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"The Impact of Real Interest Rate on Saudi Arabia's Real GDP"

Researchers:

Kholoud Bakheet Alghamdi

PhD student, Economics Department, King Abdulaziz University

Mohammad Saifuddin Zawawi

PhD student, Economics Department, King Abdulaziz University

Basel Yasser Balila

Assistant professor, Economics Department, King Abdulaziz University

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Abstract:

This study examines the impact of real interest rate on Saudi Arabia's real GDP over the period 1983 to 2023. The study uses linear-log time series dynamic model based on the Autoregressive Distributed Lags (ARDL) modelling technique to analyze the long & short-run impact of changes of real interest rate on real GDP in Saudi Arabia over the sample period using the World Bank and the Federal Reserve Bank annual data. The long run results show that the relationship between real interest rate and real GDP is negative and significant. In the short run, however, the results show that the relationship is negative but insignificant in the initial year, while it turns into a positive and significant in a one lag period. The Saudi Central Bank (SAMA) is suggested to decrease the real interest rate since this will lead to an increase in the country's real GDP in the long run. In the short run, however, and in order to increase the country's real GDP, it is suggested to increase the real interest rate in a one lag period.

Key Words: Real interest rate, GDP, ARDL, Monetary policy, Macroeconomics.

1- General framework of the study

1-1 Introduction:

Studying the impact of real interest rate changes is an important topic in macroeconomics, as it represents an essential part of the economic policies adopted by countries to achieve stability and economic growth. Interest rates are also a major tool for central banks to control the money supply and levels of investment and savings within the economy, as changes in the real interest rate directly or indirectly affect the decision of investors and consumers, which in turn is reflected in the overall performance of the national economy.

According to economic theory, when a change occurs in the real interest rate, investment decisions are significantly affected (Born et al., 2023). Reducing the interest rate makes borrowing less expensive, which encourages companies to invest in new projects, which may lead to GDP growth. Conversely, raising the interest rate increases the cost of borrowing, which may limit investments and slow economic growth (Borio & Gambacorta, 2017).

The relevant economic literature and reports indicate that the impact of changes in interest rates varies according to the economic structure of each country. In high-income countries, such as the Gulf Cooperation Council countries, the impact of raising interest rates on the growth of the non-oil sector is limited because higher oil revenues support liquidity and enhance investor and consumer confidence. As for middle- and low-income Arab countries, there are different negative repercussions of high interest rates, especially countries with high debt ratios (Arab Monetary Fund, 2024).

On the other hand, GDP is of great importance in economic systems, especially in the Kingdom of Saudi Arabia, as it is the main indicator for measuring the efficiency of economic performance and the level of comprehensive development (Raworth, 2017). In this regard, real interest rates are one of the factors influencing capital movement (Chowdhry & Titman, 2001), as they govern the inter-temporal purchasing decisions faced by households, businesses, and all levels of government. This means that almost all market interactions that require a choice between spending now and spending later necessarily involve real interest rates, which determine the true cost of borrowing to complete a purchase, or on the other hand, the true gain from saving (Yi & Zhang, 2017). Consequently, changes in these rates lead to varying effects on different economic sectors such as industry, agriculture, and services that constitute the country's GDP. Also, the impact of interest rates extends to include the economy's ability to maintain a balance between growth and inflation, which highlights the importance of studying and analyzing this relationship within the Saudi context.

The presented study seeks to provide a comprehensive analytical vision on the impact of real interest rate fluctuations on economic growth represented by GDP in Saudi Arabia, in order to understand the nature of the relationship between these two variables and reach results that support economic decision-making. The study relies on data and analysis based on quantitative economic models to assess the level of impact and provide appropriate recommendations to monetary policy makers in the Kingdom to achieve a sustainable economic balance.

2-1 Study Problem:

Interest rates are important variables that affect the cost of borrowing, deposit returns, investment activity, and demand in the economic system. The change in the real interest rate is also one of the most important economic issues that deserves study in light of its direct impact on investment, consumption, and savings, and thus on economic performance in general.

Since Arab economies, especially the Saudi economy, are closely linked to global economies, they are affected by global economic developments and interact directly with them. Most Arab countries have witnessed similar developments in interest rates as a result of these links, as these changes were characterized by responding to global trends related to inflation,

economic growth, and the monetary policies of major countries. In recent years, global economic challenges such as supply chain crises and inflationary pressures have prompted Arab central banks to take measures similar to their global counterparts, whether by raising interest rates to curb inflation or adjusting them to support growth (Arab Monetary Fund, 2024).

Economic literature indicates that the global financial crisis and the resulting slowdown in economic activities have prompted economists to reconsider the effectiveness of monetary policy (Elsayed et al., 2021). A number of studies in this field have concluded that monetary policy based on low interest rates leads to excessive banking risk and thus affects financial stability, for example (e.g. Jiménez et al., 2012; Valencia., 2014; Dell'Ariccia et al., 2014; Ioannidou, 2015; Tong, 2017). Other studies have found that interest rate fluctuations directly affect investment and economic growth rates. A study by Bano (2018), conducted on a group of emerging economies, showed that a rise in real interest rates leads to a decline in private investment, which translates into a slowdown in economic growth. Another researcher (Kozlov, 2023) indicated that lowering interest rates can lead to increased economic activity by encouraging borrowing and increasing consumer spending, while a study by Algahtani (2015) found that the impact of higher interest rates was negative on GDP and credit to all economic sectors in the Kingdom of Saudi Arabia.

In a related context, economic indicators show that the Saudi economy has witnessed flexible shifts in its response to changes in interest rates in recent years, but there is a need for a deeper understanding of the underlying factors that play a role in this dynamic. Therefore, it is necessary to analyze the impact of changes in interest rates in Saudi Arabia in the context of ongoing economic reforms and government initiatives to promote non-oil investments, in order to understand the potential consequences for GDP growth in Saudi Arabia and enhance its stability in the long term.

Based on the above, the problem of this study lies in understanding and analyzing the factors that affect changes in real interest rates on Saudi GDP at constant prices, especially in light of the major economic transformations witnessed by the Kingdom and the increasing efforts to diversify the economy away from excessive dependence on oil. Accordingly, the problem of this study crystallizes in the main question, which is: "What is the effect of changes in real interest rates on Saudi GDP at constant prices during the period from 1983 to 2023?"

3-1 Study objectives:

The study mainly aims to analyze the impact of the change in the real interest rate on the GDP in the Kingdom of Saudi Arabia at constant local currency prices for the period (1983-2023).

4-1 Importance of the Study:

This study is of great importance on both the scientific and practical levels. Scientifically, the study enhances the economic understanding of the relationship between monetary policies and overall economic performance, especially in light of global and local economic changes. It also provides a theoretical and analytical framework supported by accurate data to understand the effects of changes in the real interest rate on economic activity and growth in the Kingdom of Saudi Arabia. Practically, the results of the study provide vital information to decision makers to improve fiscal and monetary policy strategies. It also helps in identifying the potential effects of interest rate changes on the commercial and consumer sectors, enabling companies and individuals to make informed financial decisions. Finally, the study provides a framework for future research that allows studying the impact of other economic variables on GDP, which deepens the comprehensive economic understanding of the country.

5-1 Study Methodology:

The study adopts two main approaches: the descriptive approach and the econometric approach. The descriptive approach relies on collecting and analyzing available data on interest rates, GDP, and all other related variables, describing the general trends and changes that occurred in these indicators during the specified period. This is based on data and reports from reliable sources such as data from the World Bank and the Federal Reserve Bank. In addition, the econometric approach is adopted to analyze the impact of changes in the real interest rate quantitatively, using the Autoregressive Distributed Lags (ARDL) model to provide accurate results that contribute to understanding the extent of the impact of the interest rate on GDP during the period from 1983 to 2023, which enhances the economic decision-making base in the Kingdom and enriches scientific literature in this field.

6-1 Research Hypothesis:

Based on the research problem mentioned above, and to achieve the research objectives, the research hypotheses were formulated as follows:

First Hypothesis: Changes in the real interest rate have an impact on GDP of Saudi Arabia.

Second Hypothesis: There is a positive relationship between the real interest rate and the GDP in Saudi Arabia.

7-1 Study concepts:

1-7-1 Interest rate:

the interest rate is "the price one must pay to obtain a certain number of monetary units immediately; this price reflects the number of units one must return in exchange at the end of the set term or time period" (DeSoto, 2020, p.285). The real interest rate is also defined as: the economic variable that reconciles and links lenders and borrowers in financing relationships, where the borrower pays it as a cost for using the borrowed money for a specified period of time, and the lender takes it as income from the loans he grants, since if he keeps it, he has sacrificed the return he could get from the lending process (Ben Daas, 2008, p.151).

2-7-1 Gross Domestic Product:

It is "the total monetary value of all final goods and services produced (and sold in the market) within a country during a period of time (usually one year)" (Leamer, 2009, p.19). The World Bank Group defines GDP (in constant local currency) as: the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without deducting depreciation of manufactured assets or making any allowances for depletion and degradation of natural resources. Data are in constant local currency (World Bank Group, 2023).

2 Literature review and theoretical framework:

This section deals with the theoretical literature by addressing previous studies, then an overview of the real interest rate and the impact of its change, with a review of Saudi economic growth within the framework of the gross domestic product and the extent to which it is affected by the change in real interest rates in Saudi Arabia.

1-2 Literature review:

The importance of the impact of changes in interest rates on various aspects of the economic system has led to this field being of interest to many researchers and economic organizations. Within the limits of the survey conducted by the researcher, taking into account a number of research considerations, the most important studies directly related to the variables of the current study were addressed. We review them as follows:

Abu Omeira's study (2024) dealt with the continuous change in interest rates and their impact on the savings and investment rates, through a standard study according to the (ARDL) methodology to determine the extent of the success of the important tool of monetary policy (interest rates) in the continuous increase in the last decade and the extent of the response of savings and investment rates to this increase in the short and long term in the Egyptian economy. The study methodology was based on the theoretical analytical aspect and the standard approach, and the study reached a set of results, the most important of which are: There is a positive relationship between the interest rate and the savings rate in the short and long term, and also a negative relationship between the interest rate and the investment rate in the short and long term, which affects economic growth and the growth rate of the gross domestic product.

Yahia (2023) conducted a study that aimed to measure the effectiveness and consistency of monetary policy transmission in Algeria through interest rate, credit and exchange rate channels in both the short and long term, using the non-linear autoregressive distributed lag (NARDL) method. The results showed that monetary policy transmission in Algeria exhibits an asymmetric nature, except for the effect of interest rates on bank lending on real GDP and inflation, and that the traditional interest rate channel is the most effective in transmitting the effects of monetary policy to real GDP, while positive changes in credit volume are the most effective in the long term, and negative changes in the exchange rate are the most efficient in the short term with regard to transmission to inflation.

The study of Fleih and Kanawi (2023) aimed to know the impact of the change in the real interest rate and its repercussions on the gross domestic product in Iraq for the period 2004-2020. The descriptive approach was used to identify the concepts of the real interest rate and the gross domestic product and the relationship between them, while the analytical method was used to analyze the relationship between the real interest rate and the gross domestic product in Iraq. The study reached a number of results, including: that interest rates in general, including real rates, are inversely proportional to the investor's desire to invest. The higher the interest rates on capital, the less investment, and vice versa. When the interest rates

imposed on the investor decrease, he is encouraged to invest, and thus the volume of production increases and the volume of the gross domestic product increases as a result. However, if the interest rate increases, it will reduce the desire to invest and thus the size of the country's gross domestic product decreases.

The study of Al-Ansari and Balila (2023), which sought to analyze the impact of money supply on economic growth in the Kingdom of Saudi Arabia during the period from 2001 to 2021, through the time series analysis methodology (ARDL), and the results of this study showed that monetary policy through money supply does not have a significant impact on the real side of the economy represented in the levels of gross domestic product. It also concluded that monetary policy through the interest rate has a negative significant impact on the levels of gross domestic product and thus a negative impact on economic growth. The study recommended that the overall policy should reduce interest rates to allow the expansion of productive and investment activity of economic institutions, which is considered an incentive that increases the profitability of their economic activity and contributes to achieving comprehensive economic growth.

The study by Elsayed et al., (2021), which investigated the interaction between monetary policy and financial stability in the Gulf Cooperation Council countries, by presenting a new composite financial stability index to monitor financial vulnerabilities and crisis periods. To achieve this goal, the study estimated the monetary policy reaction functions for each country using the non-linear autoregressive distributed lag (NARDL) model over the period from the fourth quarter of 2006 to the second quarter of 2020. The empirical results of this study indicate that the response of monetary authorities to deviations from the target level of inflation, the output gap, or the movement of the exchange rate varies in terms of size, sign, and importance across the GCC countries. The results also show that monetary authorities react significantly to negative or positive shocks to financial stability, but their response differs in the short and long term.

The study conducted by Ben Azza (2020) aimed to know the impact of the change in the real interest rate on economic growth, through a standard study of Algeria for the period (1990-2013), using the analytical method. The study reached a number of results, the most important of which are: The growth rate is negatively affected by changes in the interest rate and does not affect it, and thus had a role in worsening the economic situation, as a single positive fluctuation in interest rate changes has a negative impact on growth for several years. The results also showed a one-way relationship, meaning that the change in the real interest rate is what causes the real GDP growth rate, and the relationship between them is negative. This result was attributed to the fact that increasing interest rate differentials leads to a decrease in economic growth, which results in a high interest rate deepening the economic crisis.

The study of Salhi (2017) addressed the impact of interest rates on investment decisions in economic institutions through a survey of a sample of economic institutions in the state of Guelma in Algeria. Using the descriptive analytical approach, the study found that there is an increasing interest among economic institutions in the determinants of investment decisions, especially the interest rate, due to its association with financing, which remains the main concern of decision-makers before embarking on any investment project. The study recommended that monetary authorities, through their monetary policy, avoid high interest rates due to their negative effects on investment decisions taken by the private sector, through several channels.

Al-Qahtani (2015) measured the impact of high interest rates on the Saudi economy using quarterly data for the period 2005-2013. Different specifications of vector autoregression (VAR) were used to capture the impact on most sectors of the Saudi economy. The study found that the impact of high interest rates was negative on GDP, non-GDP and credit for all economic sectors as well.

Chelghoum (2013). aimed to assess the interest rate overshoot rate in the GCC countries during the period from January 2007 to July 2018. Using the ARDL time series econometric approach, the study found that there is a slow and inert relationship in the short run between the money market rate and retail interest rates, and there is no significant short-term relationship in many cases. It also indicated that the change in the money market rate takes a long time to be fully reflected in retail interest rates, which in turn reduces the effectiveness of monetary policy.

Hansen & Seshadri (2013). analyzed long-term data on real interest rates and productivity growth, focusing on estimating the long-run association between them in the US economy using two methodologies: nonparametric and vector autoregression (VAR). The study revealed a moderate negative association, and the study explained this negative association by the fact that the long-term costs resulting from a period of low interest rates will tend to be slightly offset by a period of high productivity growth. Conversely, long-term benefits during a period of high interest rates will offset lower productivity growth.

2-2 Theoretical framework

In this section, the study deals with the theoretical knowledge related to the study variables. A summary of the theories that attempted to explain the relationship between the real interest rate and economic growth is presented, in addition to clarifying the factors affecting the change in the real interest rate, and it also sheds light on the reality of the relationship between changes in the real interest rate and the gross domestic product in the Kingdom of Saudi Arabia.

1-2-2 Theories of the relationship between interest rates and economic growth

The relationship between real interest rates and growth rates has long been the focus of intense interest and study by economists, as understanding this relationship is essential for developing monetary and fiscal policies that promote sustainable development. Here we briefly mention the most important theories that provide predictions regarding this relationship.

1-1-2-2 McKinnon-Shaw Theory:

According to McKinnon and Shaw (1973), financial constraints arise when a country imposes a ceiling on deposits. They conclude that easing financial constraints and allowing market forces to determine real interest rates leads to higher real interest rates. Higher real rates of return lead to higher levels of saving, which in turn stimulates economic growth. Thus, the prediction from their framework is that real interest rates and growth rates are positively related.

2-1-2-2 Keynesian Theory of Interest Rate:

The Keynesian theory of interest rate is an important part of Keynesian economic theory introduced by British economist John Maynard Keynes (1936). This theory focuses on the role of interest rate in determining the level of investment and saving within an economy. According to Keynes, interest rate is not only determined by the interaction between the supply and demand for money, but also plays a crucial role in influencing the level of economic activity and employment. Keynes sees interest rate as the major factor influencing investors' decisions to spend on capital projects. When interest rates are low, borrowing is cheaper, which encourages new investment and thus boosts economic growth and employment. Conversely, when interest rates are high, saving becomes more attractive than investment, which can lead to economic recession. Keynesian philosophy is based on the idea that government intervention through monetary and fiscal policies can be necessary to maintain economic equilibrium, especially in the face of unexpected fluctuations in aggregate demand levels (Appelt, 2016).

2-2-2 Factors affecting the change in the real interest rate:

Many factors play a pivotal role in determining the change in the real interest rate, which is considered a vital indicator of the health of the economy. Among these factors, inflation rates come at the forefront of the influential factors; as high inflation erodes the real value of the interest earned, which forces central banks to adjust nominal interest rates to ensure the real return for investors (Born et al., 2023). In addition, the monetary policies pursued by central banks directly affect the determination of the real interest rate (Beyer et al., 2024), through open market operations and determining the reserve requirement ratio (Friedman & Kuttner, 2010). The state of the global economy also plays an undeniable role, as international economic changes, such as global recessions or financial crises, contribute to interest rate fluctuations because economies are interconnected and affect each other (Arab Monetary Fund. 2024). Moreover, investors' expectations of future economic conditions play a role in determining interest rate levels, as investors rely on macroeconomic indicators and trend analysis to assess future returns and determine investment criteria (Duffee, 2013).

3-2-2 The Relationship Between Real Interest Rate and GDP in Saudi Arabia:

Official reports issued by the Saudi Ministry of Finance indicate that real GDP achieved positive growth of 12.5% in the first half of 2023 compared to the first half of 2022, as real GDP for oil activities recorded a decrease of 1.5% in the first half of 2023 due to a decrease in the Kingdom's oil production by approximately 0.9% in the first half of 2023 in line with OPEC's decision. Real GDP for non-oil activities also recorded a growth of 5.7% compared to the first half of 2022. In contrast, the average interest rates on local and foreign bonds issued during the first half of this year amounted to about 4.4%, while the average interest rates on local bonds issued during the first half of 2022 amounted to about 3.2%. It is worth noting that the US Federal Reserve, in order to control inflation rates, has raised interest rates 3 times by 25 basis points each time In February, March and May 2023, bringing the number of interest rate hikes to 10 since March 2022 until the first half of this year 2023. In line with the objectives of maintaining financial and monetary stability, the Saudi Central Bank also raised interest rates in line with the Federal Reserve's interest rate hike (Ministry of Finance, 2023). In light of what the first half

of 2023 witnessed, fiscal policy continues to work to achieve a balance between economic growth objectives, maintaining financial sustainability, developing non-oil revenues, and continuing to work to raise spending efficiency and increase the level of private sector participation in the economy, as updated estimates for the 2023 budget indicate a budget deficit of about 82 billion riyals (equivalent to 2.0% of GDP) (Ministry of Finance, 2023).

3- Econometric Model for Estimating the Impact of Changes in the Real Interest Rate on Saudi Arabia's Real GDP (1983 – 2023)

This section aims to formulate the theoretical framework of the economic relations under study in an econometric form. This model will be used to quantitatively determine the impact of changes of real interest rate on real GDP in Saudi Arabia, during the period (1983 -2023). Therefore, this section will address the following:

1. Model Description, Identification of Variables, Their Indicators and Data Sources
   a) Descriptive Statistics
   b) Correlation Matrix
2. Determining The Appropriate Econometric Methodology to Estimate the Model's Parameters
3. Testing The Stability of Variables in Time Series Model Using (Unit Root Tests)
4. Determine The Optimal Lags of All Combined Variables
5. Cointegration Test
6. Estimating and Interpreting Quantitative Relationships
   a) Estimating and Interpreting Long-Run Quantitative Relationships
   b) Estimating and Interpreting Short-Run Quantitative Relationships
7. Diagnostic Tests
   a) Multicollinearity
   b) Serial/Auto Correlation
   c) Heteroskedasticity
   d) Specification Bias or Error/Misspecification
   e) Normality
8. Conclusion, Recommendations, and Future Studies

Appendices

3.1 Model Description, Identification of Variables, Their Indicators and Data Sources

This section focuses on determining the econometric form of the model under study based on the theoretical basis, as well as determining the variables that are included in each model and the methods of measuring those variables.

$$GDP_t = f(House_t, GFCF_t, GOV_t, EXTER_t, INTEREST_t, DUM_t) \quad \ldots\ldots (1)$$

It should be noted from the following equation that the linear-log functional form has been chosen. Therefore, the equation of the proposed model is as follows:

$$GDP_t = \beta_o + \beta_1 lnHOUSE_t + \beta_2 lnGFCF_t + \beta_3 lnGOV_t + \beta_4 EXTER_t + \beta_5 INTEREST_t + \beta_6 DUM_t + \varepsilon_t \quad \ldots\ldots (2)$$

According to (Equation 2) above, the symbols of the variables, the indicators that express them and the method of measuring them will be displayed. In addition to that, the prior expectations of the explanatory variables and their impact on GDP in a manner consistent with the theoretical and applied economic literature previously reviewed, as follows:

GDP_t= Gross Domestic Product: It measures by (Constant 2015 US$) and includes the total spending in the economy (the expenditure approach) adjusted for inflation. The increase in its value over time means an increase in the rate of economic growth in society, and vice versa.

$House_t$= Households and NPISHs Final Consumption Expenditure: It measures by (Current US$) and includes the total spending by households on goods and services. The increase in its value over time means an increase in the aggregate demand in the economy, and vice versa. Households and NPISHs Final Consumption Expenditure is expected to have a positive impact on GDP $\beta_1 > 0$

$GFCF_t$= Gross Fixed Capital Formation: It measures as a (% of GDP), and it includes creating schools, offices, hospitals, private residences, commercial and industrial structures, and other infrastructure, as well as purchasing plant, machinery, and equipment and improving land (fences, ditches, drains, etc.). The increase in its value over time means an increase in the

aggregate demand in the economy, and vice versa. Gross Fixed Capital Formation is expected to have a positive impact on GDP $\beta_2 > 0$

GOV_t = General Government Final Consumption Expenditure: It measures by (Current US$) and includes all current government spending on goods and services (including staff remuneration). The majority of national defence and security spending is also included, although government military spending that is a component of capital formation is not. The increase in its value over time means an increase in the aggregate demand in the economy, and vice versa. General Government Final Consumption Expenditure is expected to have a positive impact on GDP $\beta_3 > 0$

$EXTER_t$= External Balance on Goods and Services: It measures by (Current US$) and includes exports minus imports of goods and services. The increase in its value over time means an increase in the aggregate demand in the economy, and vice versa. External Balance on Goods and Services is expected to have a positive impact on GDP $\beta_4 > 0$

$INTEREST_t$ = Real Interest Rate: It measures as (%), 10-Year Real Interest Rate, Percent, Annual, Not Seasonally Adjusted. The increase in its value over time means a decrease in the aggregate demand in the economy, and vice versa. Real Interest Rate is expected to have a negative impact on GDP $\beta_5 < 0$

DUM_t = Dummy Variable (1 for crisis / shocks; 0 for others): (Table 1) below summarize the number of crisis / shocks, their types, and dates that occurred on, in which researchers expect to have a negative impact on GDP $\beta_6 < 0$

Table 1

#	**Types of The Crisis / Shocks in The Model**	**Date**
1	Oil Glut	1986
2	Gulf War 1&2	1990-1991
3	Sep 11th Attack	2001
4	Iraq Invasion	2003
5	Saudi Stock Market (Tdawul) Crash 2006	2006
6	Global Financial Crisis	2007-2009
7	Arab Spring	2011
8	Al-Hazm Storm	2015-2017
9	Covid 19	2020-2022
10	Russian-Ukraine War	2022-Present

Source: Researchers Preparation

This research relies on the use of secondary data in the form of annual time series. Data on most of the study's variables were obtained via the World Development Indicators (WDI) issued by the World Bank in 2023. This was in Saudi Arabia during the period (1983 - 2023), except for the Real Interest Rate data, in which was obtained via the Federal Reserve Bank of St. Louis website.

Descriptive Statistics

Descriptive statistics summarize and describe the main features of a dataset, providing a concise overview of its central tendency, dispersion, and distribution shape.

Table 2
Descriptive Statistics of The Study's Variables
Date: 11/29/24
Time: 19:41
Sample: 1983 2023

	GDP	LNHOUSE	LNGFCF	LNGOV	EXTER	INTEREST	DUM
Mean	455.5917	4.713461	3.072476	3.234116	9.866788	2.334847	0.414634
Median	394.4067	4.299858	3.096174	3.219287	9.318900	2.039322	0.000000
Maximum	782.0184	6.055749	3.379497	3.561686	32.14741	6.637399	1.000000
Minimum	202.0993	3.822142	2.851222	2.873805	-10.70054	-0.119478	0.000000
Std. Dev.	176.8795	0.736625	0.140075	0.169464	11.76266	1.732201	0.498779
Skewness	0.387767	0.521336	0.178224	0.133478	0.049398	0.557876	0.346552
Kurtosis	1.844914	1.694997	2.068741	2.396663	2.081211	2.564568	1.120098
Jarque-Bera	3.306784	4.766585	1.698592	0.743605	1.458804	2.450611	6.857974
Probability	0.191400	0.092246	0.427716	0.689490	0.482197	0.293668	0.032420
Sum	18679.26	193.2519	125.9715	132.5988	404.5383	95.72874	17.00000
Sum Sq. Dev.	1251454.	21.70463	0.784842	1.148725	5534.410	120.0209	9.951220
Observations	41	41	41	41	41	41	41

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 2 above shows the mean, standard deviation, skewness, kurtosis, and normality of the variables. The mean of the variables shows their average values from 1983 to 2023. The standard deviation shows that there is some dispersion in all the variables. Lastly, the Jarque-Bera (JB) statistics showed that its probability is greater than 5% level of significant of all variables and therefore, we do not reject the null hypothesis and conclude that data are normally distributed except for the Dummy Variable (DUM) which its data is not normally distributed.

Correlation Matrix

A correlation matrix shows how strongly each pair of variables is related. It provides insights into whether the variables move together (positive correlation), move in opposite directions (negative correlation), or show no relationship (near zero correlation).

Table 3

The Correlation Matrix Between the Dependent Variable (GDP) and The Independent Variables

	GDP	LNHOUSE	LNGFCF	LNGOV	EXTER	INTEREST	DUM
GDP	1.000000	0.985065	0.523341	-0.582238	0.325539	-0.870253	0.390322
LNHOUSE	0.985065	1.000000	0.620080	-0.548292	0.232058	-0.825135	0.381460
LNGFCF	0.523341	0.620080	1.000000	-0.112376	-0.292930	-0.294068	0.363625
LNGOV	-0.582238	-0.548292	-0.112376	1.000000	-0.819758	0.667034	-0.158415
EXTER	0.325539	0.232058	-0.292930	-0.819758	1.000000	-0.537602	0.103583
INTEREST	-0.870253	-0.825135	-0.294068	0.667034	-0.537602	1.000000	-0.353225
DUM	0.390322	0.381460	0.363625	-0.158415	0.103583	-0.353225	1.000000

Source: Researchers Preparation Using Statistical Software (EViews 9)

Based on Table 3 above, we can see that the correlation coefficient $r_{GDP,LNHOUSE} = 0.98$, which indicates that there is a strong positive correlation between the dependent variable (GDP) and the independent variable (LNHOUSE). However, we can't drop the independent variable (LNHOUSE) from our regression model since it has stipulated on it in the economic theory; it is one of the controlled variables.

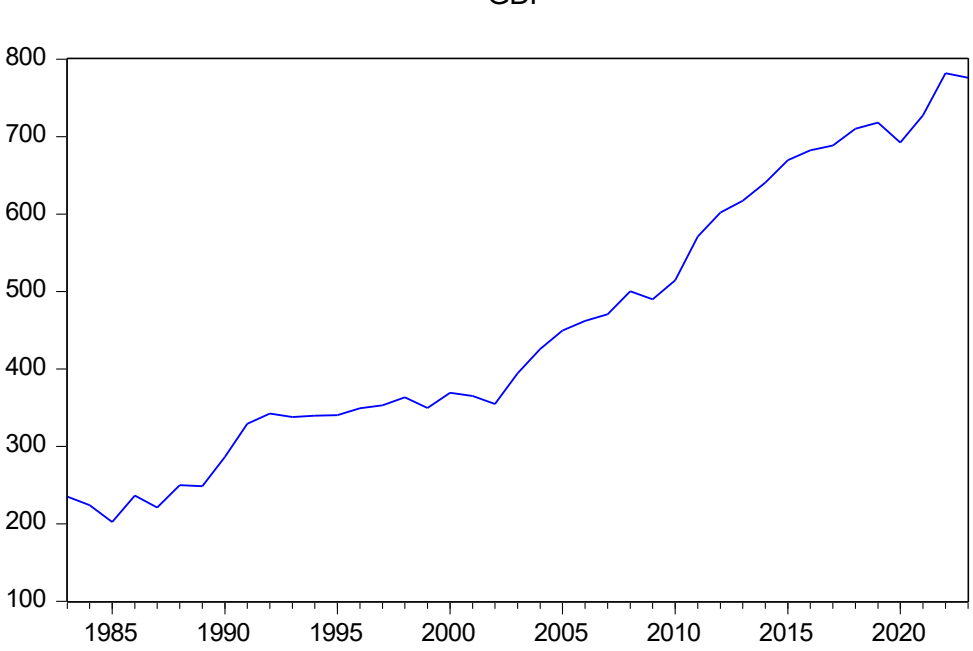
3.2 Determining The Appropriate Econometric Methodology to Estimate the Model's Parameters

The Autoregressive Distributed Lags (ARDL) model will be employed to estimate the relationships between the variables, which depends on introducing lag periods for each of the explanatory variables in addition to lag periods for the dependent variable within the regression model. This model is also based on a main pillar, which is that there is cointegration between all the variables of the model, which leads to the existence of a long-term relationship that forms a linear combination between all the variables, which makes all the variables under study proceed as if they were only one variable, which makes it possible to reach an equilibrium value estimate for the model parameters in the long term. There is no doubt that reaching long-term equilibrium values for the estimated parameters of the model is of great importance to economic policy makers and decision makers, as the existence of an equilibrium value for each parameter makes the explanatory variables included in the model as tools (Instruments) that can be used to through it, it influences the phenomenon under study.

3.3 Testing The Stability of Variables in Time Series Model Using (Unit Root Tests)

Unit Root Tests are used to detect the extent of integration of the time series of the study variables and to determine their degree of integration. There are several unit root tests; however, the most used in applied studies are two tests: The Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. This research relied on both tests together. First, we are going to start with the study's dependent variable (GDP) and test whether it has a unit root (non-stationary) or not.

Figure 1
Non-Stationary Random Walk Graph of The Dependent Variable



Source: Researchers Preparation Using Statistical Software (EViews 9)

Augmented Dickey-Fuller (ADF) Unit Root Test on GDP

Table 4
Case1: Level – Intercept

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.892600	0.9944
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 11/09/24 Time: 09:43
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.017078	0.019133	0.892600	0.3777
C	5.884253	9.155357	0.642711	0.5243

R-squared	0.020536	Mean dependent var	13.52793
Adjusted R-squared	-0.005239	S.D. dependent var	20.42972
S.E. of regression	20.48317	Akaike info criterion	8.925791
Sum squared resid	15943.28	Schwarz criterion	9.010234
Log likelihood	-176.5158	Hannan-Quinn criter.	8.956323
F-statistic	0.796735	Durbin-Watson stat	2.015030
Prob(F-statistic)	0.377689		

Source: Researchers Preparation Using Statistical Software (EViews 9)

It is clear from Figure 1 and Table 4 above that GDP time series data is NOT stationary. Also, and according to the probability of Augmented Dickey-Fuller (ADF) test statistic (p-value= 0.99) which is greater than 5% level of significant, we do NOT reject the null hypothesis and conclude that GDP time series data is NOT stationary in its original (Level) whether at 1%, 5%, or 10% level of significance in the presence of only the (Intercept) in the ADF test equation.

We need, now, to find out if GDP time series data is stationary in its original (Level) at 1%, 5%, or 10% level of significance in the presence of (Trend and Intercept) in the ADF test equation.

Table 5
Case2: Level – Trend and Intercept

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.150450	0.5031
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 11/09/24 Time: 18:02
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.176766	0.082200	-2.150450	0.0381
C	32.91948	14.12309	2.330897	0.0253
@TREND("1983")	2.913420	1.205387	2.416999	0.0207

R-squared	0.154095	Mean dependent var	13.52793
Adjusted R-squared	0.108370	S.D. dependent var	20.42972
S.E. of regression	19.29099	Akaike info criterion	8.829192
Sum squared resid	13769.27	Schwarz criterion	8.955858
Log likelihood	-173.5838	Hannan-Quinn criter.	8.874991
F-statistic	3.370068	Durbin-Watson stat	1.921376
Prob(F-statistic)	0.045232		

Source: Researchers Preparation Using Statistical Software (EViews 9)

According to the probability of Augmented Dickey-Fuller (ADF) test statistic (p-value= 0.50) which is greater than 5% level of significant, we do NOT reject the null hypothesis and conclude that GDP time series data is NOT stationary in its original (Level) whether at 1%, 5%, or 10% level of significance in the presence of (Trend and Intercept) in the ADF test equation.

We need, now, to find out if GDP time series data is stationary in its original (Level) at 1%, 5%, or 10% level of significance in the presence of None (No Trend and Intercept) in the ADF test equation.

Table 6
Case3: Level – None (No Trend and Intercept)

Null Hypothesis: GDP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		4.254811	1.0000
Test critical values:	1% level	-2.624057	
	5% level	-1.949319	
	10% level	-1.611711	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 11/09/24 Time: 18:36
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.028580	0.006717	4.254811	0.0001

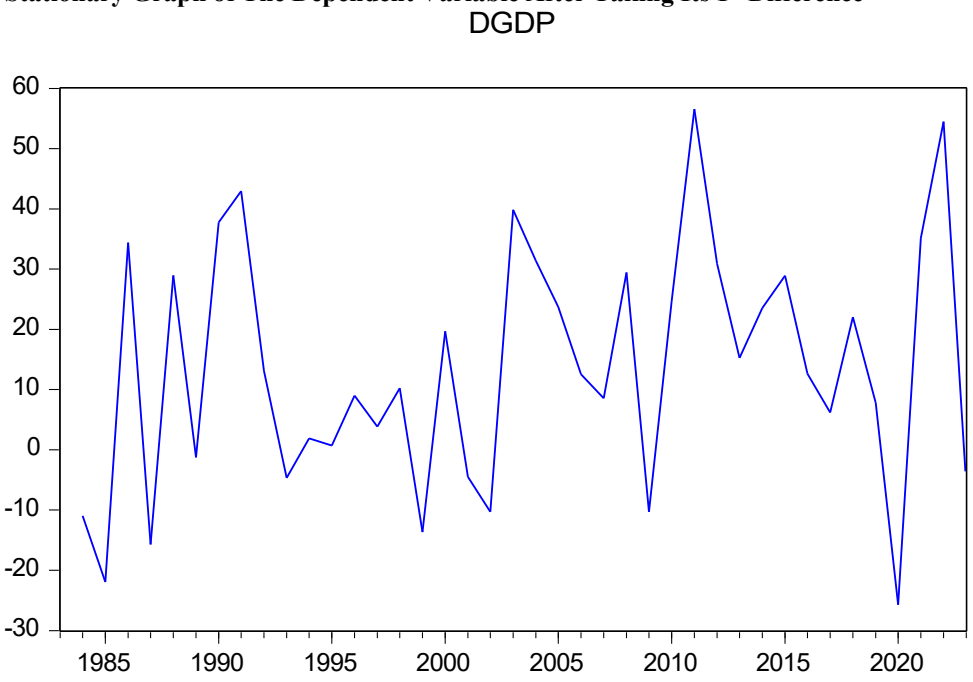
R-squared	0.009889	Mean dependent var	13.52793
Adjusted R-squared	0.009889	S.D. dependent var	20.42972
S.E. of regression	20.32845	Akaike info criterion	8.886602
Sum squared resid	16116.59	Schwarz criterion	8.928824
Log likelihood	-176.7320	Hannan-Quinn criter.	8.901868
Durbin-Watson stat	2.016726		

Source: Researchers Preparation Using Statistical Software (EViews 9)

According to the confliction of the Augmented Dickey-Fuller (ADF) test statistic table above, we can't conclude that GDP time series data is either stationary nor not in its original (Level) whether at 1%, 5%, or 10% level of significance in the presence of None (No Trend and Intercept) in the ADF test equation.

We need, now, to find out if GDP time series data is stationary at the (1st Difference) at 1%, 5%, or 10% level of significance in the presence of only the (Intercept) in the ADF test equation.

Figure 2
Stationary Graph of The Dependent Variable After Taking Its 1st Difference



Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 7
Case4: 1st Difference – Intercept

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-6.131563	0.0000
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/09/24 Time: 19:38
Sample (adjusted): 1985 2023
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.000781	0.163218	-6.131563	0.0000
C	14.16663	4.011899	3.531155	0.0011

R-squared	0.503995	Mean dependent var	0.129507
Adjusted R-squared	0.490590	S.D. dependent var	28.82704
S.E. of regression	20.57472	Akaike info criterion	8.935923
Sum squared resid	15662.80	Schwarz criterion	9.021234
Log likelihood	-172.2505	Hannan-Quinn criter.	8.966532
F-statistic	37.59606	Durbin-Watson stat	2.007094
Prob(F-statistic)	0.000000		

Source: Researchers Preparation Using Statistical Software (EViews 9)

According to Figure 2 and Table 7 above that present the probability of Augmented Dickey-Fuller (ADF) test statistic (p-value= 0.0000) which is less than 5% level of significant, we REJECT the null hypothesis and conclude that GDP time series data is stationary at the (1st Difference) whether at 1%, 5%, or 10% level of significance in the presence of only the (Intercept) in the ADF test equation. All other cases related to the GDP time series data are presented in Appendix (1).

Table 8 below shows the summary results of the unit root test for all variables in their original form or after taking their first difference, using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests.

Table 8

Time Series Stability Results (UR) Using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Tests

Test for Unit Root In	Level						1st Difference						I( )
Test Type	(ADF)			(PP)			(ADF)			(PP)			
Series/ Variable	C	Trend & C	None	C	Trend & C	None	C	Trend & C	None	C	Trend & C	None	
GDP	t= 0.89 P= 0.99	t= -2.15 P= 0.50	t= 4.25 P= 1.00	t= 0.92 P= 0.99	t= -2.15 P= 0.50	t= 4.25 P= 1.00	t= -6.13 P= 0.00	t= -5.20 P= 0.00	t= -1.60 P= 0.10	t= -6.13 P= 0.00	t= -6.22 P= 0.00	t= -4.45 P= 0.00	I(1)
LNHOUSE	t= 0.53 P= 0.98	t= -2.45 P= 0.34	t= 2.12 P= 0.99	t= 1.22 P= 0.99	t= -2.31 P= 0.41	t= 3.28 P= 0.99	t= -2.95 P= 0.04	t= -3.28 P= 0.08	t= -1.50 P= 0.12	t= -2.85 P= 0.05	t= -3.24 P= 0.09	t= -1.87 P= 0.05	I(1)
LNGFCF	t= -1.98 P= 0.29	t= -3.03 P= 0.13	t= -0.02 P= 0.66	t= -1.98 P= 0.29	t= -2.91 P= 0.16	t= 0.01 P= 0.68	t= -6.32 P= 0.00	t= -6.58 P= 0.00	t= -6.41 P= 0.00	t= -6.49 P= 0.00	t= -7.13 P= 0.00	t= -6.61 P= 0.00	I(1)
LNGOV	t= -2.07 P= 0.25	t= -2.63 P= 0.26	t= -0.47 P= 0.50	t= -1.97 P= 0.29	t= -2.61 P= 0.27	t= -0.64 P= 0.42	t= -7.16 P= 0.00	t= -7.06 P= 0.00	t= -7.22 P= 0.00	t= -7.59 P= 0.00	t= -7.80 P= 0.00	t= -7.47 P= 0.00	I(1)
EXTER	t= -2.33 P= 0.16	t= -2.14 P= 0.50	t= -1.48 P= 0.12	t= -2.15 P= 0.22	t= -1.87 P= 0.64	t= -1.28 P= 0.17	t= -6.61 P= 0.00	t= -5.72 P= 0.00	t= -6.67 P= 0.00	t= -7.00 P= 0.00	t= -14.5 P= 0.00	t= -6.97 P= 0.00	I(1)
INTEREST	t= -2.10 P= 0.24	t= -1.89 P= 0.63	t= -2.29 P= 0.02	t= -2.67 P= 0.08	t= -1.35 P= 0.85	t= -3.96 P= 0.00	t= -5.81 P= 0.00	t= -6.32 P= 0.00	t= -5.27 P= 0.00	t= -5.44 P= 0.00	t= -7.15 P= 0.00	t= -5.22 P= 0.00	I(1)

Source: Researchers Compilations

GDP: Based on Table 8 results above, we can see that GDP time series data is not stationary in its original (Level) using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in the presence of the Intercept, Trend & Intercept, and None since the (P-value > 0.05) in all these cases. Also, the series is not stationary at the (1st Difference) using (ADF) test in the presence of None since its (P-value = 0.10). However, it has been found that GDP time series is stationary at the (1st Difference) using (ADF) test in the presence of the Intercept (P-value = 0.00) and in the presence of Trend & Intercept (P-value = 0.0007). And stationary at the (1st Difference) using Phillips-Perron (PP) test in the presence of the Intercept, Trend & Intercept, and in None since all of them (P-value = 0.00).

LNHOUSE: Based on Table 8 results above, we can see that LNHOUSE time series data is not stationary in its original (Level) using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in the presence of the Intercept, Trend & Intercept, and None since the (P-value > 0.05) in all these cases. Also, the series is not stationary at the (1st Difference) using (ADF) test in the presence of Trend & Intercept, and None, as well as in the presence of Trend & Intercept using Phillips-Perron (PP) test since the (P-value > 0.05) in all these cases. However, it has been found that LNHOUSE time series is stationary at the (1st Difference) using both (ADF) and (PP) tests in the presence of the Intercept, as well as in the presence of None using (PP) test since the (P-value $\leq$ 0.05) in these cases.

LNGFCF: Based on Table 8 results above, we can see that LNGFCF time series data is not stationary in its original (Level) using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in the presence of the Intercept, Trend & Intercept, and None since the (P-value > 0.05) in all these cases. However, it has been found that LNGFCF time series is stationary at the (1st Difference) using both (ADF) and (PP) tests whether in the presence of Intercept, Trend & Intercept, or None since the (P-value < 0.05) in all these cases.

LNGOV: Based on Table 8 results above, we can see that LNGOV time series data is not stationary in its original (Level) using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in the presence of the Intercept, Trend & Intercept, and None since the (P-value > 0.05) in all these cases. However, it has been found that LNGOV time series is stationary at the (1st Difference) using both (ADF) and (PP) tests whether in the presence of Intercept, Trend & Intercept, or None since the (P-value < 0.05) in all these cases.

EXTER: Based on Table 8 results above, we can see that EXTER time series data is not stationary in its original (Level) using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in the presence of the Intercept, Trend & Intercept, and in None since the (P-value > 0.05) in all these cases. However, it has been found that EXTER time series is stationary at the (1st Difference) using both (ADF) and (PP) tests whether in the presence of Intercept, Trend & Intercept, or None since the (P-value < 0.05) in all these cases.

INTEREST: Based on Table 8 results above, we can see that INTEREST time series data is not stationary in its original (Level) using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in the presence of Intercept and Trend & Intercept since the (P-value > 0.05) in these cases. However, the series is stationary in its original (Level) using both (ADF)

and (PP) tests in the presence of None, as well as at the (1st Difference) using both tests in the presence of the Intercept, Trend & Intercept, and in None since the (P-value < 0.05) in all these cases.

Therefore, and according to the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests above, we can conclude that all the study's series/ variables have become stationary and integrated after taking its (1st Difference) in the presence of only the Intercept, which means that all the study's series/ variables have an integration of order one I(1). The next step is to determine the optimal lag length for the study's series/ variables.

3.4 Determine The Optimal Lags of All Combined Variables

Performing cointegration tests and parameter estimation in both long and short run requires determining the optimal lag length for the study's series/ variables, and that is done by using the Vector Autoregressive Model (VAR). The mechanism for applying this model is crystallized by conducting each of the following tests: (LogL, LR, FPE. AIC, SC, and HQ) as they are representing in Table 9 below.

Table 9

Determining The Optimal Number of Lags According to (VAR) Analysis

VAR Lag Order Selection Criteria
Endogenous variables: GDP LNHOUSE LNGFCF LNGOV EXTER INTEREST
Exogenous variables: C DUM
Date: 11/29/24 Time: 20:44
Sample: 1983 2023
Included observations: 38

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-283.6699	NA	0.231054	15.56157	16.07871	15.74557
1	-84.54897	314.4015	4.48e-05	6.976262	9.044792*	7.712229
2	-37.05558	59.99166*	2.93e-05*	6.371346*	9.991274	7.659289*
3	-8.344828	27.19966	7.00e-05	6.754991	11.92632	8.594909

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 9 above and according to (SC) test shows that there is only one lag period for each variable in the model; whereas it shows according to (LR), (FPE), (AIC) and (HQ) tests that there are two lag periods for each variable in the model. Therefore, we can confidently say that the optimal lag length for the study's series/ variables are 2 lags based on the four tests/ criterias above. In this situation, we can use the Autoregressive Distributed Lags (ARDL) model and applying the Bounds Testing Approach in order to see the extension of cointegration between the model's variables since ARDL model and under the Bounds Testing Approach does not require the same integration order to all variables.

3.5 Cointegration Test

After identifying the degree of integration of the time series of the variables under study, and ensuring that there is no time series whose integration order study is higher than the first order I(1), the next step is to determine the extent of the availability of the cointegration property between the model variables. The cointegration property means that there is a long-term relationship between the model variables, i.e. there is a linear combination that makes all the model variables appear as if they were one stable variable, which makes it possible to estimate the equilibrium values of the model parameters. ARDL regression reporting result is presented in Appendix (2).

Table 11
Results of ARDL Cointegration Test Using (Bounds Test)

ARDL Bounds Test
Date: 11/29/24 Time: 23:07
Sample: 1987 2023
Included observations: 37
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	13.57828	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.49	3.38
5%	2.81	3.76
2.5%	3.11	4.13
1%	3.5	4.63

Test Equation:
Dependent Variable: D(GDP)
Method: Least Squares
Date: 11/29/24 Time: 23:07
Sample: 1987 2023
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHOUSE)	98.32395	35.86481	2.741516	0.0145
D(LNGFCF)	0.907310	26.82885	0.033818	0.9734
D(LNGFCF(-1))	150.1091	25.91939	5.791384	0.0000
D(LNGFCF(-2))	39.24458	24.63463	1.593066	0.1307
D(LNGOV)	-17.51395	26.82904	-0.652798	0.5232
D(LNGOV(-1))	-46.15968	28.35506	-1.627917	0.1231
D(EXTER)	1.283370	0.481885	2.663228	0.0170
D(EXTER(-1))	0.535492	0.571214	0.937463	0.3625
D(EXTER(-2))	-0.592861	0.411324	-1.441349	0.1688
D(EXTER(-3))	-0.927835	0.253225	-3.664072	0.0021
D(INTEREST)	-2.410995	3.723523	-0.647504	0.5265
D(INTEREST(-1))	16.71364	3.668066	4.556526	0.0003
DUM	-0.157910	3.724055	-0.042403	0.9667
C	-827.5352	182.2282	-4.541203	0.0003
@TREND	-5.381051	1.155332	-4.657580	0.0003
LNHOUSE(-1)	260.5376	34.09393	7.641759	0.0000
LNGFCF(-1)	-143.3695	33.57930	-4.269579	0.0006
LNGOV(-1)	162.5440	32.26496	5.037786	0.0001
EXTER(-1)	2.747503	0.731938	3.753739	0.0017
INTEREST(-1)	-14.56642	5.051771	-2.883428	0.0108
GDP(-1)	-0.782894	0.102157	-7.663662	0.0000

R-squared	0.953250	Mean dependent var	14.58467
Adjusted R-squared	0.894813	S.D. dependent var	19.68056
S.E. of regression	6.382916	Akaike info criterion	6.841933
Sum squared resid	651.8659	Schwarz criterion	7.756238
Log likelihood	-105.5758	Hannan-Quinn criter.	7.164268
F-statistic	16.31234	Durbin-Watson stat	2.439254
Prob(F-statistic)	0.000000		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 11 above illustrates the results of ARDL cointegration test between the GDP as a dependent variable and its determinants as explanatory variables using the Bounds Test on which the cointegration methodology is based on according to the ADRL model. The results of the table show that F-Statistics Value (13.57) is greater than the Upper Bound Critical Values at 1%, 2.5%, 5%, and at 10% level of significant, and therefore, we reject the null hypotheses and accept the alternative one, which means that there is cointegration between the model variables. In other words, there is a long-run relationship and a linear combination that links the GDP as a dependent variable with its determinants as explanatory variables. This indicates that it is possible to estimate the equilibrium values of the model parameters in the long run.

Moreover, it is noted that the coefficient of determination (R-squared = 0.95) of the estimated model shows that about 95% of the variation in GDP of Saudi Arabia is jointly explained and accounted for by the independent variables in the estimated ARDL (1, 1, 3, 2, 4, 2) model. This when adjusted for degree of freedom based on the adjusted coefficient of determination (Adjusted R-squared = 0.89) shows that the ARDL (1, 1, 3, 2, 4, 2) model has about 89% explanatory power with respect to variations in GDP of Saudi Arabia. This implies that the ARDL model has a satisfactory goodness of fit. The F-test which is used to determine the overall statistical significance of a regression model shows that the overall regression is statistically significant at 1% level.

3.6 Estimating and Interpreting Quantitative Relationships

a) Estimating and Interpreting Long-Run Quantitative Relationships

Long-run quantitative relationships are measured by using the Autoregressive Distributed Lags (ARDL) model, which is based on adding several appropriate lags - which are pre-specified by this model - to the independent variables in the model and to the dependent variable among the explanatory variables in the model. The general formula for long-run equations according to this model is as follows:

$$\boldsymbol{GDP_t = \eta_0 + \sum_{i=1}^{p} \eta_1\, lnHOUSE_{t-i} + \sum_{i=1}^{p} \eta_2\, lnGFCF_{t-i} + \sum_{i=1}^{p} \eta_3\, lnGOV_{t-i} + \sum_{i=1}^{p} \eta_4\, EXTER_{t-i} + \sum_{i=1}^{p} \eta_5\, INTEREST_{t-i} + \sum_{i=1}^{p} \eta_6\, DUMt + \varepsilon_t \ldots\ldots (3)}$$

The above parameters in Equation 3 represent the long-run model parameters, and they are considered elasticities between the dependent variable on the one hand and the explanatory variables on the other hand. ε_t refers to the random error whose arithmetic mean is zero and whose variance is constant. p is the optimal number of time lags for each explanatory variable, as three lags will be relied upon for each variable of the model, according to the VAR Lag Order Selection Criteria obtained above.

The data in the Table 12 below shows the summary results that were estimated for the relationships between the model variables in the long run, corresponding to the previous equation. It is noted that based on the theoretical basis of the ARDL model, it is intended to carry out the (Normalization) process, and the idea of this procedure is based on the fact that in the long run, the model variables tend to be stable at their equilibrium levels, and accordingly there is no fundamental difference between the value of the variable under study in the current period and its values in the different lag periods.

Table 12
Results of Estimating Long-Run Parameters According to The ARDL Model

ARDL Cointegrating And Long Run Form
Dependent Variable: GDP
Selected Model: ARDL(1, 1, 3, 2, 4, 2)
Date: 11/29/24 Time: 23:12
Sample: 1983 2023
Included observations: 37

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHOUSE)	98.509326	20.833468	4.728417	0.0002
D(LNGFCF)	0.195478	17.901959	0.010919	0.9914
D(LNGFCF(-1))	149.684293	17.882806	8.370291	0.0000
D(LNGFCF(-2))	39.503696	19.108478	2.067339	0.0553
D(LNGOV)	-18.640417	18.301513	-1.018518	0.3236
D(LNGOV(-1))	-45.784991	21.534710	-2.126102	0.0494
D(EXTER)	1.268744	0.312730	4.056998	0.0009
D(EXTER(-1))	0.539334	0.329480	1.636925	0.1212
D(EXTER(-2))	-0.578555	0.239062	-2.420103	0.0278
D(EXTER(-3))	-0.938285	0.174004	-5.392310	0.0001
D(INTEREST)	-2.287594	2.396247	-0.954657	0.3540
D(INTEREST(-1))	16.504358	2.548833	6.475261	0.0000
D(DUM)	0.261354	1.884024	0.138721	0.8914
C	-833.030618	73.047685	-11.403929	0.0000
CointEq(-1)	-0.782971	0.068206	-11.479435	0.0000

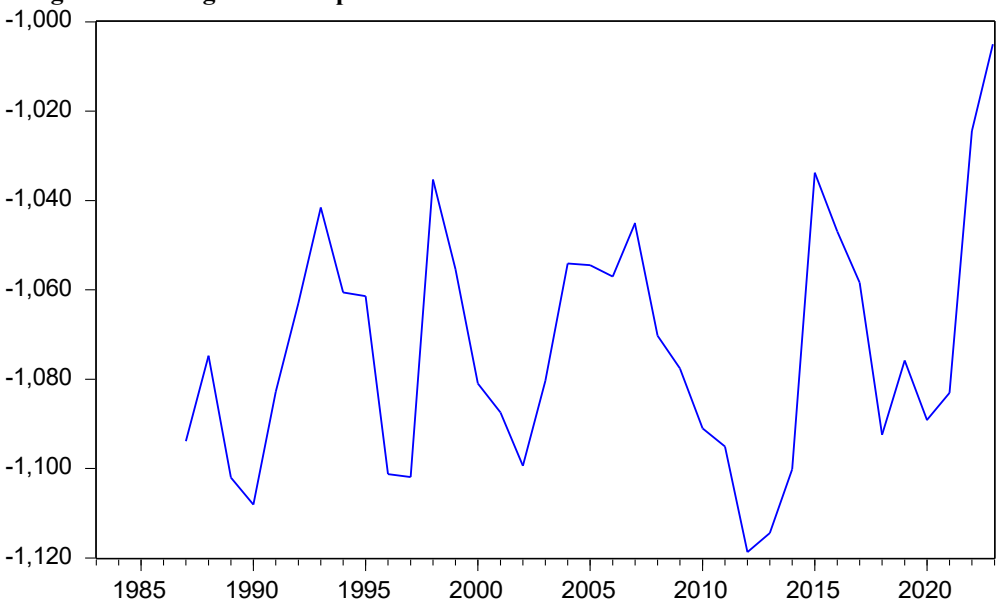
Cointeq = GDP - (332.7878*LNHOUSE -183.1275*LNGFCF + 207.6193 *LNGOV + 3.5094*EXTER -18.6059*INTEREST -0.2017*DUM -6.8733*@TREND)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNHOUSE	332.787755	28.592539	11.638972	0.0000
LNGFCF	-183.127492	41.329557	-4.430909	0.0004
LNGOV	207.619318	38.020242	5.460757	0.0001
EXTER	3.509418	0.892128	3.933762	0.0012
INTEREST	-18.605860	7.115534	-2.614823	0.0188
DUM	-0.201701	4.752142	-0.042444	0.9667
@TREND	-6.873279	1.734132	-3.963527	0.0011

Source: Researchers Preparation Using Statistical Software (EViews 9)

Figure 3
Long-Run Cointegration Graph



Source: Researchers Preparation Using Statistical Software (EViews 9)

Based on the results shown above, the estimated long run cointegration regression equation can be formulated in its final interpretable form as follows:

$$\mathbf{GDP = 332.787LNHOUSE - 183.127LNGFCF + 207.619}\boldsymbol{LNGOV} + \mathbf{3.509}\boldsymbol{EXTER} - \mathbf{18.605INTEREST - 0.201DUM - 6.873@TREND + \varepsilon_t} \quad \ldots\ldots (4)$$

Depending on the value and sign of each of the previous parameters in (**Equation 4**) above, an interpretation can be provided for each parameter individually, as shown below:

LNHOUSE: It is clear from the sign of the estimated parameter for current US$ households' final consumption expenditure (LNHOUSE) that it has a positive effect on constant 2015 US$ Gross Domestic Product (GDP), and its value shows that an increase in current US$ households final consumption expenditure by 1%, leads to an increase in GDP by 332.787 US$, holding other explanatory variables constant. This effect was achieved at a 1% level of significance.

LNGFCF: It is clear from the sign of the estimated parameter for Gross Fixed Capital Formation as a % of GDP (LNGFCF) that it has a negative effect on constant 2015 US$ Gross Domestic Product (GDP), and its value shows that an increase in Gross Fixed Capital Formation as a % of GDP by 1%, leads to a decrease in GDP by 183.127 US$, holding other explanatory variables constant. This effect was achieved at a 1% level of significance.

LNGOV: It is clear from the sign of the estimated parameter for current US$ Government Expenditure (LNGOV) that it has a positive effect on the constant 2015 US$ Gross Domestic Product (GDP), and its value shows that an increase in current US$ Government Expenditure by 1% leads to an increase in GDP by 207.619 US$, holding other explanatory variables constant. This effect was achieved at a 1% level of significance.

EXTER: It is clear from the sign of the estimated parameter for current US$ External Balance on Goods and Services (EXTER) that it has a positive effect on constant 2015 US$ Gross Domestic Product (GDP), and its value shows that an increase in current US$ External Balance on Goods and Services by 1US%, leads to an increase in GDP by 3.509 US$, holding other explanatory variables constant. This effect was achieved at a 1% level of significance.

INTEREST: It is clear from the sign of the estimated parameter for 10-Year Real Interest Rate, Percent, Annual, Not Seasonally Adjusted (INTEREST) that it has a negative effect on constant 2015 US$ Gross Domestic Product (GDP), and its value shows that an increase in 10-Year Real Interest Rate, Percent, Annual, Not Seasonally Adjusted by 1%, leads to a

decrease in GDP by 18.605 US$, holding other explanatory variables constant. This effect was achieved at a 1% level of significance.

DUM: The sign of the estimated parameter for the Dummy Variable (DUM) represents the constant 2015 US$ Gross Domestic Product (GDP) mean difference between the years in which crisis/ shocks occurred on and the years in which crisis/ shocks did not occur on, holding other explanatory variables constant. In other words, the constant 2015 US$ Gross Domestic Product (GDP) in the years in which crisis/ shocks occurred on is, in average, less (have a better GDP) than the years in which crisis/ shocks did not occur on by 0.201 US$, holding other explanatory variables constant. This effect was, however, found insignificant since its p-value (0.96) is greater than even 10% level of significance.

@TREND: It is clear from the sign of the estimated parameter for Time Trend (TREND) that it has a negative effect on the constant 2015 US$ Gross Domestic Product (GDP), and its value shows that an increase in time by one year leads to a decrease in GDP by 6.873 US$, holding other explanatory variables constant. This effect was achieved at a 1% level of significance.

The results of the long-run quantitative relationship estimation concluded that all study variables have a significant impact on GDP, except for the dummy variable that represents the years in which crisis/ shocks occurred on (DUM). This may be justified, given the short time frame of crisis/ shocks on one hand, the fact that most of them occurred outside of Saudi Arabia, and the lack of a noticeable impact of the repercussions of crisis/ shocks of those years on GDP on the other hand.

The long-run results also showed that there are three variables that had a positive impact on GDP: current US$ households' final consumption expenditure (LNHOUSE), current US$ Government Expenditure (LNGOV), and current US$ External Balance on Goods and Services (EXTER), While four other explanatory variables had a negative effect on GDP: Gross Fixed Capital Formation as a % of GDP (LNGFCF), 10-Year Real Interest Rate, Percent, Annual, Not Seasonally Adjusted (INTEREST), the Dummy Variable that represents the years in which crisis/ shocks occurred on (DUM), and the Time Trend (TREND).

b) Estimating and Interpreting Short-Run Quantitative Relationships

After estimating the long-run relationships, the next step is to estimate the short-run relationships in order to know the size and direction of the impact of each explanatory variable on GDP in Saudi Arabia in the short-run. To achieve this, we will rely on estimating the Error Correction Model (ECM), which depends on estimating the random error term (residuals) from the long-run regression to the short-run regression in their form as explanatory variables. The idea of this model is to regress the dependent variable on each of the explanatory variables with appropriate lag periods - one period less than the long-run model, and the error correction term with one lag period, after taking the first difference for all variables except the variable that reflects the error correction term. Therefore, the short-run model is represented by (Equation 5) below:

$$\Delta GDP_t = \eta_0 + \sum_{i=1}^{p} \eta_1 \Delta lnHOUSE_{t-i} + \sum_{i=1}^{p} \eta_2 \Delta lnGFCF_{t-i} + \sum_{i=1}^{p} \eta_3 \Delta lnGOV_{t-i} + \sum_{i=1}^{p} \eta_4 \Delta EXTER_{t-i} + \sum_{i=1}^{p} \eta_5 \Delta INTEREST_{t-i} + \sum_{i=1}^{p} \eta_6 DUMt + \varphi ECT_{t-1} + \varepsilon_t \quad (5)$$

The parameters in (Equation 5) above represent the short-term model parameters, which are considered as elasticities between the dependent variable on one hand and the explanatory variables on the other hand, but in the short term. ($\Delta GDP_t, \Delta lnHOUSE_{t-i}, \Delta lnGFCF_{t-i}, \Delta lnGOV_{t-i}, \Delta EXTER_{t-i}, \Delta INTEREST_{t-i}, DUMt$) express the first difference of the model variables and their different time lags. ***P*** is the optimal number of time lags for the model variables that are specified with three-time lags as shown in the table above. (ECT_{t-1}) represents the (Error Correction Term), which measures the speed of adaptation or (Adjustment Speed), through which the imbalance is addressed in the short term, in order to achieve equilibrium in the long term. Therefore, the number of time periods required to achieve equilibrium in the long term is determined through the adjustment speed coefficient. (φ) represents the adjustment speed coefficient, and this coefficient represents the percentage that is adjusted each period from the imbalance in the previous period, which means that the absolute value of this coefficient reflects the speed at which the equilibrium is restored, and it is expected that this coefficient will carry a negative sign in order to correct the equilibrium error and move towards equilibrium again. ε_t refers to the random error term whose arithmetic mean is zero and its variance is constant

Based on the above, the results of the model in the short term can be explained based on the parameters that showed statistical significance in the short term through the table below:

Table 13

Results of Estimating Short-Run Parameters According to The ARDL Model

ARDL Cointegrating And Long Run Form
Dependent Variable: GDP
Selected Model: ARDL(1, 1, 3, 2, 4, 2)
Date: 11/29/24 Time: 23:12
Sample: 1983 2023
Included observations: 37

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHOUSE)	98.509326	20.833468	4.728417	0.0002
D(LNGFCF)	0.195478	17.901959	0.010919	0.9914
D(LNGFCF(-1))	149.684293	17.882806	8.370291	0.0000
D(LNGFCF(-2))	39.503696	19.108478	2.067339	0.0553
D(LNGOV)	-18.640417	18.301513	-1.018518	0.3236
D(LNGOV(-1))	-45.784991	21.534710	-2.126102	0.0494
D(EXTER)	1.268744	0.312730	4.056998	0.0009
D(EXTER(-1))	0.539334	0.329480	1.636925	0.1212
D(EXTER(-2))	-0.578555	0.239062	-2.420103	0.0278
D(EXTER(-3))	-0.938285	0.174004	-5.392310	0.0001
D(INTEREST)	-2.287594	2.396247	-0.954657	0.3540
D(INTEREST(-1))	16.504358	2.548833	6.475261	0.0000
D(DUM)	0.261354	1.884024	0.138721	0.8914
C	-833.030618	73.047685	-11.403929	0.0000
CointEq(-1)	-0.782971	0.068206	-11.479435	0.0000

Cointeq = GDP - (332.7878*LNHOUSE -183.1275*LNGFCF + 207.6193 *LNGOV + 3.5094*EXTER -18.6059*INTEREST -0.2017*DUM -6.8733*@TREND)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNHOUSE	332.787755	28.592539	11.638972	0.0000
LNGFCF	-183.127492	41.329557	-4.430909	0.0004
LNGOV	207.619318	38.020242	5.460757	0.0001
EXTER	3.509418	0.892128	3.933762	0.0012
INTEREST	-18.605860	7.115534	-2.614823	0.0188
DUM	-0.201701	4.752142	-0.042444	0.9667
@TREND	-6.873279	1.734132	-3.963527	0.0011

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 13 above shows the following:

ECT: It is clear from the error correction coefficient - the adjustment speed coefficient - that it takes a negative sign ($\varphi = -0.78$), in addition to being statistically significant at a significance level of 1%, which confirms the results obtained in the

Bounds Test, which is the existence of long-term co-integration between the model variables. As for the absolute value of this coefficient, it means that approximately 78% of the equilibrium error resulting from the previous year's shocks is corrected annually on average, which means that the equilibrium is restored in approximately 15 months per year, which indicates a high adjustment speed for this model.

LNHOUSE: As for the impact of the current US$ households' final consumption expenditure (LNHOUSE) on the constant 2015 US$ Gross Domestic Product (GDP) in the short-run, it is noted that this impact has maintained the same sign (positive) in the short-run as it was in the long-run, and during the same time period, i.e. during the same year, and in the absence of any lag period in the short-run, as well as, it shows a significant impact on GDP.

LNGFCF: As for the impact of the Gross Fixed Capital Formation as a % of GDP (LNGFCF) on the constant 2015 US$ Gross Domestic Product (GDP) in the short run, it is noted that this impact has differ its sign. While its sign was negative in the long-run, it became positive in the short-run, and during the same time period, i.e. during the same year, but it has shown a positive and significant impact on GDP with the presence of a lag period and two lag periods, respectively, in the short term.

LNGOV: As for the impact of the current US$ Government Expenditure (LNGOV) on the constant 2015 US$ Gross Domestic Product (GDP) in the short run, it is noted that this impact has differ its sign. While its sign was positive in the long-run, it became negative in the short-run, and during the same time period, i.e. during the same year, but it has shown a negative and significant impact on GDP with the presence of one lag period in the short term.

EXTER: As for the impact of the current US$ External Balance on Goods and Services (EXTER) on the constant 2015 US$ Gross Domestic Product (GDP) in the short-run, it is noted that this impact has maintained the same sign (positive) in the short-run as it was in the long-run, and during the same time period, i.e. during the same year. Moreover, and while it has shown a positive and insignificant impact on GDP with the presence of a one lag period, it has shown a negative and significant impact on GDP with the presence of two and three lag periods, respectively, in the short term.

INTEREST: As for the impact of 10-Year Real Interest Rate, Percent, Annual, Not Seasonally Adjusted (INTEREST) on the constant 2015 US$ Gross Domestic Product (GDP) in the short-run, it is noted that this impact has maintained the same sign (negative) in the short-run as it was in the long-run, and during the same time period, i.e. during the same year, but it has shown a positive and significant impact on GDP with the presence of one lag period in the short term.

DUM: As for the impact of the Dummy Variable (DUM) on the constant 2015 US$ Gross Domestic Product (GDP) in the short-run, it is noted that this impact has differ its sign. While its sign was negative in the long run, it became positive in the short run, and during the same time period, i.e. during the same year, and in the absence of any lag period in the short run, as well as it has shown an insignificant impact on GDP.

3.7 Diagnostic Tests

Diagnostic tests are statistical methods for assessing a model's validity and underlying assumptions. Diagnostic tests are used in statistical analysis and econometrics to find any model flaws such autocorrelation, heteroskedasticity, and misspecification that could compromise the accuracy of the estimates and conclusions. We can make sure that the model is appropriately stated and that the outcomes are trustworthy by running diagnostic tests. The following diagnostic tests are the ones that are used in our regression analysis:

a) Multicollinearity
b) Serial/Auto Correlation
c) Heteroskedasticity
d) Specification Bias or Error/Misspecification
e) Normality

a) Multicollinearity

Multicollinearity occurs when two or more explanatory variables in a regression model are highly correlated, meaning that they provide redundant information. In a dynamic model, this could mean that lagged variables or other time-varying predictors are too strongly correlated, which can distort the estimation of coefficients.

The Variance Inflation Factor (VIF) table reveals the extent of multicollinearity in the model. Generally, VIF values above 5 indicate moderate multicollinearity, and values above 10 suggest high multicollinearity between predictors.

Table 14

Variance Inflation Factors
Date: 11/29/24 Time: 23:32
Sample: 1983 2023
Included observations: 37

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
GDP(-1)	0.010436	2308.672	250.5603
LNHOUSE	1286.285	27424.93	612.7109
LNHOUSE(-1)	3086.269	64157.16	1403.795
LNGFCF	719.7875	6134.553	12.44081
LNGFCF(-1)	1065.176	9042.547	16.58312
LNGFCF(-2)	858.6016	7275.556	12.94049
LNGFCF(-3)	606.8648	5145.726	9.307223
LNGOV	719.7973	6754.451	16.32556
LNGOV(-1)	1036.642	9795.125	26.16884
LNGOV(-2)	804.0095	7651.679	20.67447
EXTER	0.232213	52.44217	22.60533
EXTER(-1)	0.342738	77.63953	36.83300
EXTER(-2)	0.337366	74.40705	38.57274
EXTER(-3)	0.140370	31.11005	17.59013
EXTER(-4)	0.064123	14.34492	8.466591
INTEREST	13.86462	73.63456	23.95515
INTEREST(-1)	20.80792	117.4772	37.98904
INTEREST(-2)	13.45471	86.17295	28.35310
DUM	13.86858	5.446454	3.091231
C	33207.12	30157.45	NA
@TREND	1.334792	724.9001	138.1917

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 14 above shows high multicollinearity among most of the model's variables since most of them reveal VIFs greater than 10; however, it is not a significant issue because it did not affect the significant of the estimated coefficient specially in the long run.

b) Serial/Auto Correlation

Serial /Autocorrelation refers to the correlation of a variable with itself across time. In a regression context, if the residuals from a model are autocorrelated, it suggests that the model has not fully captured the temporal dynamics of the data. Serial/ Autocorrelation in the residuals violates the assumption of independence of errors in many regression models (especially OLS), which can lead to inefficient estimates and invalid statistical inferences. Several tests and diagnostic tools can help detect serial/ autocorrelation in a dynamic model, such as the Breusch-Godfrey Serial Correlation LM Test, in which we are going to use.

Table 15

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.648468	Prob. F(2,14)	0.5379
Obs*R-squared	3.137009	Prob. Chi-Square(2)	0.2084

Test Equation:

Dependent Variable: RESID
Method: ARDL
Date: 11/30/24 Time: 00:07
Sample: 1987 2023
Included observations: 37
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.021649	0.112233	0.192898	0.8498
LNHOUSE	-6.445075	37.21306	-0.173194	0.8650
LNHOUSE(-1)	5.320431	58.19567	0.091423	0.9285
LNGFCF	0.404541	27.59509	0.014660	0.9885
LNGFCF(-1)	-3.360681	33.56696	-0.100119	0.9217
LNGFCF(-2)	-0.305253	30.03839	-0.010162	0.9920
LNGFCF(-3)	2.805410	25.53660	0.109858	0.9141
LNGOV	-6.069914	27.95546	-0.217128	0.8312
LNGOV(-1)	9.988272	34.30849	0.291131	0.7752
LNGOV(-2)	-3.425758	29.29455	-0.116942	0.9086
EXTER	0.008408	0.493523	0.017037	0.9866
EXTER(-1)	0.071448	0.603735	0.118343	0.9075
EXTER(-2)	-0.062297	0.603741	-0.103186	0.9193
EXTER(-3)	0.045789	0.393852	0.116260	0.9091
EXTER(-4)	0.029796	0.263626	0.113023	0.9116
INTEREST	-0.019473	3.811690	-0.005109	0.9960
INTEREST(-1)	-0.035601	4.668883	-0.007625	0.9940
INTEREST(-2)	0.190039	3.808156	0.049903	0.9609
DUM	0.027661	3.846286	0.007192	0.9944
C	-0.524118	188.3131	-0.002783	0.9978
@TREND	-0.246656	1.204713	-0.204742	0.8407
RESID(-1)	-0.247791	0.306028	-0.809701	0.4317
RESID(-2)	0.157642	0.301965	0.522055	0.6098

R-squared	0.084784	Mean dependent var	2.00E-13
Adjusted R-squared	-1.353412	S.D. dependent var	4.255277
S.E. of regression	6.527951	Akaike info criterion	6.861446
Sum squared resid	596.5981	Schwarz criterion	7.862827
Log likelihood	-103.9368	Hannan-Quinn criter.	7.214480
F-statistic	0.058952	Durbin-Watson stat	1.908317
Prob(F-statistic)	1.000000		

Source: Researchers Preparation Using Statistical Software (EViews 9)

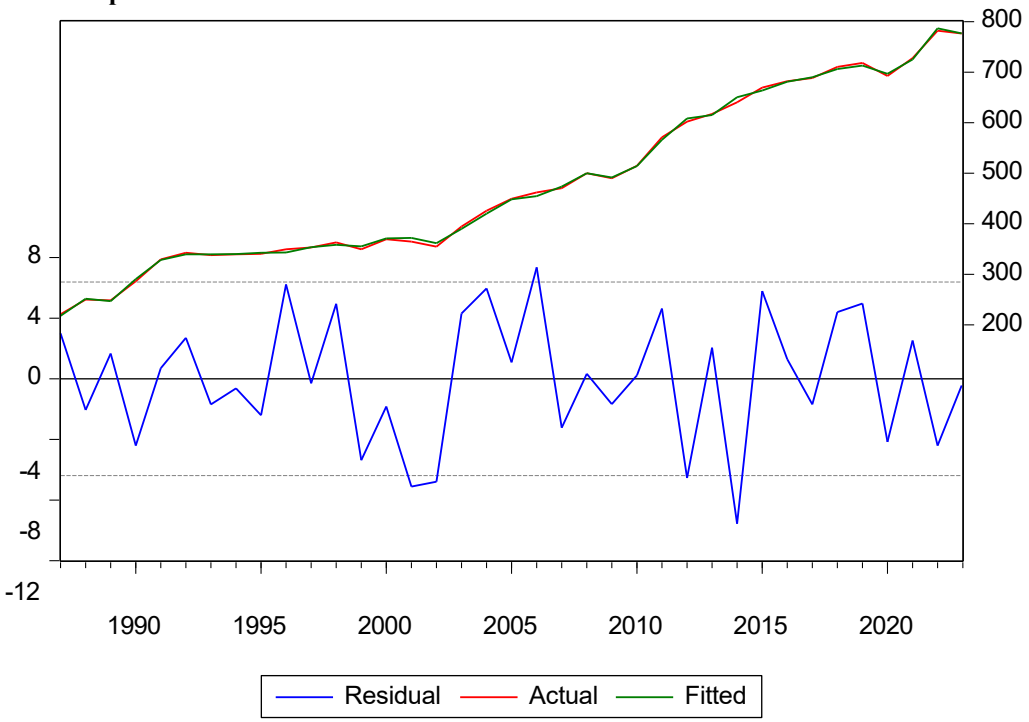
Table 15 above shows a (p-value= 0.53) which is greater than 5% level of significant, and therefore, we do not reject the null hypothesis and conclude that there is no evidence of serial correlation in the residuals. This suggests that the model is appropriately specified with respect to the temporal structure, and the error terms are independent.

c) Heteroskedasticity

Heteroskedasticity refers to a situation where the variance of the residuals (errors) in a regression model is not constant across all levels of the independent variables. In the presence of heteroskedasticity, standard errors can become biased, leading to inefficient estimates and unreliable statistical tests. Therefore, heteroskedasticity tests are crucial for diagnosing and addressing this issue, and in this context, we are going to test it using the Residual Plots, Breusch-Pagan-Godfrey, and the White test.

Figure 4

Residual plots



Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 16

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.032943	Prob. F(20,16)	0.4802
Obs*R-squared	20.85110	Prob. Chi-Square(20)	0.4059
Scaled explained SS	2.522653	Prob. Chi-Square(20)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/30/24 Time: 07:38
Sample: 1987 2023
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	197.8239	574.8114	0.344154	0.7352
GDP(-1)	0.345646	0.322238	1.072644	0.2993
LNHOUSE	25.70610	113.1301	0.227226	0.8231
LNHOUSE(-1)	-98.31120	175.2373	-0.561017	0.5826
LNGFCF	-69.27858	84.62757	-0.818629	0.4250
LNGFCF(-1)	15.76548	102.9486	0.153139	0.8802
LNGFCF(-2)	-159.0845	92.42843	-1.721165	0.1045
LNGFCF(-3)	177.8836	77.70621	2.289182	0.0360
LNGOV	25.57050	84.62815	0.302151	0.7664
LNGOV(-1)	140.4666	101.5603	1.383085	0.1856

LNGOV(-2)	-122.7462	89.44176	-1.372359	0.1889
EXTER	-0.758763	1.520034	-0.499175	0.6244
EXTER(-1)	2.652248	1.846676	1.436228	0.1702
EXTER(-2)	-3.029559	1.832147	-1.653557	0.1177
EXTER(-3)	2.062311	1.181808	1.745048	0.1001
EXTER(-4)	0.265707	0.798760	0.332649	0.7437
INTEREST	4.708837	11.74529	0.400913	0.6938
INTEREST(-1)	-10.98869	14.38878	-0.763699	0.4562
INTEREST(-2)	-2.276775	11.57036	-0.196777	0.8465
DUM	1.638185	11.74697	0.139456	0.8908
@TREND	-1.170702	3.644320	-0.321240	0.7522

R-squared	0.563543	Mean dependent var	17.61800
Adjusted R-squared	0.017973	S.D. dependent var	20.31735
S.E. of regression	20.13395	Akaike info criterion	9.139497
Sum squared resid	6486.012	Schwarz criterion	10.05380
Log likelihood	-148.0807	Hannan-Quinn criter.	9.461833
F-statistic	1.032943	Durbin-Watson stat	2.833820
Prob(F-statistic)	0.480206		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 17

Heteroskedasticity Test: White

F-statistic	0.740631	Prob. F(20,16)	0.7403
Obs*R-squared	17.78710	Prob. Chi-Square(20)	0.6014
Scaled explained SS	2.151956	Prob. Chi-Square(20)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/30/24 Time: 07:40
Sample: 1987 2023
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.39216	205.8538	-0.084488	0.9337
GDP(-1)^2	-1.12E-06	0.000339	-0.003311	0.9974
LNHOUSE^2	9.675951	14.44006	0.670077	0.5124
LNHOUSE(-1)^2	-10.48810	20.10308	-0.521716	0.6090
LNGFCF^2	-2.143534	14.26823	-0.150231	0.8825
LNGFCF(-1)^2	-4.946108	17.62221	-0.280675	0.7826
LNGFCF(-2)^2	-16.89330	15.34988	-1.100550	0.2874
LNGFCF(-3)^2	20.15456	12.24294	1.646219	0.1192
LNGOV^2	9.156601	10.78485	0.849025	0.4084
LNGOV(-1)^2	7.217664	11.18117	0.645520	0.5277
LNGOV(-2)^2	-4.903673	10.17090	-0.482128	0.6362
EXTER^2	-0.014040	0.033740	-0.416126	0.6828
EXTER(-1)^2	0.043086	0.050202	0.858256	0.4034
EXTER(-2)^2	-0.056302	0.040364	-1.394869	0.1821
EXTER(-3)^2	0.047046	0.037550	1.252910	0.2282
EXTER(-4)^2	-0.016777	0.033792	-0.496474	0.6263

INTEREST^2	-0.467461	2.742742	-0.170436	0.8668
INTEREST(-1)^2	-2.082764	3.284974	-0.634028	0.5350
INTEREST(-2)^2	-1.395536	1.870998	-0.745878	0.4666
DUM^2	-2.086477	12.07347	-0.172815	0.8650
@TREND^2	-0.014770	0.085130	-0.173501	0.8644

R-squared	0.480732	Mean dependent var	17.61800
Adjusted R-squared	-0.168352	S.D. dependent var	20.31735
S.E. of regression	21.96109	Akaike info criterion	9.313228
Sum squared resid	7716.634	Schwarz criterion	10.22753
Log likelihood	-151.2947	Hannan-Quinn criter.	9.635563
F-statistic	0.740631	Durbin-Watson stat	2.810804
Prob(F-statistic)	0.740286		

Source: Researchers Preparation Using Statistical Software (EViews 9)

The observed data points in Figure 4 above show tendency to be closer to the regression line, which is an indicator of the absence of heteroskedasticity in the residuals. Moreover, both Breusch-Pagan-Godfrey and White tests results above show (p-value= 0.48), (p-value= 0.74), respectively, which are greater than 5% level of significant, and therefore, we do not reject the null hypothesis and conclude that there is no evidence of heteroskedasticity in the residuals. This suggests that the variance of the residuals (errors) in this regression model is constant across all levels of the independent variables.

d) Specification Bias or Error/Misspecification

The issue that occurs when a statistical model is improperly specified, resulting in skewed or wrong estimates, is known as specification bias (or specification error). This problem usually occurs when the assumptions or structure of the model do not adequately reflect the underlying data generating process. It can occur in a variety of models, such as machine learning algorithms, econometric models, or regression models. Misleading conclusions and poor policy recommendations can arise from specification bias. Several tests and diagnostic tools can help detect specification bias or error/misspecification such as the Ramsey RESET (Regression Specification Error Test), in which we are going to use.

Table 18

Ramsey RESET Test
Equation: UNTITLED
Specification: GDP GDP(-1) LNHOUSE LNHOUSE(-1) LNGFCF LNGFCF(-1) LNGFCF(-2) LNGFCF(-3) LNGOV LNGOV(-1) LNGOV(-2) EX ER EXTER(-1) EXTE R(-2) EXTER(-3) EXTER(-4) INTEREST INTEREST(-1) INTEREST(-2) DUM C @TREND
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.609205	15	0.5515
F-statistic	0.371131	(1, 15)	0.5515

F-test summary:

	Sum of Sq	df	Mean Squares
Test SSR	15.73908	1	15.73908
Restricted SSR	651.8659	16	40.74162
Unrestricted SSR	636.1268	15	42.40846

Unrestricted Test Equation:
Dependent Variable: GDP

Method: ARDL
Date: 11/30/24 Time: 07:45
Sample: 1987 2023
Included observations: 37
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic):
Fixed regressors: C @TREND

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	0.213092	0.104434	2.040456	0.0593
LNHOUSE	105.7687	38.57784	2.741696	0.0151
LNHOUSE(-1)	184.2626	67.24932	2.739993	0.0152
LNGFCF	8.375827	29.99216	0.279267	0.7839
LNGFCF(-1)	5.793974	33.29802	0.174004	0.8642
LNGFCF(-2)	-120.7885	34.04544	-3.547860	0.0029
LNGFCF(-3)	-42.31337	25.63334	-1.650716	0.1196
LNGOV	-21.76314	28.24705	-0.770457	0.4530
LNGOV(-1)	150.7780	42.97411	3.508576	0.0032
LNGOV(-2)	54.10782	31.73517	1.704980	0.1088
EXTER	1.374801	0.514041	2.674495	0.0173
EXTER(-1)	2.233749	0.710250	3.145017	0.0067
EXTER(-2)	-1.253732	0.627315	-1.998567	0.0641
EXTER(-3)	-0.455568	0.430463	-1.058320	0.3067
EXTER(-4)	0.964524	0.265280	3.635874	0.0024
INTEREST	-0.932182	4.508255	-0.206772	0.8390
INTEREST(-1)	3.970031	4.753040	0.835261	0.4167
INTEREST(-2)	-18.23174	4.496104	-4.055009	0.0010
DUM	-0.317494	3.808491	-0.083365	0.9347
C	-984.6355	317.9097	-3.097218	0.0074
@TREND	-5.553359	1.212188	-4.581268	0.0004
FITTED^2	-0.000103	0.000169	-0.609205	0.5515

R-squared	0.999373	Mean dependent var	480.5848
Adjusted R-squared	0.998494	S.D. dependent var	167.8126
S.E. of regression	6.512178	Akaike info criterion	6.871546
Sum squared resid	636.1268	Schwarz criterion	7.829389
Log likelihood	-105.1236	Hannan-Quinn criter.	7.209231
F-statistic	1137.646	Durbin-Watson stat	2.460419
Prob(F-statistic)	0.000000		

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

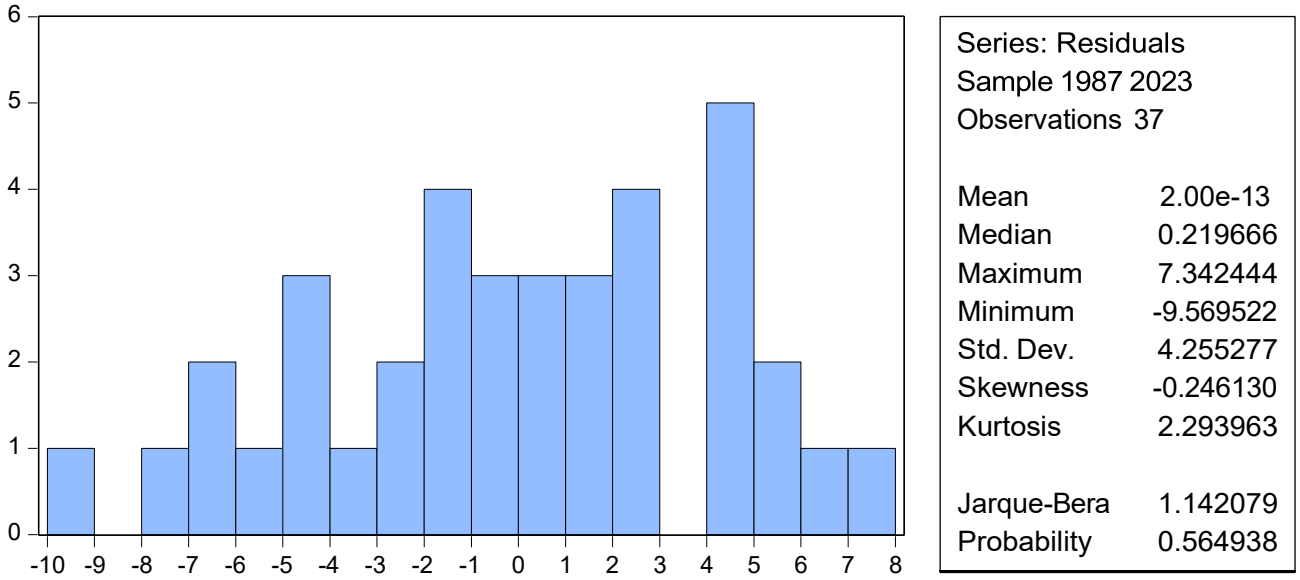
Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 18 above shows a (p-value= 0.55) which is greater than 5% level of significant, and therefore, we do not reject the null hypothesis and conclude that there is no evidence of specification bias or error/ misspecification. This suggests that the model is correctly specified.

e) Normality

Normality test results in regression or econometric analysis involve assessing whether the residuals (errors) of a model follow a normal distribution. This is important because many statistical tests and confidence intervals rely on the assumption that errors are normally distributed. There are various tests and diagnostic tools that can help detect normality, such as Jarque-Bera Test, which we are going to use.

Figure 5



Source: Researchers Preparation Using Statistical Software (EViews 9)

Figure 5 above shows a (p-value= 0.56) which is greater than 5% level of significant, and therefore, we do not reject the null hypothesis and conclude that there is no significant departure from normality in the residuals. This suggests that the residuals of the model follow a normal distribution.

4. Conclusion, Recommendations, and Future Studies

This study has empirically attempted to investigate the effect of real interest rate on GDP of Saudi Arabia during the period 1983 – 2023, using the Autoregressive Distributed Lags (ARDL) methodology to estimate long & short run relationships between the variables. The empirical results of the study regarding the nature of the quantitative relationship showed that the first hypothesis of the research was achieved, and as it was proven that the GDP of Saudi Arabia, indeed, got affected by the changes of real interest rate during the period 1983 – 2023. Also, the measurement results have indicated that the second hypothesis of the research has not been achieved. This was proven in the applied section through running the regression model on the study variables, where it was found that the coefficient of the real interest rate showed a negative value, which indicates that the relationship between the real interest rate and the GDP in Saudi Arabia is not positive during the study's period.

The long-term measurement results showed the existence of cointegration relationships between the variables under study through the Bounds Test. The results also showed, using the (ARDL) model, that the relationship between the real interest rate and GDP was negative and significant in Saudi Arabia's economy during the study period. These results were consistent with the classical theories and number of applied studies.

The short-term measurement results showed the size and direction of the impact of real interest rate on GDP in Saudi Arabia during the study period through the Error Correction Model (ECM). This impact was found negative and insignificant in the initial year; however, it was found positive and significant in a one lag period.

In light of these findings, this research paper recommends the Saudi Central Bank (SAMA), in the long run, to implement an expansionary monetary policy, aiming to increase the money supply, in which will lead to a decrease in the real interest rate. The implementation of such an economic policy in a such period of time will significantly increase the country's GDP. However, this expansionary monetary policy, in the short run, will not be effective in the initial year, since it was found insignificant. Contractionary monetary policy is suggested, in a one lag period, since it was found positive and significant. In other words, implementing a contractionary monetary policy, aiming to decrease the money supply, will lead to an increase in the real interest rate, in which will result in (Contrary to economic theory) an increase in the GDP.

This research paves the way for further future research by measuring the impact of some other variables, rather than the real interest rate, that may affect the GDP in Saudi Arabia, such as trade, labour, foreign direct investment, inflation, exchange

rate, and / or non-economic factors, such as the country's political conditions. The relationship between the real interest rate and GDP can also be estimated in a group of developing and developed countries as a comparative study using panel data, or in a group of economically liking countries such as GCC countries. Measuring the impact of real/nominal interest rate on other dependent variable, rather than the GDP, such as the financial and banking stability in Saudi Arabia could also be suggested for future studies.

Appendices
Appendix (1)

Testing The Stability of GDP Time Series Data Using (Unit Root Tests)
Augmented Dickey-Fuller (ADF) Unit Root Test on GDP
Table 1

Case5: 1st Difference – Trend and Intercept

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.208810	0.0007
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/09/24 Time: 21:34
Sample (adjusted): 1986 2023
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.245036	0.239025	-5.208810	0.0000
D(GDP(-1),2)	0.155936	0.172129	0.905924	0.3714
C	12.38544	7.284595	1.700224	0.0982
@TREND("1983")	0.281385	0.311715	0.902697	0.3730

R-squared	0.563876	Mean dependent var	0.422114
Adjusted R-squared	0.525394	S.D. dependent var	29.15524
S.E. of regression	20.08552	Akaike info criterion	8.937176
Sum squared resid	13716.56	Schwarz criterion	9.109554
Log likelihood	-165.8064	Hannan-Quinn criter.	8.998507
F-statistic	14.65314	Durbin-Watson stat	1.839969
Prob(F-statistic)	0.000003		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 2

Case6: 1st Difference – None (No Trend and Intercept)

Null Hypothesis: D(GDP) has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.607941	0.1007
Test critical values:	1% level	-2.628961	
	5% level	-1.950117	
	10% level	-1.611339	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/09/24 Time: 21:38
Sample (adjusted): 1987 2023
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.334380	0.207955	-1.607941	0.1171
D(GDP(-1),2)	-0.422809	0.210445	-2.009123	0.0525
D(GDP(-2),2)	-0.318238	0.169742	-1.874827	0.0694

R-squared	0.413255	Mean dependent var	-1.088821
Adjusted R-squared	0.378740	S.D. dependent var	28.00855
S.E. of regression	22.07635	Akaike info criterion	9.104496
Sum squared resid	16570.42	Schwarz criterion	9.235110
Log likelihood	-165.4332	Hannan-Quinn criter.	9.150543
Durbin-Watson stat	1.989132		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Phillips-Perron (PP) Unit Root Test on GDP

Table 3

Case1: Level – Intercept

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.927076	0.9949
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	398.5821
HAC corrected variance (Bartlett kernel)	382.2495

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 11/09/24 Time: 21:43
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.017078	0.019133	0.892600	0.3777
C	5.884253	9.155357	0.642711	0.5243

R-squared	0.020536	Mean dependent var	13.52793
Adjusted R-squared	-0.005239	S.D. dependent var	20.42972
S.E. of regression	20.48317	Akaike info criterion	8.925791
Sum squared resid	15943.28	Schwarz criterion	9.010234
Log likelihood	-176.5158	Hannan-Quinn criter.	8.956323
F-statistic	0.796735	Durbin-Watson stat	2.015030
Prob(F-statistic)	0.377689		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 4

Case2: Level – Trend and Intercept

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.150923	0.5028
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	344.2318
HAC corrected variance (Bartlett kernel)	344.5537

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares

Date: 11/09/24 Time: 22:14
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.176766	0.082200	-2.150450	0.0381
C	32.91948	14.12309	2.330897	0.0253
@TREND("1983")	2.913420	1.205387	2.416999	0.0207

R-squared	0.154095	Mean dependent var	13.52793
Adjusted R-squared	0.108370	S.D. dependent var	20.42972
S.E. of regression	19.29099	Akaike info criterion	8.829192
Sum squared resid	13769.27	Schwarz criterion	8.955858
Log likelihood	-173.5838	Hannan-Quinn criter.	8.874991
F-statistic	3.370068	Durbin-Watson stat	1.921376
Prob(F-statistic)	0.045232		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 5

Case3: Level – None (No Trend and Intercept)

Null Hypothesis: GDP has a unit root
Exogenous: None
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		4.254811	1.0000
Test critical values:	1% level	-2.624057	
	5% level	-1.949319	
	10% level	-1.611711	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	402.9149
HAC corrected variance (Bartlett kernel)	402.9149

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 11/09/24 Time: 22:18
Sample (adjusted): 1984 2023
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.028580	0.006717	4.254811	0.0001

R-squared	0.009889	Mean dependent var	13.52793
Adjusted R-squared	0.009889	S.D. dependent var	20.42972
S.E. of regression	20.32845	Akaike info criterion	8.886602

Sum squared resid	16116.59	Schwarz criterion	8.928824
Log likelihood	-176.7320	Hannan-Quinn criter.	8.901868
Durbin-Watson stat	2.016726		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 6
Case4: 1st Difference – Intercept

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.132250	0.0000
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	401.6103
HAC corrected variance (Bartlett kernel)	378.3178

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/09/24 Time: 22:22
Sample (adjusted): 1985 2023
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.000781	0.163218	-6.131563	0.0000
C	14.16663	4.011899	3.531155	0.0011

R-squared	0.503995	Mean dependent var	0.129507
Adjusted R-squared	0.490590	S.D. dependent var	28.82704
S.E. of regression	20.57472	Akaike info criterion	8.935923
Sum squared resid	15662.80	Schwarz criterion	9.021234
Log likelihood	-172.2505	Hannan-Quinn criter.	8.966532
F-statistic	37.59606	Durbin-Watson stat	2.007094
Prob(F-statistic)	0.000000		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 7
Case5: 1st Difference – Trend and Intercept

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.225469	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	387.9306
HAC corrected variance (Bartlett kernel)	370.1917

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/09/24 Time: 22:24
Sample (adjusted): 1985 2023
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.053207	0.169152	-6.226380	0.0000
C	7.723823	6.976912	1.107055	0.2756
@TREND("1983")	0.341817	0.303376	1.126711	0.2673

R-squared	0.520890	Mean dependent var	0.129507
Adjusted R-squared	0.494273	S.D. dependent var	28.82704
S.E. of regression	20.50020	Akaike info criterion	8.952550
Sum squared resid	15129.29	Schwarz criterion	9.080516
Log likelihood	-171.5747	Hannan-Quinn criter.	8.998463
F-statistic	19.56968	Durbin-Watson stat	1.988846
Prob(F-statistic)	0.000002		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Table 8
Case6: 1st Difference – None (No Trend and Intercept)

Null Hypothesis: D(GDP) has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.456709	0.0000
Test critical values:	1% level	-2.625606	
	5% level	-1.949609	

	10% level	-1.611593

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	536.9535
HAC corrected variance (Bartlett kernel)	581.6352

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/09/24 Time: 22:27
Sample (adjusted): 1985 2023
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.671898	0.152931	-4.393481	0.0001

R-squared	0.336841	Mean dependent var	0.129507
Adjusted R-squared	0.336841	S.D. dependent var	28.82704
S.E. of regression	23.47518	Akaike info criterion	9.175071
Sum squared resid	20941.19	Schwarz criterion	9.217726
Log likelihood	-177.9139	Hannan-Quinn criter.	9.190375
Durbin-Watson stat	2.069290		

Source: Researchers Preparation Using Statistical Software (EViews 9)

Appendix (2)

Table 9
ARDL Regression Reporting Result

Dependent Variable: GDP
Method: ARDL
Date: 11/29/24 Time: 23:03
Sample (adjusted): 1987 2023
Included observations: 37 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LNHOUSE LNGFCF LNGOV EXTER INTEREST
Fixed regressors: DUM C @TREND
Number of models evalulated: 3125
Selected Model: ARDL(1, 1, 3, 2, 4, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	0.217106	0.102157	2.125223	0.0495
LNHOUSE	98.32395	35.86481	2.741516	0.0145
LNHOUSE(-1)	162.2137	55.55420	2.919917	0.0100
LNGFCF	0.907310	26.82885	0.033818	0.9734
LNGFCF(-1)	5.832367	32.63703	0.178704	0.8604
LNGFCF(-2)	-110.8646	29.30190	-3.783527	0.0016

LNGFCF(-3)	-39.24458	24.63463	-1.593066	0.1307
LNGOV	-17.51395	26.82904	-0.652798	0.5232
LNGOV(-1)	133.8982	32.19692	4.158728	0.0007
LNGOV(-2)	46.15968	28.35506	1.627917	0.1231
EXTER	1.283370	0.481885	2.663228	0.0170
EXTER(-1)	1.999625	0.585438	3.415604	0.0035
EXTER(-2)	-1.128353	0.580832	-1.942651	0.0699
EXTER(-3)	-0.334973	0.374660	-0.894073	0.3845
EXTER(-4)	0.927835	0.253225	3.664072	0.0021
INTEREST	-2.410995	3.723523	-0.647504	0.5265
INTEREST(-1)	4.558214	4.561569	0.999264	0.3325
INTEREST(-2)	-16.71364	3.668066	-4.556526	0.0003
DUM	-0.157910	3.724055	-0.042403	0.9667
C	-827.5352	182.2282	-4.541203	0.0003
@TREND	-5.381051	1.155332	-4.657580	0.0003

R-squared	0.999357	Mean dependent var	480.5848
Adjusted R-squared	0.998553	S.D. dependent var	167.8126
S.E. of regression	6.382916	Akaike info criterion	6.841933
Sum squared resid	651.8659	Schwarz criterion	7.756238
Log likelihood	-105.5758	Hannan-Quinn criter.	7.164268
F-statistic	1243.380	Durbin-Watson stat	2.439254
Prob(F-statistic)	0.000000		

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

Source: Researchers Preparation Using Statistical Software (EViews 9)

Appendix (3)

Time Series Data for The Variables Under Study

Years	1 GDP	2 LNHouse	3 LNGFCF	4 LNGov	5 Exter	6 Interest	Dum
1983	235.00	4.06	3.29	3.39	-9.21	5.89	0
1984	224.04	4.04	3.23	3.41	-10.70	6.64	0
1985	202.10	4.01	3.10	3.46	-6.57	5.66	0
1986	236.48	3.87	3.12	3.55	-9.08	4.05	1
1987	220.80	3.82	3.11	3.56	-6.27	4.22	0
1988	249.74	3.85	2.94	3.43	-3.88	4.45	0
1989	248.49	3.89	2.92	3.51	-4.33	4.40	0
1990	286.24	4.00	2.94	3.37	8.96	4.32	1
1991	329.20	4.06	3.01	3.53	1.92	3.93	1
1992	342.33	4.10	3.01	3.39	3.12	3.38	0
1993	337.66	4.15	3.08	3.27	0.90	2.71	0
1994	339.54	4.16	2.91	3.19	7.93	3.54	0
1995	340.26	4.20	2.96	3.16	9.63	3.31	0
1996	349.24	4.24	2.85	3.19	13.39	3.14	0
1997	353.09	4.25	2.87	3.26	13.13	3.20	0
1998	363.31	4.21	3.02	3.34	3.18	2.63	0
1999	349.64	4.21	2.97	3.24	11.49	2.89	0

2000	369.30	4.23	2.85	3.25	18.64	3.12	0
2001	364.83	4.23	2.90	3.31	15.71	2.24	1
2002	354.55	4.25	2.89	3.26	17.30	2.03	0
2003	394.41	4.30	2.91	3.20	21.88	1.45	1
2004	425.80	4.36	2.95	3.13	26.89	1.70	0
2005	449.53	4.46	2.96	3.06	32.15	1.89	0
2006	462.06	4.59	3.02	3.09	29.72	2.28	1
2007	470.60	4.75	3.16	3.03	25.01	2.04	1
2008	500.01	4.94	3.13	2.87	28.12	1.30	1
2009	489.71	5.06	3.25	3.10	9.32	1.05	1
2010	514.39	5.14	3.20	3.01	16.59	0.87	0
2011	570.94	5.20	3.11	2.96	26.34	0.53	1
2012	601.82	5.35	3.10	2.99	24.83	-0.01	0
2013	617.08	5.42	3.16	3.10	20.92	0.29	0
2014	640.60	5.51	3.22	3.25	12.93	0.61	0
2015	669.48	5.61	3.38	3.38	-4.38	0.59	1
2016	682.10	5.67	3.24	3.22	0.41	0.42	1
2017	688.31	5.71	3.18	3.16	5.32	0.73	1
2018	710.34	5.77	3.03	3.16	12.44	1.16	0
2019	718.13	5.82	3.11	3.15	7.98	0.53	0
2020	692.41	5.78	3.18	3.33	0.09	-0.12	1
2021	727.55	5.91	3.19	3.17	8.41	-0.03	1
2022	782.02	5.98	3.20	3.04	16.93	1.06	1
2023	776.11	6.06	3.33	3.15	7.37	1.66	1

Source: Researchers Preparation, based on the WB - World Development Indicators (WDI) and the Federal Reserve Bank of St. Louis website.

1,2,3,4,5 based on World Bank data.
6 based on the Federal Reserve Bank of St. Louis data.

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"تأثير سعر الفائدة الحقيقي على الناتج المحلي الإجمالي الحقيقي للمملكة العربية السعودية"

إعداد الباحثين:

خلود بخيت الغامدي

محمد سيف الدين زواوي

باسل ياسر بليلة

ملخص:

تهدف هذه الدراسة إلى بحث تأثير سعر الفائدة الحقيقي على الناتج المحلي الإجمالي الحقيقي للمملكة العربية السعودية خلال الفترة من عام 1983 إلى عام 2023. تستخدم الدراسة نموذجًا ديناميكيًا للسلاسل الزمنية شبه لوغاريتمي خطي يعتمد على تقنية نموذج الانحدار الذاتي للإبطاء الموزع (ARDL) لتحليل التأثيرات الطويلة والقصيرة الأجل للتغيرات في سعر الفائدة الحقيقي على الناتج المحلي الإجمالي الحقيقي في المملكة العربية السعودية خلال فترة الدراسة، وذلك باستخدام البيانات السنوية الصادرة عن البنك الدولي وبنك الاحتياطي الفيدرالي. تُظهر النتائج على المدى الطويل وجود علاقة سلبية وهامة بين سعر الفائدة الحقيقي والناتج المحلي الإجمالي الحقيقي. أما على المدى القصير، فتُظهر النتائج وجود علاقة سلبية ولكنها غير ذات دلالة إحصائية في السنة الأولية، في حين أنها تتحول إلى علاقة إيجابية وذات دلالة إحصائية في فترة الإبطاء اللاحقة. يُقترح على البنك المركزي السعودي (ساما) تخفيض سعر الفائدة الحقيقي لأن ذلك سيؤدي إلى زيادة الناتج المحلي الإجمالي الحقيقي للبلاد على المدى الطويل. أما على المدى القصير، ومن أجل زيادة الناتج المحلي الإجمالي الحقيقي للبلاد، يُقترح زيادة سعر الفائدة الحقيقي في فترة الإبطاء اللاحقة.

الكلمات المفتاحية: سعر الفائدة الحقيقي، الناتج المحلي الإجمالي، ARDL، السياسة النقدية، الاقتصاد الكلي.