

Transitioning beyond oil: How economic diversification shapes Saudi Arabia's growth path



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ABSTRACT

This study examines the impact of economic diversification and oil rent on economic growth in Saudi Arabia over the period 1980–2024. To analyze both short-term and long-term relationships, the Autoregressive Distributed Lag (ARDL) cointegration approach is employed. The results are further validated using Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimators to ensure robustness. The findings indicate that economic diversification has a significant and positive effect on long-term economic growth. In addition, oil rent, population, and gross fixed capital formation also contribute positively and significantly to long-term development, consistent with theoretical expectations. In contrast, inflation does not have a statistically significant effect. Overall, these results highlight the important role of economic diversification in supporting Saudi Arabia's Vision 2030 and demonstrate the country's progress toward achieving this strategic goal.

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1. Introduction

Diversification is defined as the structural transformation from a reliance on traditional sectors, such as agriculture and mining, to a more diverse set of economic sectors. It helps build an economic structure that is resilient to market fluctuations and global changes. According to empirical studies, there is a strong interdependence between economic diversification and enhanced macroeconomic performance in developing countries, including greater stability, faster economic growth, and higher per capita income (Delechat et al., 2024).

For decades, the Saudi Arabian economy has relied heavily on oil revenues as its primary source of national income. Consequently, periods of economic expansion in the Kingdom have historically been closely linked to rising oil prices. It can therefore be argued that oil prices play a central role in shaping the trajectory of economic growth in Saudi Arabia (Albassam, 2015).

Since the early 1970s, the oil sector has dominated the Saudi economy. Between 2000 and

2018, oil contributed on average approximately 48% to GDP, while oil revenues accounted for nearly 90% of total government income. Although heavy dependence on oil has supported a certain level of economic growth, it has not translated into sustainable economic development. Consequently, Saudi Arabia has identified economic diversification as a strategic priority to reduce economic instability and vulnerability to external shocks (Houfi, 2021).

While natural resource dependence can drive growth in Gross Domestic Product (GDP), it does not necessarily generate economic development. An economy structured around primary resources might achieve increases in GDP, but these gains often do not translate into meaningful development. Achieving sustainable economic development requires a fundamental structural transformation of the economy. This involves redistributing value added across all economic sectors, ensuring growth is broad-based rather than concentrated in a single sector.

Economic diversification plays a vital role in fostering long-run economic stability and resilience, particularly in resource-dependent economies like Saudi Arabia. By reducing reliance on a single sector—primarily oil—it mitigates the risks associated with sector-specific shocks and global price volatility. Within the framework of Saudi Vision 2030, diversification aims to expand the economic base, stimulate private sector participation, and enhance productivity and

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innovation across non-oil sectors. These efforts collectively contribute to achieving more balanced, stable, and sustainable economic growth.

According to [Bove and Elia \(2017\)](#), the growth dividend from economic diversity is both more reliable and pronounced in developing and resource-dependent countries. Unlike in advanced economies, diversity gains in such contexts translate directly into accelerated GDP growth by catalyzing innovation.

Economic diversification plays a crucial role in driving economic growth, though its impact can vary significantly across different regions and contexts. The relationship between diversification and growth is often complex, shaped by a country's unique economic structure and stage of development.

The primary objective of this paper is to evaluate the Saudi government's efforts toward economic diversification and assess the impact of diversification on economic growth. Since 1970, successive development plans have emphasized the need to diversify sources of national income and reduce dependence on oil by increasing the contribution of other productive sectors to the gross domestic product.

The research question guiding this study is: How effective has Saudi Arabia been in advancing economic diversification, measured against Vision 2030 targets? The research hypothesis posits that the Herfindahl-Hirschman Index (HHI) of economic concentration has a significant negative association with economic growth in Saudi Arabia, such that lower HHI values (higher diversification) correlate with higher growth rates.

The remainder of this paper is structured as follows. Section 2 provides the theoretical background for the relationship between diversification and growth, along with a review of the relevant literature. Section 3 describes the stage of diversification in Saudi Arabia. Section 4 outlines the data sources and research methodology. Section 5 presents and discusses the empirical results. Finally, Section 6 summarizes the main findings and offers the conclusion and policy recommendations

2. Literature review

2.1. Theoretical background

The relationship between economic diversification and growth is based on both classical, neoclassical, and endogenous growth theories. In the Solow–Swan model of growth, growth arises simply from capital accumulation, labor force growth, and technological growth, with substitutability between inputs contributing to sustained growth potential even when subject to limited resources. This process entails the development of a greater productive and diversified base, as investment and innovation drive new sectors, increase productivity, and detach from a narrow range of economic activity ([Ferrara, 2025](#)). For Endogenous Growth Theory ([Lucas, 1988](#); [Romer, 1986](#)): This theory asserts that sustained

economic growth is a function of factors within the economy—specifically, human capital accumulation, knowledge creation, and dissemination—rather than exogenous, not internally driven factors. In essence, this theory provides the importance of educating, inventing, and funding research and technology as drivers of productivity and long-run growth—not solely relying on forces outside the economy. Regarding Structural Change Theory ([Kuznets and Murphy, 1966](#)): According to this theory, a country's economic growth is observed as a process of shifting factors and resources out of low-productivity sectors (sectors such as agriculture or extractive) and into activities that generate higher value (sectors such as manufacturing or services). This also aids in increasing productivity, expanding the job base, and creating a more balanced and resilient economic structure altogether. Collectively, these theoretical suggestions each endorse economic diversification as a pathway to sustainable growth that can help economies such as that of Saudi Arabia become less reliant on resources and utilize a better-balanced model of development centered on innovation while remaining mindful of long-term strategy goals, such as Vision 2030.

2.2. Diversification and economic growth

Empirical studies on the effect of economic diversification on growth have yielded mixed findings. While some studies argue that diversification promotes macroeconomic stability and enhances long-term growth, others find that its influence depends on structural factors, policy frameworks, and the level of resource dependence. The diversity of results largely reflects differences in research methodologies, time periods, and country contexts. In the case of Saudi Arabia and other resource-dependent economies, the literature presents varying conclusions regarding the extent to which diversification policies have succeeded in mitigating oil dependence and fostering sustainable economic development. The following section summarizes key empirical studies that examined the association between economic diversification and economic growth, with particular attention to the Kingdom of Saudi Arabia.

[Feldman and Audretsch \(1999\)](#) provided considerable support for the diversity thesis but little support for the specialization thesis. [Banafea and Ibnrubbian \(2018\)](#) aimed to evaluate the Saudi government's efforts to diversify its economy over 45 years, spanning from 1970 to 2014. Utilizing a descriptive analysis, the findings indicate that noticeable progress toward diversification was primarily achieved during the last two development plans (2005–2014). The study also highlights the private sector's continued underperformance, underscoring the need for immediate government intervention to improve the legislative and regulatory environment, promote competition, and attract major international companies. Such measures are essential to enhance private sector

efficiency and reduce the economy's heavy reliance on oil revenues.

Gnangnon (2021) examined the impact of services export diversification on economic growth using a sample of 131 countries over the period 1985–2014. The empirical analysis, based on the two-step System Generalized Method of Moments (GMM), indicates that services export diversification fosters economic growth in developing countries. In contrast, for high-income countries (HICs), it is services export specialization that appears to drive economic growth.

Houfi (2021) investigated the association between economic diversification and economic growth in Saudi Arabia by employing both ARDL and NARDL models to examine cointegration between the two variables and to assess whether this relationship is symmetric or asymmetric. The findings reveal that economic diversification has a positive impact on economic growth in the long term. The results also confirmed that economic growth responds symmetrically to both positive and negative changes in economic diversification.

Bitat and Djellit (2022) explored the relationship between economic diversification and economic growth using a panel data model applied to six Arab countries—Algeria, Saudi Arabia, the United Arab Emirates, Tunisia, Morocco, and Egypt—over the period 1999 to 2020. The findings reveal a positive association between economic diversification and economic growth in these countries, suggesting that efforts to diversify, particularly within the services sector, contribute significantly to enhancing economic performance.

Al Zahrani and Shaheen (2025) analyzed the effect of economic diversification on economic growth in Saudi Arabia. The study covers the period from 2000 to 2023 and concluded that fuel exports, total exports, and capital formation have a positive and significant association with GDP (total, oil, and non-oil GDP). Export diversification is negatively and significantly affected by oil GDP but positively and significantly affected by non-oil GDP.

While existing studies on Saudi Arabia's economic diversification focused on pre-2016 reforms or sector-specific analyses, this research fills a gap by conducting a time-series investigation of the economy's structural transformation. It specifically analyzes the different stages of change—from early diversification attempts to Vision 2030-driven restructuring—to evaluate the continuity and impact of policy interventions.

3. The linkage between economic diversification and economic growth in Saudi Arabia

Economic diversification is a key factor in the development process and in enhancing living standards, particularly for those who rely on natural resources as a primary source of income. It entails increasing the contribution of productive sectors to the gross domestic product (GDP), which, in turn, fosters economic growth, reduces dependence on

natural resources, and mitigates vulnerability to fluctuations in their prices (Bogdański, 2021). Economies with greater complexity, that is, more diverse and sophisticated production structures, tend to grow more rapidly. Consequently, diversification can be seen as a means of stimulating economic complexity, thereby promoting sustainable growth (Hausmann and Bry, 2013).

Undoubtedly, economic diversification, which in turn leads to the diversification of income sources, plays a vital role in fostering economic growth. The association between economic diversification and economic growth can be analyzed through several key aspects:

- **Stability and Resilience:** Economic diversification contributes to greater resilience against shocks, as a broader base of industries and ideas enables more effective adaptation and recovery during economic downturns. This means that diversity is associated with higher levels of stability and growth (Wagner and Deller, 1998).
- **Innovation and Knowledge Spillovers:** Economic diversification facilitates the transfer of knowledge, expertise, and skills—whereby experts and practitioners share insights across sectors. This intersectoral exchange enhances innovation, leading to higher productivity and new products that ultimately enhance economic growth (Nathan and Lee, 2013; Ozgen, 2021).
- **Job Creation and Inclusive Growth:** Diversification creates job opportunities across multiple sectors, thereby reducing unemployment (Al Zahrani and Shaheen, 2025). Successful diversification can contribute to reductions in poverty and inequality by creating new industries that require labor, increasing employment, and raising income levels. Diversification in technological sectors may also contribute to higher wages and improved job opportunities (Delechat et al., 2024).

3.1. The Herfindahl-Hirschman index (HHI) and economic diversification

The diversification index is calculated using the Herfindahl-Hirschman Index (HHI), a standard measure of sectoral concentration as follows:

$$H = \frac{\sum_{i=1}^N \left(\frac{x_i}{X}\right)^2 - \frac{1}{N}}{1 - \frac{1}{N}}$$

It represents a normalized version of the Herfindahl-Hirschman Index (HHI), which is commonly used to measure concentration or diversification in a distribution. N: The number of categories or elements (number of economic sectors). x_i represents the output of sector i . $X = \sum x_i$ over all sectors (total GDP). x_i / X denotes the share of sector i in total GDP.

A higher value of the Herfindahl-Hirschman Index (HHI) reflects a greater degree of economic concentration, indicating a reliance on a limited

number of sectors or markets. Conversely, a lower HHI value signifies a higher level of diversification, suggesting a more balanced and distributed economic structure across various sectors or products. Values closer to 1 → high concentration/monopoly; values closer to 0 → high diversification.

3.2. Phases of economic diversification in Saudi Arabia (1980–2024)

Based on the evolution of the Herfindahl-Hirschman Index HHI from 1980 to 2024, as shown in Fig. 1, the graph reveals a clear transformation in the degree of economic diversification. The structural transformation of the Saudi economy can be expressed as four main stages:

1. 1980–1995: Gradual decline in HHI, indicating the beginning of diversification, expansion of non-oil sectors, and early infrastructure development.
2. 1995–2005: Slight increase in HHI, reflecting renewed dependence on certain sectors, possibly due to oil market shocks or limited private sector growth.
3. 2005–2015: Moderate decline in HHI during the 9th and 10th Development Plans, highlighting targeted diversification initiatives and the introduction of new industrial and service sectors.
4. 2016–2024: Sharp decline in HHI, reflecting successful implementation of Vision 2030 reforms, diversification of income sources, and expansion of the services, technology, and tourism sectors, highlighting the Kingdom's achievement in advancing economic diversification.

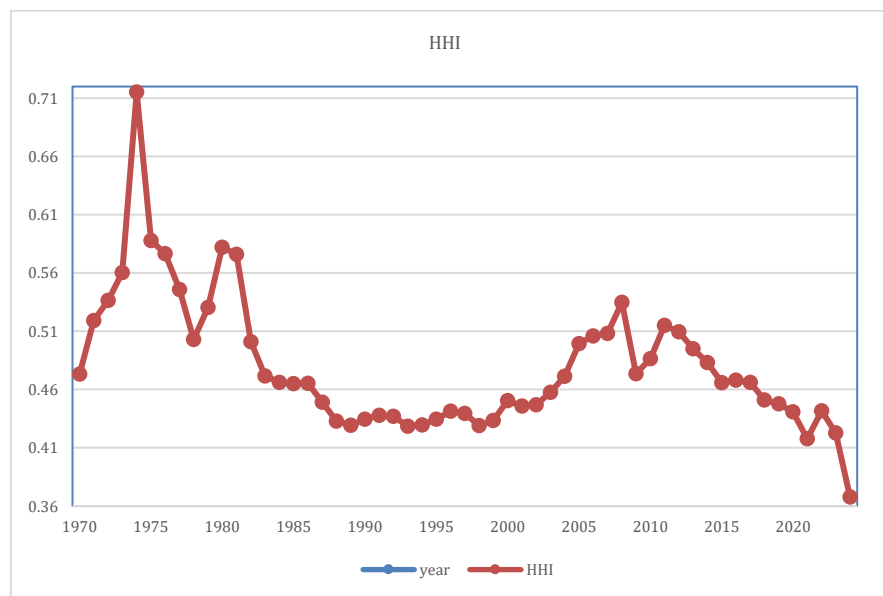


Fig. 1: Herfindahl-Hirschman index (HHI) in Saudi Arabia (1980-2024)

The period from 1980 to 2024 was chosen because it offers reliable and consistent data and covers key stages of Saudi Arabia's economic development. This period includes crucial structural changes, such as the oil boom, subsequent economic adjustments, and the diversification efforts launched under Vision 2030. Selecting this extended timeframe makes it possible to observe long-term patterns and transitions within the Saudi economy. Using a dynamic estimation approach, such as the Autoregressive Distributed Lag (ARDL) model, is particularly suitable, as it captures both short- and long-run relationships. Overall, this timeframe provides a solid foundation for analyzing how economic diversification has evolved and influenced economic growth in Saudi Arabia.

4. Methodology

4.1. Data description

The data used in this study were obtained from the World Development Indicators (WDI) database of the World Bank, as presented in Table 1. The

dependent variable is Economic Growth (GDP per capita). The independent variables include Economic Diversification are measured using the Herfindahl-Hirschman Index (HHI), which serves as a standard indicator for assessing the concentration or diversification of economic activity. constructed from sectoral value-added data obtained from the World Development Indicators (WDI). The economy is divided into major sectors reported by WDI, including agriculture, industry (excluding oil), oil-related activities, and services. The share of each sector in total GDP is calculated annually, and the HHI is computed as the sum of squared sectoral shares. A normalized HHI is employed to ensure consistency over time, where higher values indicate greater concentration and lower values reflect higher diversification; oil revenues (OIL), Gross Fixed Capital Formation (GFCF), and Population (POP). In addition, inflation (CPI) is included as a control variable. The selection of variables is grounded in theoretical frameworks and supported by empirical evidence from previous studies, such as Bitat and Djellit (2022), Gnanon (2021), and Houfi (2021).

Table 1: Data description

Variables	Abbreviation	Definition	Source
Economic growth	GDPP	GDP per capita (constant LCU)	WDI
Herfindahl-Hirschman index	HHI	A standard measure of sectoral concentration, calculated as the sum of squared sectoral shares in total GDP.	WDI
Oil revenues	OIL	Oil revenues % GDP	WDI
Inflation	CPI	Consumer price index %	WDI
Gross fixed capital Formation	GFCF	Gross fixed capital formation (% of GDP)	WDI
Population	POP	The growth in the population of the country	WDI

4.2. Model specification

This study examines the impact of economic diversification, as measured by the Herfindahl-Hirschman Index (HHI), and oil rent on economic growth in the Kingdom of Saudi Arabia during 1980–2024. To capture both short-run and long-run dynamics of the relationship, the Autoregressive Distributed Lag (ARDL) modeling approach is employed. Accordingly, the relationship between economic growth, economic diversification, and oil rent is specified in the functional form of Model (1) as follows:

$$GDPP = f(HHI, oil, GFCF, POP, CPI) \quad (1)$$

This relationship can be formally expressed in a linear form, as presented in Eq. 2:

$$GDPP_t = \beta_0 + \beta_1 HHI + \beta_2 oil + \beta_3 GFCF + \beta_4 \ln POP + \beta_5 cpi + U_t \quad (2)$$

While traditional cointegration techniques, such as those proposed by [Engle and Granger \(1987\)](#) and [Johansen and Juselius \(1990\)](#), require all variables to be integrated of the same order, the ARDL model provides greater flexibility by allowing for the inclusion of variables that are integrated of order $I(0)$, $I(1)$, or a mix of both. To assess the existence of a long-run equilibrium relationship among the variables, the study employs the bounds testing approach developed by [Pesaran et al. \(2001\)](#).

4.3. Estimation procedure

The analysis begins by determining the order of integration for each time series using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. After confirming the integration properties of the variables, it is crucial to ensure that the residuals from the estimated unrestricted model satisfy the white noise assumption. This involves verifying the absence of serial correlation and heteroscedasticity, which supports the validity of the model specification. If these conditions are met, the bounds testing approach can be employed to examine the presence of a long-run equilibrium relationship. Once cointegration is established through the bounds test, the long-run coefficients can be reliably estimated ([Moustafa and Elroukh, 2025](#)).

To investigate the long-run relationship specified in Eq. 2, it is essential to establish the presence of

cointegration among the variables. For this purpose, the bounds testing approach developed by [Pesaran and Shin \(1996\)](#) is employed within the Autoregressive Distributed Lag (ARDL) framework, which is well-suited for variables integrated of different orders, specifically $I(0)$ and $I(1)$. Following the bounds test, the next step involves estimating the corresponding Unrestricted Error Correction Model (UECM) using the Ordinary Least Squares (OLS) method.

$$\begin{aligned} \Delta GDPP_t = & C_0 + \sum_{i=1}^p \gamma_{1i} \Delta GDPP_{t-i} + \sum_{i=1}^{q_1} \gamma_{2i} \Delta HHI_{t-i} + \\ & \sum_{i=1}^{q_2} \gamma_{3i} \Delta oil_{t-i} + \sum_{i=1}^{q_3} \gamma_{4i} \Delta GFCF_{t-i} + \\ & \sum_{i=1}^{q_4} \gamma_{5i} \Delta POP_{t-i} + \sum_{i=1}^{q_5} \gamma_{6i} \Delta cpi_{t-i} + \beta_1 GDPP_{t-i} + \\ & \beta_2 HHI_{t-i} + \beta_3 oil_{t-i} + \beta_4 GFCF_{t-i} + \beta_5 POP_{t-i} + \\ & \beta_6 cpi_{t-i} + \epsilon_t \end{aligned} \quad (3)$$

In this specification, Δ denotes the first-difference operator. The coefficients γ_{11} to γ_{61} represent the short-run dynamic effects of the respective variables, each associated with appropriate lag lengths denoted by $p, q_1, \dots, q_5$. The parameters β_1 through β_6 capture the long-run relationships among the variables included in the cointegrating equation. The error term ϵ_t is assumed to be white noise, indicating that it is independently and identically distributed with a zero mean and constant variance ([Elroukh, 2024](#)).

$$\begin{aligned} \Delta GDPP_t = & C_0 + \sum_{i=1}^p \gamma_{1i} \Delta GDPP_{t-i} + \sum_{i=1}^{q_1} \gamma_{2i} \Delta HHI_{t-i} + \\ & \sum_{i=1}^{q_2} \gamma_{3i} \Delta oil_{t-i} + \sum_{i=1}^{q_3} \gamma_{4i} \Delta GFCF_{t-i} + \\ & \sum_{i=1}^{q_4} \gamma_{5i} \Delta POP_{t-i} + \sum_{i=1}^{q_5} \gamma_{6i} \Delta cpi_{t-i} + \psi EC_{t-1} + \mu_t \end{aligned} \quad (4)$$

Eq. 4 examines the short-run dynamics through a restricted error correction model (ECM). The coefficient of the error-correction term, denoted by ψ , is expected to be negative and have an absolute value less than one, reflecting the speed of adjustment and confirming convergence toward the long-run equilibrium after a shock.

4.4. Diagnostic and stability tests

To ensure the model's adequacy, we employed several post-estimation diagnostics. We checked residual normality using the Jarque-Bera test ([Thadewald and Büning, 2007](#)), assessed serial correlation with the Breusch-Godfrey LM test ([Breusch, 1978](#); [Godfrey, 1978](#)), and tested for heteroskedasticity via the Breusch-Pagan-Godfrey test. Model specification was evaluated using the Ramsey RESET test ([Ramsey, 1969](#)). Finally, we examined parameter stability throughout the sample

period using the CUSUM and CUSUM of Squares procedures (Brown et al., 1975)

4.5. Robustness checks

To assess the robustness of ARDL long-run estimates, we applied three alternative cointegration estimators: Dynamic Ordinary Least Squares (DOLS) (Stock and Watson, 1993), Fully Modified OLS (FMOLS) (Phillips and Hansen, 1990). These methods correct for endogeneity and serial correlation, yielding efficient and precise long-run parameters. The strong alignment in the direction, size, and significance of these coefficients across

methods provides compelling evidence for the robustness of our results (Hechmi, 2025).

5. Results and discussion

5.1. Descriptive statistics

The descriptive statistics as shown in the Table 2, reveal that the central tendency and range values of the study variables are consistent with the nature of economic data. The results indicate that GFC, POP, GDPP, cpi, and oil approximately follow the normal distribution, as suggested by the non-significant Jarque-Bera test ($p > 0.05$).

Table 2: Descriptive statistics

Measures	GFCF	POP	OIL	CPI	GDPP
Mean	20.95788	20167940	3.490842	1.559761	28.44847
Median	21.21729	19410280	3.444973	1.206073	28.28012
Maximum	29.99077	36408820	4.252637	9.870248	29.16838
Minimum	8.834236	6106191	2.771270	-3.203331	27.85046
Std. Dev.	4.278270	9567084	0.312608	2.562853	0.410009
Skewness	-0.577232	0.209992	0.192155	0.633137	0.286837
Kurtosis	3.618117	1.790722	2.642483	3.990401	1.750091
Jarque-Bera	3.786972	3.618885	0.516585	4.845642	3.546328
Probability	0.150546	0.163745	0.772369	0.088671	0.169795
Observations	44	44	44	44	44

5.2. Stationary unit root tests

The findings of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests in Table 3 reveal that certain variables—specifically the economic growth rate (GDPP), gross capital formation (GFCF), oil revenues (oil), and economic diversification (HHI) are stationary at first

difference, indicating integration of order 1 [I(1)]. In contrast, other variables, including inflation (CPI) and population (POP), are stationary at level, signifying integration of order one [I(0)]. This combination of I(0) and I(1) variables satisfies the prerequisites for employing the Autoregressive Distributed Lag (ARDL) modeling approach.

Table 3: Results of unit-root tests

Specification	Variable	ADF: level p-value	ADF: first difference p-value	PP: level p-value	PP: first difference p-value
Intercept	GDPP	0.9998	0.0029	0.9912	0.0029
	GFCF	0.9993	0.0293	0.9986	0.0073
	HHI	0.1852	0.0000	0.2025	0.0000
	CPI	0.0122	—	0.0122	—
	POP	0.9345	0.0000	0.0000	—
	OIL	0.3016	0.0000	0.0243	—
Trend and intercept	GDPP	0.0064	—	0.0068	—
	GFCF	0.9552	0.0264	0.8960	0.0296
	HHI	0.1818	0.0000	0.1618	0.0000
	CPI	0.0277	—	0.0277	—
	POP	0.1961	0.0254	0.9296	0.3469
	OIL	0.6120	0.0000	0.1011	0.0000
None	GDPP	0.9971	0.0111	0.9807	0.0002
	GFCF	0.9982	0.3117	0.9978	0.0032
	HHI	0.5184	0.0000	0.5218	0.0000
	CPI	0.0039	0.0000	0.0039	0.0000
	POP	0.8716	0.0768	0.9999	0.0846
	OIL	0.3827	0.0000	0.2236	0.0000

ADF: Augmented Dickey-Fuller; PP: Phillips-Perron; Level and first difference refer to the series tested at level and after first differencing, respectively; —: Indicates that no value was reported in the source table and it should not be interpreted as a test result; P-values shown as 0.0000 should be checked against the original software output and reported using an appropriate threshold or precision

The Zivot-Andrews unit-root test was employed to examine the stationarity of the study variables while allowing for a single endogenous structural break in each series. Unlike conventional unit-root tests that do not account for structural changes, this approach identifies a potential break date from the data and assesses whether the series is stationary after accounting for that break. The test results, including the test statistics, critical values, estimated break dates, and stationarity conclusions, are

presented in Table 4. At the 1% significance level, the null hypothesis of a unit root is rejected when the test statistic is more negative than the corresponding critical value. As shown in Table 4, this condition is met only for the consumer price index (CPI), whose test statistic is -4.50 , compared with a critical value of -4.28 . The null hypothesis cannot be rejected for GDPP, HHI, POP, GFCF, or OIL at this significance level. These results suggest that the evidence of stationarity differs across the

variables and that most series remain nonstationary under the reported test results. The estimated break dates indicate potential structural changes in the variables over the study period. GDPP has an estimated break in 1987, HHI in 2008, POP in 2022, GFCF in 1988, OIL in 1990, and CPI in 2008. These dates provide a basis for investigating possible associations between changes in the series and major economic events or policy developments in Saudi Arabia. However, the economic interpretation of each break should be supported by the historical

context and should not be inferred from the break date alone. The Zivot–Andrews results should be considered alongside the ADF and PP results in [Table 3](#) when determining the integration orders of the variables. Before applying the ARDL bounds-testing approach, the integration properties must be checked to ensure that none of the variables is integrated of order two, $I(2)$. The reported results should therefore be reconciled across the unit-root tests before concluding that the requirements for ARDL estimation have been satisfied.

Table 4: Zivot–Andrews test

Variable	t-statistics	1% critical value	Break date	Conclusion
GDPP	-2.41	-4.37	1987	Nonstationary
HHI	-0.730	-4.28	2008	Nonstationary
POP	-1.83	-3.79	2022	Nonstationary
GFCF	-0.987	-4.39	1988	Nonstationary
OIL	-3.79	-4.39	1990	Nonstationary
CPI	-4.50	-4.28	2008	Stationary

5.3. Long-run, short-run, and diagnostic test

As presented in [Table 5](#), the estimated coefficient of the error correction term (ECM) is -0.386 , suggesting that approximately 39% of the deviation from the long-run equilibrium is corrected in the subsequent period. The negative and statistically significant sign of the ECM provides strong evidence of a stable long-run relationship among the variables, indicating a relatively rapid adjustment toward equilibrium following short-term disturbances.

Panel A of [Table 5](#) reports the long-run ARDL estimates. The relationship between economic diversification and economic growth in Saudi Arabia is found to be positive and statistically significant in the long run, which means that Saudi Arabia has made significant progress toward achieving economic diversification. An increase in the Herfindahl–Hirschman Index (HHI)—indicating higher economic concentration and lower diversification—reduces economic growth by 1.24. This implies that greater diversification fosters growth, whereas economic concentration hinders it. Diversification encourages all sectors to generate value-added goods and services within the economy, aligning with the strategic objectives outlined in Vision 2030. This result aligns with the findings of [Bitat and Djellit \(2022\)](#), [Gnangnon \(2021\)](#), and [Houfi \(2021\)](#).

The association between labor, proxied by population growth (POP), and capital, measured by gross fixed capital formation (GFCF), exhibits the expected positive and significant impact on promoting economic growth in Saudi Arabia. A 1-point increase in capital formation leads to a 0.79 increase in economic growth, reflecting the crucial role of investment in stimulating long-term growth. Also, a 1-point increase in population raises GDP per capita by 0.95, confirming the contribution of labor force expansion and demographic growth to economic activity. Oil revenues exhibit a statistically significant impact on enhancing economic growth in

Saudi Arabia. A 1-point rise in oil revenues increases economic growth by 0.11 points, showing a positive and significant association at the 10% level. The finding also reveals that inflation has no significant impact on economic growth in the long-run.

Panel B shows that the contemporaneous change in economic diversification ($D(HHI)$) is insignificant, indicating limited immediate effects on growth. However, the lagged change ($D(LHHI(-1))$) is positive and significant, reflecting that diversification benefits materialize with a delay. This lagged effect highlights the time needed for structural reforms, investments, and sectoral adjustments to impact economic performance, consistent with the gradual influence of development plans and Vision 2030 initiatives.

Panel C: The diagnostic tests collectively affirm the adequacy and robustness of the estimated model. The Jarque-Bera test confirms that the residuals are normally distributed, while the Breusch-Godfrey LM test indicates the absence of serial correlation. Furthermore, the residuals are homoscedastic, satisfying the assumption of constant variance. The Ramsey RESET test supports the correctness of the model's functional form specification. Lastly, the coefficient of determination (R^2) is 0.83, suggesting that the model accounts for a substantial proportion of the variation in economic growth (GDPP).

[Fig. 2](#) presents the results of the CUSUM and CUSUM of squares tests, which are used to assess the structural stability of the model's coefficients over time. To further examine this, the GDP-diversification model was evaluated using both the CUSUM and CUSUM of Squares tests. The results confirm that the test statistics consistently lie within the critical bounds throughout the sample period, thereby validating the stability of the model's parameters and suggesting that the model is structurally stable throughout the study period. Accordingly, the model's estimates are considered reliable and are not affected by any structural breaks in the data.

5.4. Robustness checks

To assess the robustness of the long-run ARDL results, we employed FMOLS and DOLS estimators (Table 6). These alternative methods strongly corroborate our initial findings. Across all three

approaches (including ARDL), GDPP, GFCF, POP, OIL, and economic diversification consistently exhibit positive and significant coefficients, while CPI shows a negative and significant relationship. This convergence confirms the robustness of these core relationships.

Table 5: Long-run and short-run, and diagnostic test results of the ARDL model

Variable	Coefficient	Standard error	T-statistic	Level of significance
Panel A: Long-run results				
HHI	-1.239439	0.284590	-4.355172	0.0001
OIL	0.108782	0.062349	1.744709	0.0901
CPI	-0.000717	0.004927	-0.145535	0.8851
IGFCF	0.7932	0.058134	13.64384	0.0000
IPOP	0.946001	0.183370	5.158984	0.0000
Panel B: Error correction model (ECM) and short-run results				
COINTEQ	-0.385899	0.035793	-10.78127	0.0000
D(HHI)	-0.017862	0.102427	-0.174387	0.8626
D(LHHI(-1))	0.228911	0.088058	2.599553	0.0137
R-squared: 0.84	Adjusted R-squared: 0.83		Durbin- Watson: 2.13	
Panel C: Diagnostic tests for model validity				
Test		Statistic		
Jarque-Bera		0.95		(0.74)
LM test		0.23		(0.78)
Breusch-Pagan-Godfrey		1.69		(0.13)
Ramsey RESET		1.15		(0.25)

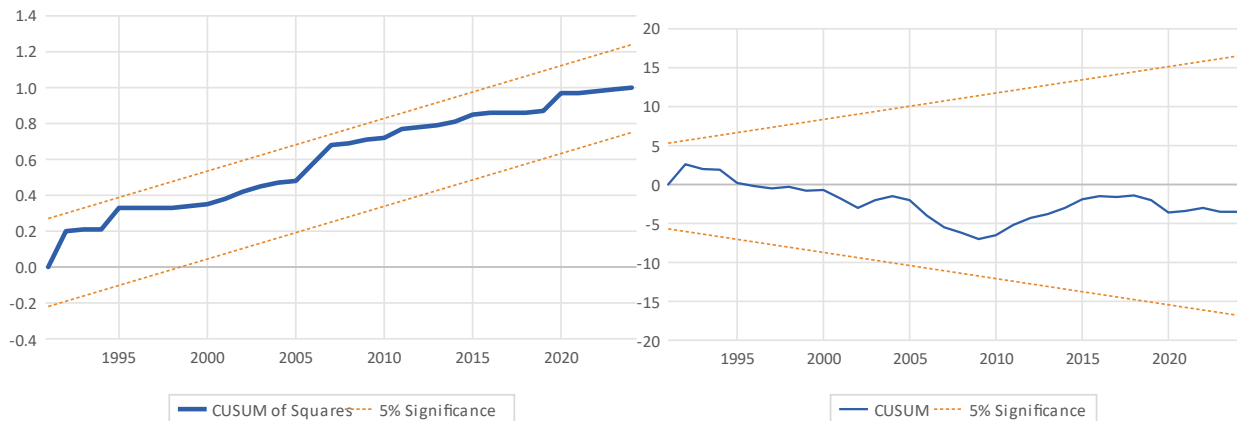


Fig. 2: CUSUM test for parameter stability

Table 6: The FMOLS and DOLS results

Variable	DOLS	p-value	FMOLS	p-value
LGFCF	0.937***	0.000	0.682***	0.0001
LPOP	1.684**	0.020	2.106***	0.0003
LOG(HHI)	-3.281***	0.002	-2.283***	0.0000
LOG(OIL)	0.776***	0.000	1.021***	0.0000
CPI	-0.057***	0.003	-0.053***	0.0000

***: $p < 0.01$

6. Conclusion

The findings of this study would contribute to providing important input pertaining to the relationship between economic diversification and economic growth under the Saudi Arabian economy during 1980-2024. Using the Autoregressive Distributed Lag (ARDL) approach, the study confirmed that economic diversification has a positive and significant effect on real GDP growth. These findings imply that the move to a broader production structure and reduction of dependence on oil are necessary factors influencing sustainable development in Saudi Arabia.

This robustness of these results was also verified by the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS)

estimators, that gave the same signs and significance levels as those resulted with ARDL model. Moreover, diagnostics confirmed that the ARDL specification was consistent with all the necessary statistical assumptions of the model and that its estimations were valid.

Moreover, the results demonstrated that economic growth is positively and significantly associated with population growth, capital accumulation, and oil revenue, and therefore, appear to be fundamentally important aspects for sustained economic growth. In contrast, inflation had a negative but statistically insignificant correlation with growth in the ARDL model, meaning inflation fluctuations had no significant effect on performance over the time considered. Taken together, these findings are in accord with neoclassical and

endogenous growth theories, which stress the importance of capital accumulation, technological change, and structural change in attaining sustainable economic development. The findings also underline the strategic necessity of economic diversification for the long-term growth path of the Saudi Arabian economy, particularly in the context of Vision 2030, which aims to shift the economy from the current oil-based structure to a more resilient, innovation-driven model of development.

The findings confirm that economic diversification positively contributes to Saudi Arabia's long-term growth, supporting the strategic goals of Vision 2030. To sustain this progress, policies should focus on expanding high-value non-oil sectors such as services, tourism, logistics, and digital industries, alongside continued investment in human capital and infrastructure. Key challenges include reducing dependence on oil revenues, addressing skill gaps in emerging sectors, and ensuring effective coordination between public and private investment. Addressing these barriers is essential for translating diversification strategies into measurable growth outcomes and achieving a resilient, innovation-driven economy.

List of abbreviations

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive distributed lag
COINTEQ	Cointegrating equation
CPI	Consumer price index
CUSUM	Cumulative sum
D(HHI)	First difference of the Herfindahl-Hirschman index
D(LHHI(-1))	Lagged difference term involving LHHI; exact definition not specified in the manuscript
DOLS	Dynamic ordinary least squares
ECM	Error correction model
FMOLS	Fully modified ordinary least squares
GDP	Gross domestic product
GDPP	GDP per capita
GFC	Gross capital formation
GFCF	Gross fixed capital formation
GMM	Generalized method of moments
HHI	Herfindahl-Hirschman index
HICs	High-income countries
I(0)	Integrated of order zero
I(1)	Integrated of order one
LCU	Local currency unit
LGFCF	Logarithm of gross fixed capital formation
LM	Lagrange multiplier
LOG	Logarithm
LPOP	Logarithm of population
N	Number of categories or elements
NARDL	Nonlinear autoregressive distributed lag
OIL	Oil revenues
OLS	Ordinary least squares
PP	Phillips-Perron
POP	Population
RESET	Regression specification error test
Std. Dev.	Standard deviation
UECM	Unrestricted error correction model
WDI	World Development Indicators

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Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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