have become significant drivers of economic growth - for example, investment in infrastructure, education, and other areas. For instance, the government has invested considerably in building roads, airports, and seaports to facilitate trade and commerce. It has invested large amounts in the educational sector to arm its people with the relevant skills and competencies they need to stand out in the global economy.
Saudi Arabia's economic growth has also been supported by its favourable business environment. The country’s robust financial sector, characterized by a well-developed banking system and one of the most prominent stock exchanges in the region, has attracted foreign investors and fostered entrepreneurship. Additionally, the political environment of Saudi Arabia has been stable, which in turn allowed business and investment to flourish and economic growth to follow. Historically, the very high savings rate and capital formation of Saudi Arabia have been highly influential due to its oil industry, traditionally representing the main source of national income. The country should, therefore, with immediate effect embark on diversification of its economy to attain sustainable long-term economic growth inclusive and depleting reliance on oil. In this economic diversification journey, the government has proposed several initiatives, which entail the recently developed Vision 2030 that aims at creating new economic sectors and increasing female participation in the workforce.
It is essential to integrate studies on economic growth, savings, and capital formation within the broader context of sustainability. Highlighting the significance of balanced growth in these areas can substantially advance the sustainability of Saudi Arabia's economy. Specifically, research papers should explicitly establish the connection between these economic factors and sustainability, thereby providing a clear context for the study. This approach ensures that the research is aligned with contemporary discussions on sustainable development and supports the formulation of policies aimed at fostering sustainable economic expansion within the country. The literature review reveals that increased savings generally lead to higher investment, which subsequently supports

economic growth (Abdallah & Aziz, 2021; Abu, 2010; Adeleke, 2014; Bakare, 2011; Jouini, 2016; Lalithambigai, Gnanachandra, & Jafari, 2023; Mandishekwa, 2014; Mohan, 2006; Odhiambo, 2009; Ribaj & Mexhuani, 2021; Saltz, 1999; Topcu, Altinoz, & Aslan, 2020; Turner, 2022). Research consistently demonstrates a positive and robust relationship between economic growth, capital development, and savings accumulation. However, the causal relationship among these variables is not uniform and may vary based on factors such as the economic context or specific conditions. Increased savings can stimulate higher investment, which in turn fosters economic development. Further investigation is required to fully elucidate how accumulated savings and capital formation contribute to economic progress in Saudi Arabia. The existing studies suggest that savings exert either a direct or indirect positive influence on GDP growth.

This research covers this area, given the small number of studies on this topic in Saudi Arabia. The current study differs from the other works through the focus on the analysis and application of economic growth, savings, and capital accumulation. This paper has tried to give a comprehensive overview of the interrelationships between economic growth, savings, and capital formations from both a long-term and short-term perspective and considering lagged effects. Interdependence among savings, the accumulation of wealth, and ensuing growth in Saudi Arabia evolves through a complex, dynamic process due to myriads of interrelated internal and external factors. The high savings ratio of the country has made possible strong capital creation and, in turn, has enabled the economic growth. Heavy dependence on oil export and government expenditure is a great risk to the economy.

Statement of Problem

Notwithstanding the fact that the economy of Saudi Arabia may be relatively well-endowed and developed, there are serious structural weaknesses flowing from an excessive dependence on exports of oil for revenue. Instability is presaged by volatility in oil prices. It is here that the Saudi regime of Vision 2030 is necessary to try to overcome excessive dependence on oil by fostering greater growth of non-oil sectors along with increasing domestic savings and capital accumulation. (Mahara, 2022). Achieving these goals necessitates a thorough analysis of the country's economic dynamics, including the critical factors of savings, capital accumulation, and long-term economic growth and development (Abdulkarim, 2023; Abramson, 2023; Al-Qahtani et al., 2022). Historically, Saudi Arabia has always exhibited high savings rates on account of substantial government surpluses, high per capita income, and a strong culture for saving. However, paradoxically, despite substantial investments in productive sectors, the expected levels of growth are yet to be fully realized. This beggars some critical questions about the quality of the capital formation process and structural impediments to utilizing savings effectively toward achieving growth. For instance, although substantial resources have been directed towards infrastructure, education, and other capital-intensive sectors, research indicates that the returns on these investments in terms of sustained economic growth have been, at best, moderate (Addisu, Chala, & Hunde, 2022). This discrepancy between savings and growth underscores the need for more targeted research to investigate the underlying causes of this phenomenon. Saudi Arabia's experience with capital formation and economic development is distinct, presenting unique challenges. Fixed capital accumulation, which involves the acquisition of physical assets such as infrastructure, machinery, and industrial capacity, plays a critical role in enhancing economic productivity (Mahara, 2022). However, the sustainability of capital formation in promoting growth depends on factors such as technological advancement, workforce training, and global economic conditions. The role of non-oil capital formation, which has evolved in a historically oil-dominated economy, remains ambiguous and appears to be less effective in driving growth (Abdulkarim, 2023). Additionally, most of the infrastructure development has been concentrated in the public sector, with limited private sector involvement. The application of savings to define economic progress is further complicated by the broader macroeconomic context, which features elevated levels of expenditure and substantial government spending. Data indicates that, despite maintaining a high savings rate, Saudi households exhibit a significant propensity to consume, thereby limiting the availability of savings for financing productive investments. Consequently, the challenge lies in finding effective strategies to stimulate household savings, efficiently mobilize capital, and simultaneously promote long-term economic growth (Addisu et al., 2022; Tejedor, Romero-Rodríguez, & Codina, 2022). This research addresses a complex problem using three dimensions. It first attempts at pre-specifying the current and future role of savings, capital formation, and economic growth in Saudi Arabia. This study also investigates some aspects that may impede efficiency in translating savings and capital formation into actual economic development. It also explores some of the policy variables that can help and further reinforce their role in achieving sustainable, long-term growth against the backdrop of current economic diversification efforts in Saudi Arabia (Mahara, 2022). In light of this goal, the analysis was intended to contribute to the processes of policymaking for the diversification of the economy and the reduction of dependence on the oil sector.

Study Objectives

1. Assess the direct and long-term relationships among gross domestic savings, capital formation, and economic growth in Saudi Arabia, with a focus on diversification strategies outlined in Vision 2030.
2. Utilize the ARDL model to differentiate between the short-term and long-term effects of gross domestic savings and capital formation on economic growth.
3. Examine how economic policies, specifically those aimed at encouraging savings and investment, can promote sustainable economic growth in Saudi Arabia by decreasing its reliance on oil revenues.
4. Offer policy recommendations grounded in empirical evidence to assist Saudi Arabia in strengthening its economic resilience by improving savings mechanisms and capital formation strategies that facilitate the expansion of the non-oil sectors.

Methodology

The methodology section describes the sources of data, the variables, the analytical approach, and the descriptive statistics applied in this study, discussed herein.

Data Sources and Variables

Thus, this is a quantitative descriptive analysis study based on the ARDL bounds model, which bifurcates the differentiation between short- and long-run effects, along with the effect of the level of co-integration between dependent and independent variables. It also probes how

each independent variable influences the dependent variable.

Data Approach and Descriptive Statistics

This study will utilize a quantitative descriptive analysis approach through the autoregressive distributed lag bound testing methodology. The approach allows for the differentiation between long-term and short-term effects, given that it ascertains a co-integrating relationship among the dependent and independent variables within one framework. Table 1 presents the mean values for Economic Growth (GDP), Savings (GS), and Capital Formation (GC) as 4.807, 32.609, and 24.220, respectively. This indicates that the average Economic Growth (GDP) is 4.807, the average Savings (GS) is 32.609, and the average GC is 24.220. The standard deviation values for GDP, GS, and GC are 11.754, 14.001, and 5.332, respectively, reflecting the extent to which the data points deviate from their respective means. Larger standard deviations indicate greater variability within the dataset.

Table 1: Descriptive Statistics.

Variables	Mean	Standard dev.	Minimization	Maximization
Economic Growth (GDP)	4.807	11.754	-20.729	58.647
Savings (GS)	32.609	14.001	8.585	67.277
Capital Formation (GC)	24.220	5.332	13.405	36.287

Source: Computed from Data

Theoretical Model

Orji et al. (2018) emphasize the importance of savings and capital accumulation for developing economies. Their study applies cointegration tests by Engle & Granger (1987), Johansen (1988), and Johansen & Juselius (1990), assuming uniform stationarity across variables. However, practical applications often face challenges due to varying integration orders. To address this, Pesaran and colleagues (1997; 2001; 1999) developed the ARDL model, which accommodates variables integrated at different orders, I(0) or I(1), but not I(2). The ARDL model is particularly effective with small samples and simplifies the estimation of both short-term and long-term relationships in a single equation. It uses multiple linear regression to analyse the relationship between the dependent variable and explanatory factors within a given time period.

$$\mathrm{GDP}_t = \theta_0 + \theta_1 \mathrm{GS}_t + \theta_2 \mathrm{GC}_t + \varepsilon_t \quad (1)$$

In equation (1), the variables GDP, GS, and GC represent GDP, domestic savings, and gross capital formation, respectively. Capital formation and savings are key drivers of GDP growth (Jagadeesh, 2015). Additionally, capital formation, which encompasses total factor productivity, significantly influences the investment cycle (Bal, Dash, & Subhasish, 2016).

Model Specification

The error correction version of the ARDL model, developed by Pesaran & Pesaran (1997), Shin & Pesaran (1999), and Pesaran et al. (2001), is employed to identify the factors influencing the long-term and short-term growth of GDP, gross domestic savings, and gross capital formation in the Saudi economy. This can be expressed as follows in equation (1).

$$\Delta\mathbf{GDP} = \boldsymbol{\delta}_{\mathbf{ls1}} + \sum_{\mathbf{i=1}}^{\mathbf{m}} \boldsymbol{\theta}_{\mathbf{1i}} \Delta\mathbf{GDP}_{\mathbf{i}} + \sum_{\mathbf{i=0}}^{\mathbf{n}} \boldsymbol{\theta}_{\mathbf{2i}} \Delta\mathbf{GS}_{\mathbf{i}} + \sum_{\mathbf{i=0}}^{\mathbf{k}} \boldsymbol{\theta}_{\mathbf{3i}} \Delta\mathbf{GC}_{\mathbf{i}} + \boldsymbol{\delta}_{\mathbf{1}}\mathbf{GDP}_{\mathbf{t-1}} + \boldsymbol{\delta}_{\mathbf{1}}\mathbf{GS}_{\mathbf{t-1}} + \boldsymbol{\delta}_{\mathbf{2}}\mathbf{GC}_{\mathbf{t-1}} + \boldsymbol{\delta}_{\mathbf{3}}\mathbf{D} + \mathbf{u}_{\mathbf{t1}} \quad (2)$$

Where the symbols $\boldsymbol{\delta}_{\mathbf{1}}$, $\boldsymbol{\delta}_{\mathbf{2}}$, and $\boldsymbol{\delta}_{\mathbf{3}}$ Indicate the coefficients that describe the long-term relationships, while while ($\boldsymbol{\theta}_{\mathbf{1i}}$, $\boldsymbol{\theta}_{\mathbf{2i}}$, and $\boldsymbol{\theta}_{\mathbf{3i}}$) Express the coefficients that symbolize the relationships in the short term. The variable m represents the time delay (lag period) for the dependent variable (GDP), n represents the deceleration period for the interpreted variable GS, and k represents the deceleration period for the interpreted variable GC. It is crucial to emphasize that the lagged times for the variables may have different numbers (m ≠ n ≠k). The symbol Δ represents the initial discrepancy of the variable. The ; $\mathbf{u}_{\mathbf{t1}}$ represents the random error, which is presumed to have a mean of 0, a constant variance across time periods, and no correlation between errors. Specifically, it satisfies the conditions $\{E(\mathbf{u}_{\mathbf{t1}}) = 0,\ E(\mathbf{u}_{\mathbf{t1}}{}^2) = \mathbf{0}, \mathbf{E}(\mathbf{u}_{\mathbf{t}}) = \boldsymbol{\sigma}_{\mathbf{u}}{}^2, \mathbf{E}(\mathbf{u}_{\mathbf{t}}\,\mathbf{u}_{\mathbf{t}^{''}}) = \mathbf{0}, \mathbf{t} = \mathbf{t}'\}$. D), where t = t'. The variable D is incorporated into the equation to account for structural breaks and to provide comprehensive information. In the ARDL Bounds testing framework, it is assumed that the variables exhibit a mix of integration orders: I(0) and I(1) (Andronicеanu et al., 2023). The estimation process begins with determining the optimal lag length for the model. In the subsequent step, the ARDL model is used to estimate the ideal lag length matrix for each variable. The final stage involves estimating the long-term model using the following equations (3).

$$\mathbf{GDP} = \boldsymbol{\delta}_{\mathbf{l1}} + \boldsymbol{\beta}_{\mathbf{1}}\mathbf{GS}_{\mathbf{t}} + \boldsymbol{\beta}_{\mathbf{2}}\mathbf{GC}_{\mathbf{t}} + \boldsymbol{\beta}_{\mathbf{3}}\mathbf{D} + \mathbf{u}_{\mathbf{t1}} \quad (3)$$

The final step involves deriving the error correction term from the ARDL model, which allows for capturing short-run dynamics as follows:

$$\Delta\mathbf{GDP} = \boldsymbol{\delta}_{\mathbf{s}} + \sum_{\mathbf{i=1}}^{\mathbf{m}} \boldsymbol{\theta}_{\mathbf{i}} \Delta\mathbf{GDP}_{\mathbf{i}} + \sum_{\mathbf{i=0}}^{\mathbf{n}} \boldsymbol{\theta}_{\mathbf{i}} \Delta\mathbf{GS}_{\mathbf{i}} + \sum_{\mathbf{i=0}}^{\mathbf{t}} \boldsymbol{\theta}_{\mathbf{i}} \Delta\mathbf{GC}_{\mathbf{i}} + \boldsymbol{\mu}\mathbf{D} + \boldsymbol{\gamma}\mathbf{ECT}_{\mathbf{i}} + \mathbf{v}_{\mathbf{t}} \quad (4)$$

The error correction term is denoted as $\mathbf{ECT}_{\mathbf{i}}$. The variable represents the long-term relationship between the outcome and predictor variables, while its coefficient measures the speed at which the system adjusts and returns to equilibrium after short-term disturbances. Error correction coefficients range from -1 to 0, with larger absolute values indicating a faster adjustment rate. A coefficient of zero signifies no long-term relationship. Therefore, a significant coefficient reflects a strong connection between the long-term and short-term variables.

Empirical Results

Order of Integration

This research conducts time-series stationarity testing to identify whether the variables in the empirical analysis are stationary. The Phillips-Perron test statistic was thus applied to check for time series stability to identify the stationarity of the variables. It can be seen from Table 2 that GDP and GC are stationary at the I(0) level, while GS becomes stationary at the I(1) level after first differences are taken. The variables' first difference acceptance of the null hypothesis of unit root in these variables implies that the GS series needs to be differenced to be stationary. GDP growth, gross domestic savings, GC, are integrated at a different order, so the ARDL approach can be applied. Table 2 demonstrates that both GC and GS were insignificant in the

years 1973 and 1976 when assessed using breakpoint and level methods. However, they become significant at the first difference for the years 1985, 1974, 1996, 1981, and 1974, respectively, when evaluated with breakpoint and trend, level, and first difference techniques. In contrast, GDP shows significance across various methods, including breakpoint and level, breakpoint and trend, level and first difference, and first difference techniques for the years 1974 and 1975. This variation in significance highlights the effectiveness of the ARDL model, which offers a more precise and robust analysis compared to alternative models, demonstrating its superiority in capturing the complex dynamics of GDP over time. The large, estimated values of breakpoint and trend, level and first difference in various years from the first difference suggest that data may be showing a behavior, either trend or stochastic, which can nicely be represented through the ARDL model. On the other hand, the significance of the GE models indicates the importance of using the same in modeling the time series dataset with various methods such as the ARDL model. These results consequently point to the better performance of the ARDL model compared with other models, primarily because it considers the problem of non-stationarity in the data. This advantage has important implications for decision-makers, policymakers, and researchers who depend on time series data for analysis and decision-making. The ARDL model's capacity to manage non-stationarity provides more accurate and reliable insights, which can support more informed strategic decisions and policy development. The estimates of the model are then derived by using the ARDL method to specify, test for cointegration, and calculate both the long-term and the short-term parameters. This can be considered an advantageous technique since it does not require the variables contained in the time series data to be integrated at the same order. Additionally, it has a distinctive feature where it differentiates the short term from the long term, which, through estimating an ARDL model, one can get both immediate and extended cointegration relationships within one equation framework. Economic theory can inform the selection of the appropriate lag length for the ARDL model, enhancing its accuracy and relevance. However, the number of lags used as regressors can be determined through statistical methods. Omitting lags from the model may result in biased estimates, while excessive lags can increase the standard error of coefficient estimates, leading to larger prediction errors. In light of this, the Schwarz Bayesian Criterion is utilized in selecting the optimal lag length for this research.

Table 2: Phillips-Perron and Augmented Dickey-Fuller Breakpoint Unit-Root Test.

Phillips- Perron unit root test						
Variable	Level I(0), Lag (0 1 1)			1st Difference I(1), lag(1 0 4)		
	Intercept	Intercept and Trend	None	Intercept	Intercept and Trend	None
GDP	-7.24*	-7.02*	-6.9*	-14.3*	-14.7*	-14.3*
GS	-2.05	-2.03	-0.74	-7.5*	-7.4*	-7.5*
GC	-3.9*	-3.96*	-0.42	-25.6*	-25.11*	-25.5*
ADF Breakpoint Unit Root Test						
		Level I(0)		Level I (1)		
Variable	Break Date	Intercept	Intercept and Trend	Intercept	Intercept and Trend	
GDP	1974	-8.13*	-8.07*	-14.05*	-13.9*	
GS	1976	-2.74	-3.43	-8.73*	-8.72*	
GC	1973	-4.165	-5.27*	-10.56*	10.41*	

* Significant at the 1% level, **Significant at the 5% level in the case of a constant term, the model can be represented as: $\Delta y_t = \alpha_0 + \lambda y_{t-1} + \varepsilon_t$In the case of a constant and atrend, the model can be represented as: $\Delta y_t = \alpha_0 + \alpha_2 t + \lambda y_{t-1} + \varepsilon_t$In the case of having no constant or trend, the model can be represented as: $\Delta y_t = \lambda y_{t-1} + \varepsilon_t$.

Source: Computed from Data.

The section presents the estimation results and discussion relating to the findings of the cointegration analysis. With the use of the ARDL model and bound testing methodology, the research work has analysed the long-term and short-term impact of capital formation and savings on economic growth. The ARDL bound test approach has been presented in Table 3, incorporating an ARDL model which establishes a long-run equilibrium relationship among variables. An F-statistic value of 5.49, larger than the upper critical value at the level of significance, pointed toward the acceptance of the alternative hypothesis of a joint co-integration relation in the long term. The result again is in tune with the test results for stationarity and meets the conditions for the model.

Table 3: Bound-Test for the Presence of Long-Run.

F-statistic	5.49	
Critical Value		
Significance Level	Lower Bound I(0)	Upper Bound I(1)
1%	2.63	3.35
5%	3.1	3.87
2.5%	3.55	4.38
1%	4.13	5

Source: Computed from Data

Estimating the Long-Run Relationship

The estimation was performed using the ARDL model specifications of 2, 3, 4, and 1. The results are shown in Table 4 for the long-run cointegration. From the analysis, it can be seen that GC has a negative significant effect on economic growth, while savings have an insignificant effect at 10% level of significance with a negative coefficient of D that is also insignificant at 5% level. However, this intercept did not change from 1980, indicating no structural changes in the Saudi economy. This stability supports the reliability of the statistical estimates

from the ARDL model. The estimated equation for the long-term relationship is significant at 1%, with an F-value of about 3.6, greater than its critical value at the same level of significance. This result supports the fact that the relationship between the dependent and independent variable is not spurious. The adjusted R^2 implies that around 52.3% of the variation in the GDP is explained by the independent variables of the model. However, the model presents insignificance in the long-run effect from national savings, and capital formation has a negative significant association with the GDP, where for a 10% rise in capital formation, GDP decreases by 12.6%.

Table 4: Estimates for Long Run Coefficients for ARDL (2 3 4 1).

Equation	$\mathbf{GDP} = \delta_{l1} + \beta_1 GDP_t + \beta_2 GS_t + \beta_2 GC_t + \beta_3 \mathbf{D} + u_{t1}$			
Variables	**Coefficient**	**Std. Error**	**t. Statistics**	**P-Value**
GS	0.187	0.1625	1.148	0.258
GC	- 1.26	0.675	-1.859	0.0712
D	-5.61	3.71	-1.509	0.140
C	26.52	13.225	2.005	0.0525

$\mathbf{R^2}$ = 0.52 $\mathbf{R^{-2}}$= 0.38 F = 3.6*

* Significant at the 1% level

Source: Computed from Data

Estimating the ECM Error Model

Equation 4 represents the ECM-ARDL model that captures the short-run dynamics between the dependent and independent variables. The parameters for this short-run relationship were estimated using the ARDL specifications (2, 3, 4, 1). Following the estimation of the long-term relationship within the ARDL (2, 4, 3, 1) model and guided by the Schwarz Bayesian Criterion (SBC), an error correction model was applied to elucidate the short-term dynamics. The results are presented in Table 5, which depicts that from the estimates, capital formation has a positive and significant contribution to economic development in the third and fourth phases, while savings have a negative and significant effect on economic development in the third phase. The estimated error correction term (ECM) of -0.71 suggests that the model efficiently corrects 71% of short-term disequilibria and restores long-term equilibrium. This implies that 69.2% of deviations in the model can be adjusted to reach equilibrium within approximately 1.7 years. Additionally, a 10% increase in capital formation leads to a 4.4 and 7.9 percentage point boost in GDP expansion during the third and fourth phases, respectively. Conversely, a 10% rise in national savings results in a 3.1% decrease in income, a statistically significant relationship at the 5% level in the third phase. Overall, this study utilizes the ARDL model and bound testing techniques to explore the relationships between GDP growth, gross domestic savings, and gross capital formation in the Saudi economy.

Table 5: Estimated for Short-Turn Coefficient for ECM-ARDL (2 3 4 1).

Equation	$\Delta\mathbf{GDP} = \boldsymbol{\delta_s} + \sum_{i=1}^{m} \boldsymbol{\theta_i} \Delta \boldsymbol{GDP_i} + \sum_{i=0}^{n} \boldsymbol{\theta_i} \Delta \boldsymbol{GS_i} + \sum_{i=0}^{t} \boldsymbol{\theta_i} \Delta \boldsymbol{GC_i} + \boldsymbol{\mu}\mathbf{D} + \boldsymbol{e_{t1}}$			
Variables	**Coefficient**	**Std. Error**	**t. Statistics**	**P-Value**
GDP (-1)	-0.311548	0.114253	-2.726833	0.0098
GS (-1)	0.148535	0.118428	1.254224	0.2178
GS(-2)	-0.215222	0.120534	-1.785564	0.2178
GS(-3)	-0.318771	0.135173	-2.358238	0.0239
GC(-1)	-0.206410	0.213611	-0.966290	0.3403
GC(-2)	-0.246960	0.225936	-1.093049	0.2816
GC(-3)	0.444774	0.206757	2.151192	0.0382
GC(-4)	0.799392	0.199822	4.000528	0.0003
D(-1)	10.251	6.340	1.616	0.115
CE	-0.711	0.125	-5.690	0.0000
R-Squared		0.751429	Mean Dependent Var	-0.436033
Adjusted R-Squared		0.700440	S.D. Dependent Var	10.98492
S.E. of Regression		6.012272	Akaike Info Criterion	6.592843
Sum Squared Resid		1409.749	Schwarz Criterion	6.943693
Log likelihood		-149.2282	Hannan-Quinn Criter.	6.725430
Diagnostic Test				
F-Statistic		**F**		**P-Value**
Heteroskedasticity Test: ARCH		3.02		0.089
Breusch-Godfrey LM		3.23		0.052
Durbin-Watson Stat		1.664358		

Source: Computed from Data

The Breusch-Godfrey serial correlation (LM) and F-statistic tests indicate that serial correlation or heteroscedasticity cannot be ruled out, suggesting that these issues may be present in the models. However, the residual diagnostic tests show no evidence of heteroscedasticity or autocorrelation, affirming the reliability of the models. The estimates from ECM-ARDL suggest that capital formation has a little negative impact on savings, whereas

economic growth influences savings positively and significantly. Economic growth is positively and significantly related to the saving in the long run, though at a rather slow adjustment rate. It also shows that 1% increase in economic growth results in an increase in savings by 3.49 percentage points.

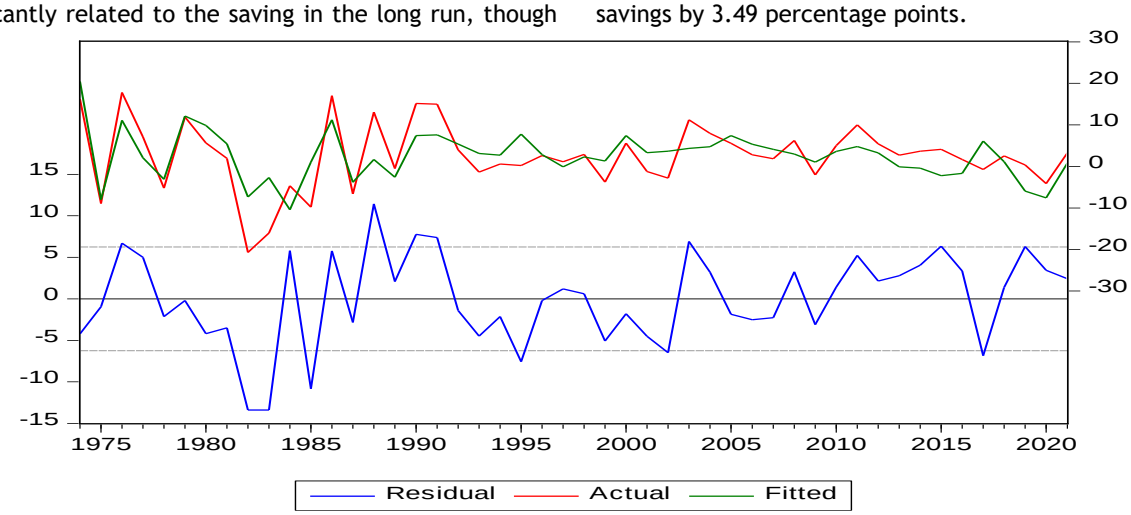

Figure 1: The Estimated Model for the Relationship Between GDP, Savings, and Capital Formation.

Model Diagnostic Test Results

Diagnostic tests were performed to evaluate the model's suitability, including assessments for serial correlation, specification errors, heteroscedasticity, and the normality of residuals. The results of these tests are summarized in Table 5. To ensure the model's integrity and absence of measurement issues, the Lagrange multiplier test was employed. The ARCH test, used to examine heteroscedasticity, indicated no presence of heteroscedasticity in the model. Serial correlation was evaluated using the LM test on random errors, which showed no evidence of serial correlation. The stability of the ARDL error correction model's coefficients was evaluated using the CUSUM test, as presented in Figure 2. The test results indicated that the coefficients remained within the critical bounds at a 5% significance level, confirming the model's stability for both the long-run and short-run analyses. In this process, the model's estimated coefficients were plotted, and their stability was determined based on whether they stayed within the critical bounds, indicating consistency in the model's performance over time.

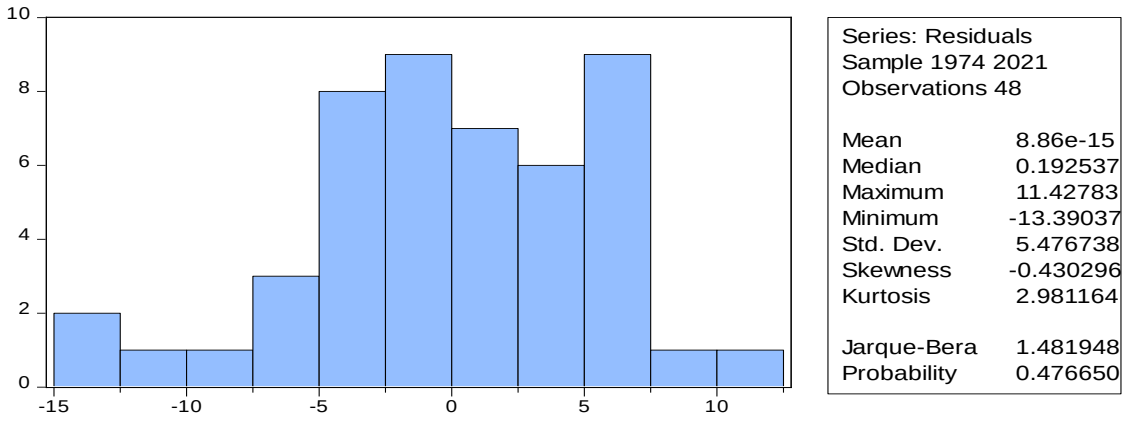

Figure 2: Residuals of Samples From 1970-2021.

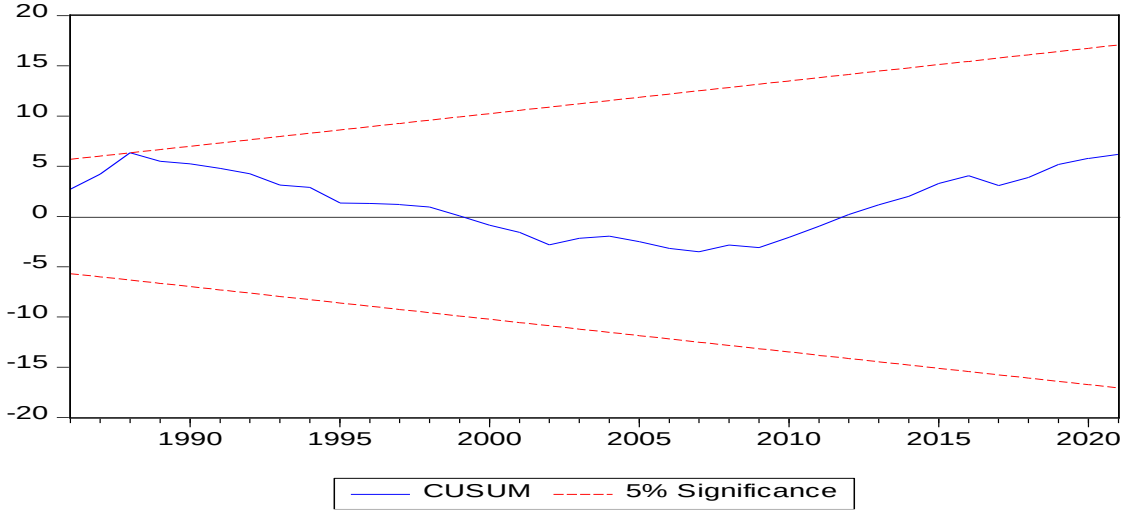

Figure 3: The Structural Stability of the Estimated Coefficients for the ARDL Error Correction Model.

Discussion

The ARDL method was applied to estimate the long-term relationship between economic growth, savings, and capital formation. This econometric technique is commonly used to analyse both short-term and long-term interactions between variables, with this study focusing on long-term effects. The findings, detailed in Table 4, reveal that capital formation has a significant negative impact on economic growth over the long term at the 10% significance level. This indicates that as capital formation increases, economic growth tends to decrease in the long run (Topcu et al., 2020). The negative coefficient for capital formation highlights an inverse relationship with economic growth. On the other hand, the influence of savings on long-term economic growth is found to be statistically insignificant, indicating no clear relationship between savings and economic growth (Mandishekwa, 2014). The estimated equation demonstrates statistical significance at the 1% level, indicating a robust relationship between economic growth and capital formation (Topcu et al., 2020). Capital formation enhances the liquidity within the economy by translating into increased investment and greater production of goods and services, which, in turn, should elevate population income and stimulate demand, thereby promoting higher economic growth. The F-statistic value of 3.6 surpasses its critical value at the same significance level, confirming the reliability of the results obtained from the model. The study's findings indicate that, in the short term, savings have a negative impact on economic growth. This contrasts with other research that has identified a positive relationship between savings and economic growth. For instance, studies by Odhiambo (2009), Abu (2010), Adeleke (2014), and Ribaj & Mexhuani (2021) provide evidence supporting the notion that savings can foster economic growth. Despite these findings, the study confirms a long-term positive relationship between capital formation and economic growth in Saudi Arabia. High rates of capital formation are beneficial as they drive technological innovation and enhance future production capabilities (Jagadeesh, 2015; Lugauer & Mark, 2013). To achieve sustained economic growth in Saudi Arabia, development strategies should focus on increasing household savings, particularly by promoting business savings (Hooi Lean & Song, 2009).

Our research makes a significant contribution to the existing literature on Saudi Arabia by addressing gaps identified in prior empirical studies, such as those by Alrasheedy & Alaidarous (2019), which primarily focused on the directional causality between private savings and private GDP but did not assess the magnitude of savings' impact on GDP growth. Our analysis underscores the critical role of gross savings in Saudi Arabia, particularly in providing additional financial capital. It suggests that implementing further reform proposals is essential for reducing savings rates, stimulating economic growth, and decreasing reliance on fluctuating oil revenues. The study offers valuable insights into Saudi Arabia's economic challenges, notably its dependence on oil revenues and the pressing need for economic diversification. We recommend increasing investments in non-oil sectors to promote economic growth and mitigate the impact of volatile oil prices. Additionally, the study advocates for reforms in the financial sector to encourage responsible spending and sustainable growth. This could include policies to enhance private sector investment, improve transparency in financial transactions, and boost financial literacy among the population.

Conclusion and Key Implications

This paper contributed to understanding the trend of the Saudi Arabian economy by underlining gross saving as an influential agency to economic growth. The analysis indicates that despite some studies focusing on the proportionality of private savings to GDP, the critical aspect of savings as a major determinant of economic expansion has little attention. Our results underscore the need to increase gross savings in order to raise financial capital and promote economic growth. What Saudi Arabia needs right now are reforms that reduce its savings rate, accelerate economic development to reduce dependence on unstable oil revenues. Additionally, economic diversification has become highly relevant considering volatile oil price changes. Investing in non-oil sectors, reforming the financial sector, and promoting responsible spending practices are essential for achieving sustainable growth. By adopting policies that encourage private sector investment, improve financial transparency, and boost financial literacy, Saudi Arabia can better address its economic challenges and promote long-term stability. Overall, these insights offer a strategic framework for policymakers and investors to support economic stability and reduce reliance on oil revenues, fostering a more resilient and diversified economy.

The study presents several recommendations aimed at fostering sustainable economic growth in Saudi Arabia and mitigating reliance on fluctuating oil revenues. To enhance economic stability and promote growth, it is advised to increase the investment rate, which can stimulate consumer spending, mitigate financial crisis risks, and address income inequality. Leveraging savings from the Public Investment Fund (PIF) can further diversify the Saudi economy, boost capital formation, and support the creation of new businesses, job opportunities, and productivity improvements. Additionally, financial sector reforms are recommended to stimulate growth and savings while reducing dependency on oil revenues. Policymakers should incentivize households to invest in physical capital and develop a robust financial sector to support sustained economic growth. The study highlights the connections between gross domestic savings, capital formation, and GDP growth in Saudi Arabia, considering both short- and long-term effects. It emphasizes the importance of capital investment for long-term economic growth, even though increased savings may have short-term negative impacts. The findings suggest that policymakers should focus on enhancing capital formation to drive growth, with investment in productive sectors and financial system development being crucial. However, strategies that encourage savings should be approached cautiously due to their potential to hinder growth.

The Study Limitations

Several limitations exist in this study. First, the analysis is based only on the Saudi Arabian economy; thus, the findings may not be generalizable to other countries or economies. Second, reliance on secondary data from national statistical agencies may involve potential measurement errors or reporting biases. Moreover, the focus of the analysis has remained stuck on influences of total domestic savings and gross capital formation to economic growth, leaving out other apparently influential variables such as inflation, foreign investment, and government policies which could also be major determinants of economic growth. This limitation basically means that the study may therefore not capture all the

variables influencing the dynamics of economic growth. Fourthly, the use of the ARDL model and bound testing techniques may involve model specification and estimation errors. Finally, the study does not account for potential endogeneity issues, which may arise if the dependent and independent variables are determined simultaneously.

Future Research

This would lead to a call for such a factor in future research to incorporate among others, trade, inflation, and foreign direct investment into the model. This could lead to the extended correspondence between savings, capital formation, and economic growth in Saudi Arabia. It may therefore be well advised to check the robustness of the results using other appropriate econometric techniques, such as Johansen Cointegration or Augmented Dickey-Fuller tests. Such a comparative study across different countries would offer useful insights by highlighting common patterns in comparable economies. Beyond this, controlling for endogeneity and performing longitudinal analysis on the effect of the Saudi Arabia Vision 2030 reforms over the longer term would enrich comprehension of these dynamics and their implications for sustainable economic growth.

Data Availability

Although this study's datasets are not publicly available, the corresponding author can provide them upon reasonable request.

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