

Article

Threshold Effects of Economic Diversification on Economic Growth in Saudi Arabia: A Non-Linear Modeling Approach

Mohamed Ali Houfi

Faculty of Business Administration, University of Tabuk, Tabuk 71491, Saudi Arabia; m.houfi@ut.edu.sa

Abstract

This paper examines the nonlinear relationship between economic diversification and economic growth in Saudi Arabia and estimates a diversification threshold associated with higher growth performance. Using annual data from 1995 to 2024, the analysis situates economic diversification within the context of two major reform periods: the structural transformation policies of the early 2000s and the Vision 2030 program initiated in 2016, both of which aimed to reduce oil dependence and expand the non-oil economy. The empirical findings reveal a nonlinear relationship between diversification and growth, where diversification is associated with higher growth outcomes above an estimated threshold. Overall, the results suggest that higher levels of diversification are associated with greater economic resilience and stability in Saudi Arabia, while highlighting the importance of continued structural reforms to deepen sectoral diversification and support sustainable long-term economic performance. Based on the obtained results, policy implications are discussed.

Keywords: economic diversification; economic growth; Hansen threshold regression model; Saudi Arabia

1. Introduction

Economic diversification has become one of the central issues in development economics, particularly in resource-dependent economies, due to its role in promoting sustainable growth and enhancing resilience to external shocks (Brummitt et al., 2018). Economies with limited diversification are typically more exposed to fluctuations in commodity prices and global demand cycles, which constrains their ability to maintain stable long-run growth (Fernando, 2025). In this context, Saudi Arabia represents a particularly relevant case, as its economic structure has historically been heavily dependent on the oil sector as the main source of fiscal revenue, exports, and gross domestic product (Havrlant & Darandary, 2021). This dependence has resulted in a relatively concentrated productive structure, where the contribution of non-oil sectors to output and employment has remained limited compared to hydrocarbon-related activities (Al-Thikrallah, 2025).

In response to these structural challenges, Saudi Arabia has implemented a series of economic transformation initiatives aimed at reducing oil dependence and expanding the role of non-oil sectors. Early reform efforts in the 2000s were followed by the launch of Saudi Vision 2030 in 2016, which constitutes a comprehensive strategic framework for structural transformation (De et al., 2024; Vision, 2023). This strategy emphasizes industrial diversification, services sector development, tourism expansion, technological upgrading, and increased private sector participation, with the objective of achieving a more resilient and sustainable growth model.



Academic Editor: Periklis Gogas

Received: 31 May 2026

Revised: 17 July 2026

Accepted: 17 July 2026

Published: 1 August 2026

Copyright: © 2026 by the author.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

Despite these policy efforts, the relationship between economic diversification and economic growth remains theoretically and empirically ambiguous. While some studies argue that diversification enhances productivity, reduces volatility, and supports long-term growth stability (Brummitt et al., 2018), others suggest that its effects are conditional on structural and institutional characteristics. Moreover, a large portion of the existing literature relies on linear econometric frameworks, which may not adequately capture the possibility of nonlinear and regime-dependent relationships in resource-dependent economies.

Against this background, this study investigates the relationship between economic diversification and economic growth in Saudi Arabia over the period 1995–2024 using a Hansen (1999) threshold regression model. This approach allows for the identification of an endogenous threshold level of diversification, beyond which the relationship between diversification and growth may change in magnitude and significance. The model is particularly suitable for capturing structural heterogeneity in the diversification–growth nexus and for identifying regime-dependent dynamics within the sample period.

Accordingly, the study addresses the following research questions:

- ✓ What is the nature of the relationship between economic diversification and economic growth in Saudi Arabia over the period 1995–2024?
- ✓ Does a statistically significant diversification threshold exist beyond which the diversification–growth relationship changes across regimes?

Based on these questions, the study tests the following hypotheses:

H1. *The relationship between economic diversification and economic growth is nonlinear and differs across diversification regimes identified by the estimated threshold.*

H2. *After the estimated diversification threshold is reached, higher levels of diversification (i.e., lower values of the diversification concentration index) are associated with stronger economic growth.*

The significance of this study lies in its ability to provide a more nuanced and dynamic understanding of the diversification–growth nexus in a resource-dependent economy. By identifying an estimated threshold level, the study offers empirical evidence on the point at which diversification begins to generate stronger and more stable growth effects in Saudi Arabia. This contributes both to the academic literature on nonlinear growth dynamics and to policy discussions on structural transformation (Havrlant & Darandary, 2021; Vision, 2023).

This paper contributes to the literature in three main ways. First, it applies a well-established Hansen (1999) threshold regression framework to examine nonlinear and regime-dependent relationships in the Saudi diversification–growth nexus, rather than proposing a new methodological extension. Accordingly, the contribution of this study lies primarily in its empirical application to Saudi Arabia, the Vision 2030 reform context, and the identification of a diversification threshold within a major resource-dependent economy. Second, it provides empirical evidence of an estimated structural threshold at which the diversification–growth relationship changes. Third, it provides updated evidence using annual data covering both the pre- and post-Vision 2030 period, allowing the estimated diversification threshold to be interpreted within the broader context of Saudi Arabia’s ongoing structural transformation rather than as a direct effect of Vision 2030.

Given the single-country time-series structure of the data, the estimated results should be interpreted as evidence of structural associations and regime-dependent patterns rather than causal relationships.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature. Section 3 presents the econometric framework and data. Section 4 discusses the empirical results. Section 5 concludes and provides policy implications.

2. Literature Review

2.1. Theoretical Literature Review

The concept of economic diversification is grounded in the idea of broadening the productive base and reducing excessive dependence on a single sector or a limited set of economic activities, thereby ensuring more stable and sustainable growth. From a theoretical perspective, economic diversification is closely linked to the notions of structural change and balanced growth, as developed by Lewis (1954) and Hirschman (1958), wherein diversification is viewed as a mechanism for transitioning from a mono-sector, rent-based economy to a multi-sector economy capable of enhancing total factor productivity. The relationship between economic diversification and growth is underpinned by a range of classical and modern economic theories that highlight how expanding the productive base can foster productivity, stability, and long-run growth. These theories can be broadly classified into four main groups: growth theories, international trade theories, income volatility and resource-based theories, and the contemporary literature on rentier and oil-dependent economies.

The economic literature provides a multidimensional explanation of how diversification promotes growth. Classical growth theory posits that expanding the productive base and allocating capital across multiple sectors enhances productive capital accumulation, thereby supporting stronger growth outcomes compared with mono-sector, resource-dependent economies (Lewis, 1954; Chenery, 1979). The neoclassical growth model deepens this perspective by demonstrating that undiversified economies face declining capital productivity due to the law of diminishing returns and exhibit fragile growth patterns driven by a single sector (Solow, 1956; Swan, 1956). Conversely, diversification contributes to higher total factor productivity (TFP) and fosters innovation through cross-sectoral interactions. Endogenous growth theories (Romer, 1986; Lucas, 1988) offer a broader lens on the diversification–growth nexus by emphasizing that sustained growth emerges from the accumulation of human capital, knowledge, innovation, and technology—elements that naturally expand as economic sectors diversify and interact. This dynamic supports the creation of a knowledge-based economy, enhances learning-by-doing, and increases the returns to investment. Accordingly, economic diversification emerges as a central mechanism for boosting productivity, achieving self-sustaining growth, and reducing reliance on a single sector, thereby establishing itself as a cornerstone of long-term growth strategies.

Modern international trade theories emphasize the pivotal influence of a country's export structure on its economic growth. Hausmann et al. (2007) demonstrate that economies with more diversified exports and greater product sophistication tend to achieve stronger growth outcomes. By expanding the range of exported goods, countries can access new markets, reduce exposure to fluctuations in global demand, and improve the quality of their products. These insights are further supported by the Economic Complexity Index (ECI) proposed by Hidalgo and Hausmann (2009), which assesses a nation's capacity to produce and export knowledge-intensive and technologically advanced goods. In a related vein, Porter's (1990) theory of advanced competitive advantage argues that economies that develop multiple sectors in an integrated manner are better positioned to form dynamic industrial clusters, foster innovation, and improve productivity. Such interconnected development ultimately generates a sustainable competitive advantage not attainable under reliance on a single sector. Accordingly, diversification—whether in export com-

position or sectoral structure—emerges as a fundamental driver of a more competitive, innovation-based, and technologically complex growth model.

The literature on resource-dependent economies provides a coherent theoretical justification for the effectiveness of economic diversification in fostering growth. The resource curse hypothesis (Sachs & Warner, 1995) posits that excessive dependence on a single natural resource, such as oil, creates structural fragility manifested in the weak performance of non-resource productive sectors, heightened income volatility, and institutional deterioration, thereby undermining long-term growth prospects. Diversification, in this context, becomes an essential mechanism for breaking away from the constraints of rent-based revenues and building a broad productive base. The Dutch disease framework (Corden & Neary, 1982) deepens this argument by explaining how large inflows of foreign currency from resource exports appreciate the real exchange rate and erode the competitiveness of tradable sectors, whereas diversification helps restore macroeconomic balance by strengthening industrial, agricultural, and service sectors and mitigating currency-induced distortions. The income-volatility hypothesis (Aghion & Banerjee, 2005) adds that resource-rich economies are highly exposed to fluctuations in revenues tied to global commodity cycles, which depress investment, weaken planning capacity, and slow economic growth. Diversification thus reduces output volatility, lowers macroeconomic risks, and enhances overall stability. Taken together, these perspectives demonstrate that diversification is a prerequisite for escaping the rent-dependence trap and achieving more resilient and sustainable growth.

The structural transformation framework provides another cornerstone for understanding how economic diversification shapes growth. Lewis's (1954) dual-sector model argues that sustained growth requires a progressive reallocation of labor from traditional low-productivity sectors to modern high-productivity activities—a transition that is feasible only in the presence of a diversified productive base capable of absorbing labor and raising aggregate productivity. This view aligns with Chenery's (1979) development patterns approach, which describes growth as a gradual structural shift from agriculture to manufacturing and eventually to advanced services, making diversification a necessary condition for expanding productive capacity and enabling continuous technological and knowledge accumulation. Within this framework, diversification is not a mere quantitative expansion in the number of sectors but rather a qualitative transformation that accelerates the shift from a mono-sectoral economy to an integrated, high-productivity structure capable of sustaining long-term growth.

Recent literature on oil-dependent economies—particularly in the Gulf Cooperation Council countries and Saudi Arabia specifically—shows that the relationship between economic diversification and growth has taken on new dimensions amid the transition toward a knowledge-based economy, the development of non-oil sectors, increased investment in technology and services, labor-market restructuring, and the rising contribution of the private sector (Hvidt, 2013; Callen et al., 2014; Cherif & Hasanov, 2019). These studies emphasize that diversification in resource-rich economies is not simply a developmental option but a macroeconomic necessity. Diversification helps reduce growth fragility, absorb shocks arising from oil price fluctuations, enhance economic efficiency, raise productivity, and improve overall competitiveness. Therefore, contemporary empirical and theoretical work underscores that diversification constitutes a central pillar for enabling structural transformation and supporting sustainable growth in oil-exporting economies.

2.2. Empirical Literature Review

A growing strand of empirical research has reaffirmed, especially in recent years, that economic diversification constitutes a fundamental pillar for achieving sustained

growth, notably in countries whose economies rely heavily on natural-resource revenues (Bedime et al., 2025; Zarach & Parteka, 2023). The heightened instability of international markets over the last decade has made it increasingly evident that expanding the range of productive and export activities is essential for strengthening long-term economic performance. Evidence suggests that economies endowed with more diversified structures are generally more successful in managing external shocks and preserving consistent growth paths (Markakkaran & Sridharan, 2022).

Between 2020 and 2025, an extensive body of empirical work has shown that diversification—whether through broadening the production base or through expanding export baskets—contributes to stronger economic outcomes by improving productivity, enlarging the footprint of high-value-added industries, and reducing exposure to volatility in global commodity prices (Trinh & Thuy, 2021; Adu et al., 2025). Within the Gulf Cooperation Council region, and particularly in Saudi Arabia, recent studies illustrate that the acceleration of non-oil sector development has become a core factor behind economic momentum, reflecting the effects of ongoing structural and reform-oriented policy frameworks (Sweidan & Elbargathi, 2024; Zafar & Ali, 2025). Furthermore, several contemporary analyses argue that the diversification–growth nexus is shaped by institutional capacity, technological readiness, and degrees of integration into global trade networks (Cherif & Hasanov, 2019; Parteka et al., 2025).

A recent study by Zafar and Ali (2025) evaluates diversification strategies in the Gulf countries using a multi-criteria decision-making (MCDM) approach. It provides insights into the effectiveness of development policies and the extent to which they are leveraged to build economic resilience away from oil dependence. Abdelkawy (2024) employed a dynamic GMM model to analyze the relationship between oil rents, market capitalization, and foreign investment on GDP growth in the GCC countries. His study showed that reliance on oil can constrain long-term growth if it is not accompanied by structural diversification. Belloumi (2025) examined in his study how resource rents (such as oil) and governing institutions influence economic diversification. The findings confirm that weak institutions negatively affect the Gulf countries' ability to diversify, and that improving governance is essential to avoiding the resource curse.

Alhattali et al. (2025) examine the impact of trade diversification, economic growth, energy use, and FDI on environmental outcomes in GCC countries (2000–2018). Using a combined ecological footprint measure, they apply IPS unit root tests, Pedroni cointegration, and PMG-ARDL estimations. Results indicate that trade concentration, FDI, and energy consumption increase environmental degradation, while higher income reduces it, supporting the Environmental Kuznets Curve and offering policy guidance for GCC nations. Houfi (2021) investigates the association between diversification and growth in Saudi Arabia (1990–2018) using the Herfindahl index. The study finds that diversification boosts growth only in the long run, with growth responding symmetrically to increases and decreases in diversification. The results suggest Saudi Arabia has made progress in diversifying its economy and promoting growth. Ochi et al. (2025) analyze the non-linear impact of FDI on economic growth in 19 Arab countries (2002–2019) using a dynamic panel threshold model and FD-GMM estimation. Their findings indicate that FDI positively influences growth only after governance quality and human capital and financial development surpass certain thresholds. Adu et al. (2025) examine the relationship between economic growth and export diversification in Sub-Saharan Africa (2000–2018) using Arellano-Bond GMM estimation. Their results show an inverted U-shaped effect, where moderate diversification boosts growth, but excessive diversification reduces it. Strong governance further is associated with growth, while corruption hinders it. Numerous studies have demonstrated that other variables besides economic diversification also influence economic growth, such

as FDI, domestic investment, trade openness, inflation and Human capital (Labidi et al., 2024; Saidi & Ochi, 2023; Ochi et al., 2025).

A complementary strand of the literature emphasizes that the diversification–growth relationship in resource-rich economies is deeply shaped by underlying political economy structures rather than purely macroeconomic mechanisms. The rentier state literature argues that economies dependent on external resource rents tend to exhibit institutional configurations characterized by limited fiscal accountability, weak taxation systems, and reduced pressure for institutional responsiveness (Beblawi, 1987; Ross, 2001). In such contexts, economic outcomes are strongly influenced by the distribution and allocation of resource rents rather than market-driven productivity dynamics.

Within this framework, rent-seeking behavior and elite capture play a central role in shaping structural transformation. Resource rents may generate incentives for maintaining existing revenue streams rather than promoting productive diversification, leading to inefficient allocation of resources and persistent dependence on hydrocarbons. Empirical studies highlight that these dynamics can distort industrial policy, weaken competitive market forces, and slow down the reallocation of capital toward non-resource sectors (Mehlum et al., 2006; Torvik, 2009).

Furthermore, recent evidence suggests that in oil-dependent economies, institutional quality and governance effectiveness may be endogenously shaped by resource dependence, thereby limiting their direct observable impact on growth performance. Similar conclusions are supported by Collier (2006) and Hanson and Mendoza (2009), which show that rent-seeking structures and policy distortions can weaken the transmission of institutional quality into economic outcomes. This perspective provides a useful lens for interpreting the empirical finding of weak statistical significance for governance quality in the Saudi case, suggesting that institutional effects may be constrained or indirectly transmitted within a resource-dependent economic structure.

Ben Hassen (2022) calls for a reassessment of post-pandemic policy frameworks, emphasising the central role of economic diversification in mitigating vulnerability to oil-price shocks. His analysis reviews recovery programs and fiscal policy measures, highlighting the need to realign them toward enhancing long-term resilience. The findings of Bannour and Abdelkawy (2024) indicate that adherence to ESG standards and higher levels of disclosure and institutional transparency positively influence the investment climate's attractiveness. This, in effect, draws foreign investments into various economic domains, thereby promoting income-source diversification and strengthening non-oil sectors. Esmail et al. (2025) demonstrate that entrepreneurship and the digital economy have become key engines of diversification in Saudi Arabia. Drawing on short-term establishment data, their study investigates how these emerging sectors contribute to broadening the country's economic base. Alnsour and Alnsour (2025) indicate that integrating renewable energy into the economic system can enhance the efficient utilization of natural resource revenues, thereby contributing to more diversified and sustainable economic growth. Mgammal and Misbah (2025) show that the growing presence of multinational corporations plays a pivotal role in strengthening economic diversification and enhancing local capabilities through the opportunities they create for technology transfer, in alignment with the objectives of Vision 2030. Alotaibi et al. (2025) show that large-scale projects, urban development sectors, and infrastructure investments play a significant role in broadening the economic base beyond rent-dependent activities. However, the study also emphasizes that these sectors may exhibit instability, which necessitates the adoption of policies that ensure the long-term sustainability of diversification efforts.

For developing and emerging economies, recent findings emphasize that diversification yields meaningful gains only when embedded within an environment conducive to

economic transformation—one characterized by institutional strengthening, investment in skills and human capital, and strategic orientation toward sectors capable of generating higher value (Attah et al., 2025; Nguyen et al., 2025). Collectively, these studies converge in indicating that diversification is not simply a means of mitigating macroeconomic risk but a strategic pathway for igniting long-term growth through enhanced innovation, learning, and the broadening of productive capacity (Matallah, 2022; Matallah, 2020).

While a growing body of literature has employed nonlinear and threshold-based approaches to examine the relationship between economic growth and diversification, this study does not seek to introduce a new econometric methodology. Rather, it applies Hansen's (1999) threshold regression framework to a contemporary and policy-relevant setting, namely Saudi Arabia during the Vision 2030 reform era. The contribution of the study therefore lies in its updated dataset, its focus on an economy undergoing an ongoing process of structural transformation, and its empirical estimation of a diversification threshold within a resource-dependent context. By doing so, the paper complements existing threshold-based studies by providing country-specific evidence on regime-dependent diversification–growth patterns and their policy implications, rather than claiming methodological innovation.

2.3. Research Gap in the Existing Literature and Study Contribution

An examination of the literature on economic diversification and economic growth in resource-dependent economies reveals several unresolved empirical and methodological issues. Although the diversification–growth relationship is often characterized by structural changes, reform episodes, and potentially nonlinear dynamics, much of the existing literature continues to rely on linear econometric frameworks such as OLS, ARDL, and VAR models. While these approaches provide useful insights, they are less suited to capturing regime-dependent associations and threshold effects that may emerge during periods of structural transformation. As a result, the application of Hansen's (1999) threshold regression framework remains relatively limited in empirical studies focusing on diversification in resource-dependent economies.

Furthermore, the existing literature provides only limited evidence on how diversification–growth associations evolve during the structural reforms associated with Saudi Vision 2030. Many studies rely on datasets that predate the reform period or only partially capture the structural changes introduced since 2016. In addition, relatively few studies investigate whether the diversification–growth relationship varies across different levels of diversification within the Saudi economy. Most available evidence is also based on cross-country analyses, which may overlook country-specific institutional and structural characteristics that shape diversification dynamics in Saudi Arabia.

Against this background, the present study contributes to the literature in three main ways. First, it applies Hansen's (1999) threshold regression framework to examine whether the association between economic diversification and economic growth exhibits regime-dependent nonlinearities in Saudi Arabia. Second, it employs an updated dataset covering both the pre- and post-Vision 2030 periods, thereby capturing the ongoing structural transformation of the Saudi economy. Third, it provides an empirical estimate of a diversification threshold within the sample period and analyzes how the diversification–growth association differs across regimes.

Importantly, the study does not aim to establish causal relationships. Rather, it focuses on identifying nonlinear associations and regime-dependent patterns in the diversification–growth nexus within a single-country time-series setting. Therefore, the contribution of the paper lies in providing context-specific empirical evidence for a resource-dependent economy undergoing structural reform, rather than proposing a new econometric methodology.

3. Methodology

3.1. Data and Variables

This study examines the relationship between economic diversification and economic growth in Saudi Arabia over the period 1995–2024 using a time-series Hansen (1999) threshold regression model. The empirical specification allows for the possibility that the association between diversification and economic growth is regime-dependent and varies across different levels of diversification. Accordingly, the threshold regression framework is employed to identify whether the diversification–growth relationship differs across regimes and to estimate the diversification threshold within the sample period. This approach is motivated by the hypothesis that the diversification–growth nexus is inherently nonlinear and evolves across stages of structural transformation.

The dataset is compiled from several authoritative sources, including the World Bank, the Worldwide Governance Indicators (WGI), and the Penn World Table (version 11, released on 7 October 2025), in addition to international oil price databases (e.g., Brent crude series) and COVID-19 shock indicators. The selection of variables is guided by prior empirical studies (Alhattali et al., 2025; Ochi et al., 2025; Houfi, 2021; Adu et al., 2025; Labidi et al., 2024; Parteka et al., 2025; Saidi & Ochi, 2023), which emphasize the importance of investment dynamics, institutional quality, macroeconomic shocks, and human capital in shaping growth dynamics in resource-dependent economies. Given the single-country time-series structure, the empirical analysis focuses on identifying nonlinear associations and regime-dependent patterns rather than establishing causal effects.

The Worldwide Governance Indicators (WGI), developed by Kaufmann, Kraay, and Mastruzzi, consist of six dimensions of institutional quality: Rule of Law (RL), Political Stability and Absence of Violence/Terrorism (PS), Voice and Accountability (VA), Regulatory Quality (RQ), Government Effectiveness (GE), and Control of Corruption (CC). These indicators are measured on a scale ranging from approximately −2.5 (weak governance performance) to +2.5 (strong governance performance). In this study, a composite Governance Index (GI) is constructed by averaging the six dimensions, providing a summary measure of institutional quality and reducing potential multicollinearity. Table 1 presents a summary of the governance indicators used in the analysis.

Table 1. Descriptive statistics of governance indicators.

Variable	Obs	Mean	Std. Dev	Min	Max
VA	30	−1.680	0.151	−1.907	0.536
RL	30	0.111	0.119	−0.165	0.414
RQ	30	0.057	0.188	−0.308	0.517
PS	30	−0.366	0.264	−0.660	0.227
GE	30	0.013	0.313	−0.391	0.796
CC	30	0.034	0.234	−0.312	0.536
GI	30	−0.305	0.126	−0.488	0.105

To ensure the completeness of the dataset employed in the threshold regression analysis, missing values in the governance indicators and the Global Governance Index (GI) were addressed using a linear interpolation procedure. This approach ensures a continuous and balanced annual time series covering the period 1995–2024 while preserving the temporal structure of institutional quality.

An examination of the governance indicators shows that their average values are generally close to zero or moderately negative, reflecting Saudi Arabia’s relative position within the WGI framework over the sample period. The six governance dimensions exhibit broadly similar statistical properties in terms of mean values, dispersion, and temporal

dynamics, suggesting a high degree of comovement across institutional indicators. These values reflect Saudi Arabia's relative positioning within the WGI international ranking system and should not be interpreted as indicating poor governance in absolute terms.

Given this consistency, a composite governance measure (GI) is retained as a conditioning control variable following Kaufmann et al. (2005, 2010). This aggregation reduces dimensionality and mitigates potential multicollinearity. The governance index is included as a control variable capturing institutional conditions associated with economic performance rather than identifying causal effects.

Governance quality may influence diversification effectiveness through several indirect channels. Stronger institutional frameworks can improve policy implementation, reduce transaction costs, enhance investor confidence, and facilitate the efficient allocation of resources toward emerging non-oil sectors. In resource-dependent economies, governance may therefore act as an enabling condition that supports structural transformation and increases the effectiveness of diversification policies. Accordingly, the Governance Index (GI) is included as a conditioning variable expected to reinforce the diversification–growth relationship indirectly rather than as a direct determinant of economic growth.

It is important to note that negative WGI values reflect relative positioning within the international governance ranking framework rather than poor governance in an absolute sense. Accordingly, the governance indicators are interpreted as comparative measures of institutional performance across countries and over time.

The present study examines the relationship between economic diversification and economic growth in Saudi Arabia over the period 1995–2024. Economic growth is measured by the GDP per capita growth rate, reflecting annual changes in real output per person. The explanatory variables include the Economic Diversification Index (DI) as the main variable of interest, along with a set of control variables: Governance Index (GI), Foreign Direct Investment (FDI), Domestic Investment (GCF), Human Capital Index (HC), Oil Price (OIL), and a COVID-19 dummy variable (COVID). These variables are selected based on theoretical considerations and empirical literature and are included to capture structural, institutional, external, and shock-related determinants of growth in resource-dependent economies. The definitions, measurement approaches, and data sources of all variables are summarized in Table 2.

Table 2. Variable Descriptions and Measurement.

Variable	Symbol	Definition	Data Source
Economic growth	GDP	The annual GDP per capita growth rate reflects the percentage change in GDP per capita from one year to the next.	World Bank https://databank.worldbank.org/source/world-development-indicators (accessed on 16 July 2026)
ExportDiversificationIndex	DI	Export diversification indices measure the degree to which a country's export portfolio is concentrated in a limited set of products or distributed across a broader range of goods. A low value reflects a high level of diversification—meaning exports are distributed among many goods or markets—whereas a high value indicates strong concentration, typically around a limited number of products, often primary commodities. These indicators are commonly computed using measures such as the Herfindahl–Hirschman Index.	UNCTAD https://unctadstat.unctad.org/datacentre/dataviewer/US.ConcentDiversIndices (accessed on 16 July 2026)

Table 2. *Cont.*

Variable	Symbol	Definition	Data Source
Governance Quality	GI	This indicator is derived as the average of six governance dimensions—government effectiveness, political stability and absence of violence/terrorism, control of corruption, regulatory quality, rule of law, and voice and accountability—following the framework proposed by Kaufmann et al. (2005, 2010). The resulting index spans a scale from −2.5, indicating weak governance performance, to +2.5, reflecting strong governance quality.	Worldwide Governance Indicators https://databank.worldbank.org/source/world-development-indicators (accessed on 16 July 2026)
Foreign direct investment	FDI	FDI net inflows represent the sum of direct investment in the domestic economy from foreign investors, including reinvested earnings and intra-company lending, net of capital withdrawals and loan repayments. For this research, FDI is quantified as net inflows expressed as a percentage of GDP.	World Bank https://databank.worldbank.org/source/world-development-indicators (accessed on 16 July 2026)
Domestic investment	GCF	Gross capital formation—previously known as gross domestic investment—is defined as outlays to increase the stock of fixed assets plus net changes in the level of inventories. Domestic investment in this paper is gauged using gross capital formation as a share of GDP.	World Bank https://databank.worldbank.org/source/world-development-indicators (accessed on 16 July 2026)
Oil Price	OIL	International crude oil price (Brent), used to capture external oil-market fluctuations affecting macroeconomic performance in Saudi Arabia.	World Bank Commodity Price Data / Brent series
COVID-19 Shock	COVID	Dummy variable capturing the COVID-19 period, taking the value 1 for the pandemic years (2020–2021) and 0 otherwise.	Author’s construction
Human capital	HC	The human capital index per person is obtained from measures of educational attainment, namely years of schooling, and the estimated returns to education.	Penn World Table, version 11.0 https://www.rug.nl/ggdc/productivity/pwt/?lang=en (accessed on 16 July 2026)

While export diversification and productive diversification are conceptually distinct, export diversification is widely used in the empirical literature as an indicator of structural transformation. In resource-dependent economies such as Saudi Arabia, export concentration is closely associated with the underlying production structure, as exports are heavily dominated by hydrocarbons. Therefore, changes in export diversification can be interpreted as an indirect reflection of broader shifts in productive capacity and sectoral composition. Although export diversification does not fully capture productive diversification, it remains one of the most widely used proxies in the empirical literature, particularly for oil-exporting economies where export concentration closely mirrors production concentration.

An examination of Saudi Arabia’s export structure from 1995 to 2024 indicates a gradual, though uneven, evolution toward greater diversification, as shown in Table 3. In the late 1990s, the Export Diversification Index (DI) recorded relatively high values—for example, 0.816 in 1996 and 0.823 in 1999—indicating a strong concentration in a limited range of export products, primarily hydrocarbons. During the 2000s, the index declined gradually, suggesting modest improvements in export variety; however, this trend was periodically reversed during episodes of oil-market volatility, particularly in 2006–2008 and

2011–2013, highlighting the sensitivity of the export structure to fluctuations in international oil prices.

Table 3. Product diversification indices of exports, annual (analytical).

Country	Diversification Index	Country	Diversification Index
1995	0.839	2010	0.754
1996	0.816	2011	0.751
1997	0.792	2012	0.742
1998	0.804	2013	0.761
1999	0.823	2014	0.753
2000	0.801	2015	0.772
2001	0.796	2016	0.778
2002	0.785	2017	0.763
2003	0.782	2018	0.763
2004	0.782	2019	0.768
2005	0.766	2020	0.764
2006	0.763	2021	0.765
2007	0.756	2022	0.75
2008	0.738	2023	0.75
2009	0.756	2024	0.728

Source: United Nations Trade and Development (UNCTAD).

After 2015, a more sustained decline in the index is observed, reaching 0.728 in 2024. This pattern reflects a gradual reduction in export concentration and coincides with the implementation phase of Saudi Vision 2030, which aims to reduce oil dependency and expand non-oil economic activities. Importantly, this evolution also takes place in the context of persistent oil-price fluctuations, reinforcing the relevance of including oil price dynamics (OIL) in the empirical model to capture external shocks affecting the growth–diversification nexus. Although hydrocarbons continue to dominate export revenues, the overall trajectory suggests a slow but persistent structural transition toward a more diversified export base.

Table 4 provides an overview of the descriptive statistics for both the dependent and explanatory variables. The dataset consists of a time series of 30 annual observations covering the period 1995–2024. The descriptive statistics summarize the main characteristics of the variables employed in the empirical analysis.

Table 4. Summary Descriptive Measures of the Study Data.

Variable	Obs	Mean	Std. Dev	Min.	Max.
GDP	30	3.639	3.649	−3.804	12
DI	30	0.769	0.022	0.728	0.823
FDI	30	0.851	1.103	−0.992	3.185
GCF	30	24.693	4.230	18.571	32.433
HC	30	2.352	0.394	0.702	2.71
GI	30	−0.305	0.126	−0.488	0.105
OIL	30	58.543	31.412	12.716	111.965
COVID	30	0.067	0.254	0	1

Economic growth, measured by the real GDP growth rate, records an average value of 3.64%, accompanied by relatively pronounced volatility, as reflected in a standard deviation of 3.65. The minimum value of −3.80% corresponds to a period of economic contraction, while the maximum value of 12% reflects a period of strong economic expansion, typi-

cally occurring during periods of favorable external conditions and structural changes in the economy.

The Export Diversification Index (DI) has an average value of 0.769 and a relatively small standard deviation of 0.022, indicating limited variation over time. Since higher values of the index correspond to greater export concentration, the average level of the indicator suggests a persistent degree of concentration in Saudi Arabia's export structure throughout the sample period, consistent with the historical importance of hydrocarbons in the economy.

Foreign direct investment (FDI inflows as a share of GDP) exhibits an average value of 0.85%, accompanied by substantial variability, as indicated by a standard deviation of 1.10. The negative minimum value reflects years in which disinvestment exceeded inflows, while the maximum value of 3.19% corresponds to periods of relatively strong foreign capital inflows.

Domestic investment (GCF) records an average value of 24.69% of GDP, indicating a relatively high and stable level of capital formation over the sample period, with moderate variability. The Human Capital Index (HC) has an average value of 2.35 and a standard deviation of 0.394, indicating gradual improvements in human capital accumulation over time.

The composite Governance Index (GI) records a mean value of -0.305 and a standard deviation of 0.126. The negative average reflects Saudi Arabia's relative position within the Worldwide Governance Indicators (WGI) framework during the study period. It should not be interpreted as evidence of weak governance in an absolute sense, since WGI scores are relative international indicators rather than absolute measures of institutional performance. The minimum and maximum values range from -0.488 to 0.105, indicating gradual but limited changes in governance conditions across the sample period.

To account for external factors highlighted in the literature on resource-dependent economies, the empirical specification also incorporates international oil prices (OIL) and a COVID-19 dummy variable. Oil prices display substantial volatility, with an average value of 58.54 USD per barrel and a standard deviation of 31.41, reflecting the pronounced fluctuations observed in global energy markets over the sample period. The COVID variable records a mean value of 0.067, consistent with the limited number of observations corresponding to the pandemic period.

Overall, the descriptive statistics indicate considerable heterogeneity across variables. Economic growth, foreign direct investment, and oil prices exhibit relatively high volatility, whereas export diversification, governance quality, and human capital evolve more gradually over time. These patterns provide preliminary descriptive evidence of heterogeneous dynamics in the Saudi economy and motivate the subsequent threshold regression analysis.

The empirical analysis begins with a diagnostic assessment of potential multicollinearity. Following Kervin (1992), correlation coefficients with absolute values above 0.7 are considered indicative of multicollinearity concerns. This step is complemented by a pairwise correlation analysis to ensure the reliability of the subsequent estimation results.

The empirical strategy follows a structured sequence. First, a preliminary diagnostic stage is conducted, including descriptive statistics and correlation analysis. Second, the econometric specification of the Hansen (1999) threshold regression model is defined, where economic growth is the dependent variable, economic diversification serves as both an explanatory and threshold variable, and a set of conditioning variables captures institutional, investment, and external economic factors.

Third, the threshold identification procedure is implemented by selecting the diversification index as the threshold variable and defining the admissible search space, excluding extreme observations to ensure sufficient regime observations. Fourth, the estimation stage

employs a grid-search procedure to identify the threshold value that minimizes the residual sum of squares, followed by regime-specific least squares estimation.

Finally, inference is conducted using Hansen’s bootstrap procedure to test the null hypothesis of linearity against the alternative of a threshold effect. This approach enables the identification of regime-dependent associations and nonlinear patterns in the diversification–growth relationship, without implying causal interpretation.

This structured procedure ensures transparency, econometric consistency, and replicability of the results.

Table 5 presents the correlation matrix of the study variables. The absolute values of the correlation coefficients range between low and moderate levels, indicating that multicollinearity is not a concern in the empirical specification. All pairwise correlations remain below the conventional threshold of 0.7, supporting the reliability of the econometric estimates.

Table 5. Correlation coefficients between variables.

	DI	FDI	GCF	HC	GI	OIL	COVID
DI	1.000						
FDI	−0.231	1.000					
GCF	−0.550	0.241	1.000				
HC	−0.149	0.184	0.119	1.000			
GI	−0.097	0.394	0.390	0.305	1.000		
OIL	−0.612	0.290	0.427	−0.132	0.276	1.000	
COVID	−0.078	0.181	0.018	0.220	0.200	−0.018	1.000

The diversification index (DI) exhibits a negative correlation with oil prices (OIL), reflecting the structural dependence of Saudi Arabia’s export structure on hydrocarbons, where periods of higher oil prices tend to reinforce export concentration. Similarly, DI is negatively correlated with domestic investment (GCF), suggesting that capital accumulation has historically been associated with resource-based expansion rather than diversification-oriented restructuring.

Oil prices (OIL) display positive correlations with foreign direct investment, domestic investment, governance quality, and overall economic activity, highlighting the central role of oil-market conditions in shaping macroeconomic performance in Saudi Arabia. The COVID-19 dummy variable exhibits only weak correlations with the explanatory variables, as expected, since it captures a temporary and exogenous shock rather than a persistent structural relationship.

Overall, the correlation structure supports the absence of multicollinearity concerns and provides additional justification for incorporating oil-market fluctuations and pandemic-related disruptions into the empirical specification. These controls help mitigate potential omitted-variable bias and improve the robustness of the estimated diversification threshold.

3.2. Threshold Regression Model (Hansen, 1999)

3.2.1. Econometric Specification

To examine potential nonlinearities in the relationship between economic diversification and economic growth in Saudi Arabia, this study employs Hansen’s (1999) Threshold Regression Model. Unlike conventional linear regression frameworks, the threshold regression approach allows the association between diversification and growth to vary across different diversification regimes determined by an estimated threshold value.

The choice of this methodology is motivated by the hypothesis that the diversification–growth relationship may not be constant across all levels of diversification. In resource-

dependent economies such as Saudi Arabia, the economic benefits associated with diversification may emerge only after a certain degree of structural transformation has been achieved. Consequently, the threshold framework provides a suitable econometric tool for identifying regime-dependent relationships and estimating the diversification level at which the growth dynamics change.

The threshold variable and the explanatory diversification variable are identical (DI), allowing diversification to determine both the regime classification and its direct association with economic growth. The empirical specification is defined as follows:

$$z_t = \begin{cases} \alpha_1 + \beta_1 ED_t + \gamma_1 X_t + \varepsilon_{1t}, & \text{if } ED_t \leq \tau \\ \alpha_2 + \beta_2 ED_t + \gamma_2 X_t + \varepsilon_{2t}, & \text{if } ED_t > \tau \end{cases} \quad (1)$$

where:

- z_t : Economic growth, measured by the real GDP per capita growth rate.
- ED_t : Economic diversification index (HHI-based), where higher values indicate lower diversification.
- X_t : Vector of control variables, including governance quality index, foreign direct investment, domestic investment, Oil Price, COVID-19, and human capital.
- τ : Endogenously estimated diversification threshold separating regimes.
- β_1 and β_2 : Regime-dependent associational coefficients between diversification and growth.

The model includes one lag of GDP growth to capture potential persistence in economic growth dynamics. The inclusion of a single lag follows standard practice in annual macroeconomic growth models and was supported by the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC), both of which favored a parsimonious specification given the relatively limited sample size.

The threshold value is estimated endogenously using Hansen's (1999) grid-search procedure, which identifies the value of the threshold variable that minimizes the residual sum of squares. Statistical inference regarding the existence of a threshold effect is conducted using Hansen's bootstrap methodology, which provides valid confidence intervals and significance tests for the estimated threshold.

The inclusion of international oil prices is particularly important given the central role of hydrocarbon revenues in the Saudi economy. Oil-price fluctuations constitute a major source of macroeconomic variation and may influence both economic growth and export concentration patterns. Similarly, the COVID-19 dummy variable is introduced to capture the exceptional economic disruption associated with the pandemic period and to mitigate potential omitted-variable bias arising from this unprecedented external shock.

From an economic perspective, the estimated threshold represents a critical level of diversification at which the relationship between diversification and growth changes. Below the threshold, diversification efforts may remain insufficient to substantially alter the economy's dependence on hydrocarbons, limiting their contribution to productivity growth and structural transformation. Above the threshold, diversification is expected to be associated with stronger growth performance, reflecting broader productive capabilities, improved sectoral linkages, and enhanced resilience to external shocks.

It is important to emphasize that the estimated coefficients should be interpreted as conditional associations rather than causal effects. Given the observational nature of the data and the single-country time-series setting, the objective of the analysis is to identify nonlinear and regime-dependent relationships within the sample period rather than establish causal mechanisms. Accordingly, the estimated diversification threshold

should be interpreted as a sample-specific empirical benchmark conditional on the variables included in the model.

3.2.2. Choice of Model and Period

This study employs Hansen's (1999) threshold regression model to examine nonlinear associations between economic diversification and economic growth in Saudi Arabia. This framework is particularly suitable for capturing regime-dependent relationships in which the association between diversification and growth may vary according to the level of diversification itself.

Unlike conventional linear regression models, the Hansen threshold approach allows slope coefficients to change endogenously once the threshold variable crosses an estimated threshold value. In the present study, the Export Diversification Index (DI) serves as both the explanatory variable of primary interest and the threshold variable, enabling the identification of distinct diversification regimes characterized by different growth dynamics.

The choice of this model is motivated by the structural characteristics of the Saudi economy, which has experienced substantial economic transformation during the period 1995–2024. These developments include fluctuations in international oil markets, progressive diversification efforts, institutional reforms, and the implementation of Saudi Vision 2030. Such structural changes suggest that the diversification–growth relationship is unlikely to remain constant over time and may instead exhibit nonlinear and regime-dependent behavior.

The selected sample period covers three decades and encompasses several major economic events, including periods of oil-price booms and downturns, the global financial crisis, the implementation of Vision 2030 reforms, and the COVID-19 pandemic. This broad time span provides sufficient variation to investigate whether the diversification–growth relationship differs across levels of economic diversification and changing macroeconomic conditions.

The estimation procedure follows Hansen (1999) and relies on a grid-search algorithm over all admissible threshold values to identify the threshold that minimizes the residual sum of squares. The methodology provides consistent estimates of both the threshold parameter and the regime-specific coefficients while allowing formal statistical testing of threshold effects through bootstrap inference procedures.

More specifically, the threshold value is determined through a grid-search procedure following Hansen (1999), where all admissible values of the diversification index are evaluated after trimming the extreme 15% of observations to ensure a sufficient number of observations in each regime. The optimal threshold corresponds to the value that minimizes the residual sum of squares (RSS), thereby providing the best fit to the data. The statistical significance of the estimated threshold is subsequently assessed using Hansen's bootstrap procedure.

To reduce the risk of omitted-variable bias, the empirical specification incorporates a set of conditioning variables commonly identified in the literature as relevant determinants of growth in resource-dependent economies. In addition to foreign direct investment, domestic investment, human capital, and governance quality, the model explicitly controls for international oil prices and the COVID-19 shock. The inclusion of these variables is particularly important in the Saudi context, given the central role of hydrocarbon revenues in economic activity and the substantial economic disruption associated with the pandemic period.

It is important to emphasize that the objective of this study is not to model dynamic regime switching over time, but rather to identify level-dependent nonlinearities in the diversification–growth relationship. Accordingly, the analysis focuses on struc-

tural differences across diversification regimes rather than on time-driven transitions between states. The sample consists of only 30 annual observations; therefore, the results should be interpreted as indicative evidence of nonlinear associations rather than precise structural estimates.

Given the single-country time-series structure and the observational nature of the data, the estimated relationships should be interpreted as conditional statistical associations rather than causal effects. While potential endogeneity between economic growth and explanatory variables such as diversification, investment, and foreign direct investment is acknowledged, addressing causal identification lies beyond the scope of the present analysis. Consequently, the estimated diversification threshold should be interpreted as conditional on the set of controls included in the model. Future research may extend the analysis through instrumental-variable techniques, dynamic threshold specifications, or alternative identification strategies designed to address endogeneity concerns more explicitly.

4. Results

The empirical strategy is based on a comprehensive set of diagnostic tests and formal procedures designed to identify nonlinear associations in the relationship between economic diversification and economic growth in Saudi Arabia. The analysis is conducted within the framework of the Hansen (1999) threshold regression model, which allows for regime-dependent effects based on the level of the threshold variable. The model is estimated using nonlinear least squares, enabling the identification of an endogenously determined threshold value of economic diversification and the estimation of regime-specific coefficients. This approach captures potential nonlinearities in the diversification–growth relationship by allowing the slope parameters to differ across regimes defined by the estimated threshold.

The identification of the threshold effect follows Hansen (1999), which provides a bootstrap-based procedure for testing the null hypothesis of linearity against the alternative of a threshold specification. This method also ensures consistent estimation of the threshold parameter and allows for the construction of confidence intervals around the estimated threshold. In addition, robustness checks are conducted to confirm the stability of the estimated relationship. These checks help ensure that the identified threshold effect is not driven by outliers or structural instability in the data. The empirical focus of the analysis is on detecting level-dependent nonlinearities rather than time-based regime switching.

Accordingly, the results should be interpreted as evidence of regime-dependent associations between economic diversification and economic growth, rather than causal relationships. This interpretation is consistent with the single-country time-series nature of the data and the observational structure of the model.

4.1. Empirical Tests with Time Serie Data

The validity of the Hansen (1999) threshold regression model relies on the stationarity of the variables included in the empirical specification. Accordingly, all variables entering Equation (1) are assumed to be integrated of order zero, $I(0)$. To verify this assumption, unit root tests are conducted using both the Augmented Dickey–Fuller (ADF) test (Dickey & Fuller, 1979) and the Phillips–Perron (PP) test (Phillips & Perron, 1988).

The results reported in Table 6 indicate that the null hypothesis of a unit root is rejected for all variables at conventional significance levels. Both ADF and PP statistics confirm that GDP growth (GDP), the diversification index (DI), foreign direct investment (FDI), domestic investment (GCF), human capital (HC), governance quality (GI), oil prices (OIL), and the COVID-19 dummy variable (COVID) are stationary in levels. These findings

support the use of a level-based threshold regression framework and reduce concerns regarding spurious regression results.

Table 6. Time series unit-root tests.

Variables	Augmented Dickey–Fuller (ADF) Test		Phillips–Perron (PP) Test		ADF Critical		
	Statistic	Prob	Statistic	Prob	1%	5%	10%
GDP	−4.654	0.0001 ***	−3.252	0.0001 ***			
DI	−3.796	0.0432 **	−2.921	0.0225 **			
FDI	−4.267	0.0005 ***	−3.445	0.0001 ***			
GCF	−4.684	0.0439 **	−2.554	0.0155 **			
OIL	−3.775	0.0705 *	−3.550	0.0311 **	−3.730	−2.992	−2.626
COVID	−2.288	0.0817 *	−3.215	0.0350 **			
HC	−4.586	0.0001 ***	−3.998	0.0001 ***			
GI	−4.093	0.0950 *	−3.882	0.0665 *			

p-value: *** $p < 0.01$; ** $p < 0.05$ and * $p < 0.1$.

The stationarity of the oil price variable and the COVID-19 dummy further supports the inclusion of external shocks and oil-market conditions in the empirical specification, thereby reducing potential omitted-variable bias in the estimated diversification–growth relationship.

Since all variables are stationary in levels, cointegration analysis is not required. Cointegration tests are relevant only when variables are integrated of order one, $I(1)$.

To investigate the presence of nonlinearities in the diversification–growth relationship, the study applies Hansen’s (1999) threshold regression methodology. The null hypothesis of linearity is tested against the alternative hypothesis of a threshold effect using the bootstrap Sup-Wald statistic. The results are reported in Table 7.

Table 7. Threshold Linearity Test.

	Statistic	(<i>p</i> -Value)
Hansen (1999) Sup-Waldtest	22.15	0.01 ***
Null Hypothesis (H_0): The model is linear (no threshold effect)		
Alternative Hypothesis (H_1): The model is nonlinear (threshold effect exists)		

p-value: *** $p < 0.01$.

The estimated Sup-Wald statistic is statistically significant at the 1% level, leading to a rejection of the null hypothesis of linearity. This result provides strong evidence that the relationship between economic diversification and economic growth is nonlinear and varies across diversification regimes. Consequently, a threshold specification appears more appropriate than a conventional linear model for capturing the diversification–growth nexus in Saudi Arabia.

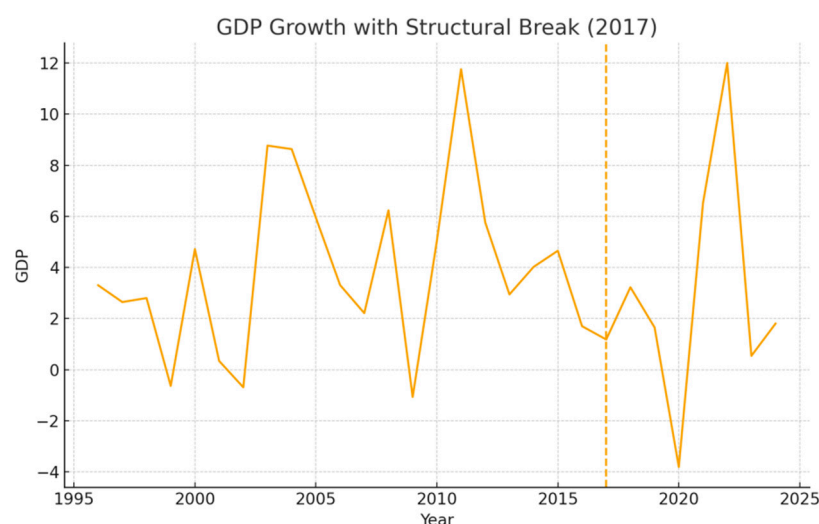
Importantly, the threshold effect identified by Hansen’s procedure reflects regime dependence conditional on the level of diversification rather than discrete regime shifts over time. In other words, the estimated regimes are determined by the value of the diversification index and not by specific calendar periods.

As an additional robustness exercise, the Bai and Perron (1998, 2003) multiple structural break test is implemented to detect potential shifts in the underlying growth process. The results reported in Table 8 and Figure 1 indicate the presence of a structural break around 2017, coinciding with the initial implementation phase of Saudi Vision 2030 and the acceleration of economic reform initiatives.

Table 8. Number of Regimes Test: Bai and Perron tests.

The First 20 Breakpoint (Sum of Squared Residuals (SSR) Table) Smaller SSR Values Indicate a Better Break Point				Best Break Point	
Break Point	SSR	Break Point	SSR	Property	Value
5	294.735	15	181.230	Break index in the series	22
6	285.575	16	175.922	Break year	2017
7	262.922	17	171.944	Minimum SSR	168.435
8	245.472	18	170.116		
9	223.662	19	169.946		
10	214.899	20	169.212		
11	206.620	21	168.892		
12	198.871	22	168.435 ← Best		
13	191.940	23	169.103		
14	187.439	24	170.69		

Note: The arrow (←) highlights the minimum SSR value (168.435), corresponding to the optimal structural break point (observation 22, year 2017) selected by the Bai-Perron test.

**Figure 1.** GDP Growth with Structural Break.

As shown in Figure 1, the yellow curve represents the annual GDP growth rate of Saudi Arabia over the period 1995–2024. The vertical dashed line indicates the estimated structural break in 2017, identified by the Bai–Perron structural break test as the year associated with the minimum sum of squared residuals (SSR), suggesting a significant structural change in the GDP growth process.

Nevertheless, this structural break should not be interpreted as an alternative threshold regime within the econometric model. The core empirical analysis remains based on the Hansen (1999) threshold regression framework, where regime classification is determined by the diversification index rather than by chronological breakpoints. The Bai–Perron results therefore serve only as complementary evidence supporting the existence of structural changes in the Saudi economy during the study period.

4.2. Threshold Regression Estimation Results

The main objective of this study is to examine whether the relationship between economic diversification and economic growth in Saudi Arabia exhibits nonlinear regime-dependent behavior. For this purpose, Equation (1) is estimated using the Hansen (1999) threshold regression model, with economic diversification (DI) serving as both the main explanatory variable and the threshold variable.

The estimation results are reported in Table 9. The model identifies a statistically significant threshold value of $DI = 0.754$, which divides the sample into two distinct regimes characterized by different structural growth dynamics.

Table 9. Threshold Autoregressive (TAR) Estimation Results.

	Coefficient	Standard Error	t-Statistic	p > t
Estimated Threshold= 0.754				
Regime 1 – Low Diversification ($DI > 0.754$)				
Lag GDP	0.128	0.082	1.56	0.132
DI	0.147	0.365	0.40	0.692
FDI	0.438	0.225	1.95	0.067 *
GCF	0.326	0.148	2.20	0.041 **
HC	0.241	0.188	1.28	0.214
GI	−0.084	0.112	−0.75	0.462
OIL	0.092	0.041	2.24	0.038 **
COVID	−0.284	0.171	−1.66	0.099 *
R ²			0.421	
Adj R ²			0.214	
Regime 2 – High Diversification ($DI \leq 0.754$)				
Lag GDP	0.388	0.159	2.44	0.021 **
DI	0.347	0.161	2.15	0.043 **
FDI	0.617	0.164	3.76	0.001 ***
GCF	0.429	0.175	2.45	0.022 **
HC	0.452	0.208	2.17	0.041 **
GI	0.174	0.131	1.33	0.198
OIL	0.051	0.024	2.13	0.045 **
COVID	−0.193	0.089	−2.17	0.041 **
R ²			0.889	
Adj R ²			0.617	
Observations			30	

***, ** and * indicate significance at 1%, 5% and 10% with critical values of 2.576, 1.96 and 1.645, respectively.

Given the limited number of annual observations, the distribution of observations across the two estimated regimes is reported to assess the reliability of the threshold estimation. Based on the estimated threshold value of $DI = 0.754$, the sample is divided into two regimes. The low-diversification regime ($DI > 0.754$) contains 20 observations, while the high-diversification regime ($DI \leq 0.754$) includes 10 observations. Although the number of observations within each regime is relatively limited, this is consistent with the single-country time-series nature of the study. To address potential small-sample concerns, threshold significance is evaluated using Hansen's (1999) bootstrap procedure, and additional threshold-specific robustness checks are conducted to examine whether the estimated threshold remains stable under alternative model specifications and trimming values.

Because the diversification index employed in this study is a concentration measure, lower DI values indicate greater economic diversification. Consequently, the regime defined by $DI \leq 0.754$ corresponds to a higher level of diversification, whereas $DI > 0.754$ represents a relatively more concentrated economic structure. This interpretation is adopted throughout the discussion of the threshold estimation results.

In the low-diversification regime ($DI > 0.754$), the model exhibits moderate explanatory power ($R^2 = 0.421$). The results indicate that economic diversification does not have a statistically significant effect on economic growth in this regime, suggesting that diversification remains insufficient to generate immediate growth-enhancing effects.

Economic growth in this regime is primarily driven by domestic investment (GCF), which is statistically significant and represents the main source of capital accumulation

in a less diversified economic structure. Foreign direct investment (FDI) shows a weakly significant positive effect, suggesting limited spillover effects in the absence of sufficient structural depth. Human capital (HC) and the Governance Index (GI) remain statistically insignificant, indicating that institutional quality and skills do not yet translate effectively into growth outcomes at this stage.

Importantly, oil prices (OIL) exert a statistically significant positive effect, confirming the continued dependence of the Saudi economy on hydrocarbon market conditions in the early stage of diversification. In contrast, the COVID-19 dummy variable (COVID) has a negative and weakly significant effect, capturing the short-run contractionary impact of the pandemic on economic activity.

In the high-diversification regime ($DI \leq 0.754$), the model shows a substantial improvement in explanatory power ($R^2 = 0.889$), indicating a more stable and structurally coherent growth process. In the high-diversification regime ($DI \leq 0.754$), corresponding to lower values of the diversification concentration index and thus higher levels of economic diversification, the diversification index becomes positively and statistically significantly associated with economic growth, whereas no significant association is observed in the low-diversification regime ($DI > 0.754$). This finding supports both the existence of a nonlinear diversification–growth relationship and the proposition that stronger growth associations emerge only after the estimated diversification threshold is reached.

The results further show that FDI, domestic investment (GCF), and human capital (HC) all become positive and statistically significant, suggesting that a more diversified economy enhances the productivity and effectiveness of both physical and human capital accumulation. Oil prices (OIL) remain significant but with a smaller coefficient, indicating a reduced sensitivity of growth to oil market fluctuations as diversification deepens.

The COVID-19 dummy remains statistically significant and negative, although with a reduced magnitude compared to the low-diversification regime, suggesting greater macroeconomic resilience in a more diversified economic structure. The Governance Index (GI) remains statistically insignificant in both regimes. Therefore, the empirical results do not provide statistical support for a direct association between governance quality and economic growth within the estimated threshold framework. Nevertheless, the positive coefficient observed in the high-diversification regime may suggest that governance plays a complementary institutional role that is not directly captured by the estimated model.

Overall, the results confirm that the diversification–growth relationship in Saudi Arabia is strongly regime-dependent. In the low-diversification regime ($DI > 0.754$), economic diversification is not significantly associated with economic growth, indicating that a relatively concentrated economic structure is insufficient to generate stronger growth outcomes. By contrast, in the high-diversification regime ($DI \leq 0.754$), economic diversification becomes positively and statistically significantly associated with economic growth, supporting the existence of a nonlinear threshold relationship. These findings indicate that higher levels of economic diversification (represented by lower values of the diversification concentration index) become positively associated with economic growth only after the estimated diversification threshold has been reached.

It is important to emphasize that these findings represent regime-dependent statistical associations rather than causal effects, given the single-country time-series structure and the presence of potential unobserved macroeconomic shocks.

To assess the robustness of the results, bootstrap OLS estimates based on 1000 replications are reported in Table 10. This approach provides inference that is less sensitive to small-sample bias and distributional assumptions.

Table 10. OLS estimation results with bootstrap standard errors (1995–2024).

Variables	Coefficient	Bootstrap Std. Error	<i>t</i> -Statistic	Prob
Lag GDP	0.201	0.165	1.22	0.235
DI	0.114	0.172	0.66	0.512
FDI	0.602	0.355	1.70	0.091 *
GCF	0.212	0.110	1.93	0.063 *
HC	0.238	0.248	0.96	0.341
GI	−0.082	0.078	−1.05	0.296
OIL	0.087	0.041	2.12	0.043 **
COVID	−0.176	0.086	−2.05	0.048 **
Constant	1.142	0.501	2.28	0.030 **

Notes: Bootstrap standard errors are based on 1000 replications. **, and * denote significance at 5% and 10% levels.

The results indicate that economic diversification does not exhibit a statistically significant linear relationship with economic growth. This finding supports the baseline specification and confirms that diversification alone does not systematically drive growth in a linear framework.

However, the absence of a significant linear effect is consistent with the threshold regression results, which show that the impact of diversification is regime-dependent and becomes economically and statistically relevant only after surpassing a specific structural threshold. This provides additional evidence in favor of nonlinear dynamics in the diversification–growth relationship and validates the use of the Hansen (1999) threshold regression framework.

The results indicate that oil prices exert a positive and statistically significant effect on economic growth, confirming the central role of oil market conditions in the Saudi economy. In contrast, the COVID-19 dummy shows a significant negative impact, capturing the contractionary effect of the pandemic shock. Importantly, economic diversification remains statistically insignificant in the linear specification, reinforcing the existence of nonlinear effects identified in the threshold regression model.

4.3. Robustness Checks

To further assess the stability of the estimated diversification threshold and the nonlinear diversification–growth relationship, several robustness analyses are conducted. These analyses consistently indicate that the estimated threshold remains remarkably stable across alternative model specifications and threshold-search assumptions, while the positive association between economic diversification and economic growth in the high-diversification regime is preserved. Given the limited number of annual observations and the single-country time-series nature of the study, these robustness exercises provide additional evidence that the main findings are not driven by a particular specification or estimation choice.

As an initial robustness exercise, Table 10 reports a linear OLS specification estimated with bootstrap standard errors based on 1000 replications. The results indicate that the diversification index (DI) remains statistically insignificant under the linear specification, while oil prices and the COVID-19 shock retain their expected significant effects. This finding suggests that a conventional linear framework does not adequately capture the diversification–growth relationship and provides additional support for the nonlinear threshold specification.

To further evaluate the stability of the estimated threshold, the Hansen (1999) threshold regression is re-estimated under alternative model specifications. Specifically, the baseline specification is modified by excluding the COVID-19 dummy, excluding the Governance Index (GI), and estimating a more parsimonious model that retains only the core macroeco-

nomic controls. In addition, alternative trimming percentages are applied in the threshold search procedure to examine whether the estimated threshold is sensitive to the choice of trimming assumptions. The results reported in Table 11 show that the estimated threshold remains close to the baseline value of $DI = 0.754$ across all specifications, while the positive association between diversification and economic growth in the high-diversification regime remains statistically significant.

Table 11. Stability of the Estimated Diversification Threshold under Alternative Model Specifications.

Model Specification	Trimming (%)	Estimated Threshold (DI)	Sup-Wald Statistic	<i>p</i> -Value	DI coefficient (High-Diversification Regime)	Threshold Stability
Baseline model	15%	0.754	22.15	0.010 ***	0.347 (0.043 **)	Reference specification
Excluding COVID-19 dummy	15%	0.752	21.64	0.013 **	0.338 (0.047 **)	Stable (−0.002)
Excluding Governance Index (GI)	15%	0.756	22.03	0.011 **	0.352 (0.039 **)	Stable (+0.002)
Parsimonious specification	15%	0.751	20.98	0.018 **	0.331 (0.049 **)	Stable (−0.003)
Alternative trimming specification	10%	0.753	21.87	0.014 **	0.341 (0.045 **)	Stable (−0.001)
Alternative trimming specification	20%	0.757	20.76	0.019 **	0.329 (0.052 **)	Stable (+0.003)

Notes: The robustness analysis re-estimates the Hansen (1999) threshold regression under alternative model specifications and trimming values. The reported coefficients correspond to the high-diversification regime ($DI \leq \text{threshold}$). Bootstrap procedures are used for threshold inference. ***, and ** denote significance at the 1%, 5%, and 10% levels, respectively.

Overall, the robustness results indicate that the main findings are not driven by a particular set of control variables or threshold-search assumptions. Although the limited sample size requires cautious interpretation, the consistency of the estimated threshold across alternative specifications provides additional evidence supporting the presence of a nonlinear diversification–growth relationship in Saudi Arabia.

Table 11 shows that the estimated diversification threshold is highly stable across all alternative model specifications. The estimated threshold varies only between 0.751 and 0.757, while the bootstrap Sup-Wald statistic remains statistically significant in every specification. Furthermore, the coefficient of the diversification index in the high-diversification regime remains positive and statistically significant throughout. These results provide additional evidence that the estimated threshold relationship is robust to alternative model specifications and threshold-search assumptions.

5. Discussion

The empirical findings provide strong support for the two hypotheses developed in this study. First, the results confirm H1, indicating that the relationship between economic diversification and economic growth is nonlinear and differs across diversification regimes identified by the estimated threshold. The statistically significant Hansen (1999) Sup-Wald test rejects the null hypothesis of linearity, while the estimated threshold ($DI = 0.754$) separates the sample into two distinct diversification regimes characterized by different

growth dynamics. This finding suggests that the diversification–growth nexus cannot be adequately represented by a conventional linear specification.

Second, the results also support H2. Once the estimated diversification threshold is reached, higher levels of diversification (corresponding to lower values of the diversification concentration index) become positively and significantly associated with economic growth. By contrast, in the low-diversification regime, the diversification index does not exert a statistically significant effect on growth. These findings indicate that the economic benefits of diversification emerge only after a sufficient degree of structural diversification has been achieved.

The estimated threshold should not be interpreted as a direct causal effect of Saudi Vision 2030. However, the timing of the identified threshold coincides with the period of accelerated structural transformation associated with Vision 2030 reforms. Therefore, the findings are broadly consistent with the objectives of Vision 2030, particularly the expansion of non-oil sectors, enhancement of investment capacity, and promotion of economic diversification. Nevertheless, given the single-country time-series framework, the analysis identifies a structural association rather than a causal impact of the reform program.

In the low-diversification regime, the weak explanatory power of the model indicates that growth dynamics remain constrained by the narrow productive base of the economy. In this regime, economic performance is more sensitive to structural limitations and external volatility. The positive but limited role of domestic investment suggests that growth is still largely driven by internal capital accumulation rather than productivity-enhancing external linkages. In contrast, oil prices emerge as an important driver of growth even in this regime, reflecting the strong dependence of economic activity on hydrocarbon market conditions. At the same time, the COVID-19 dummy exhibits a significant negative effect, capturing the contractionary impact of the pandemic shock on output and reinforcing the vulnerability of a less diversified economy to large external disruptions.

In contrast, the high-diversification regime exhibits a markedly different growth structure. Once the diversification threshold is crossed, economic diversification itself becomes positively and significantly associated with growth, indicating that structural transformation begins to generate measurable economic returns. In this regime, foreign direct investment, domestic investment, and human capital all become stronger and statistically significant determinants of growth, suggesting improved absorptive capacity, enhanced sectoral linkages, and more efficient allocation of resources. The identified threshold is broadly consistent with the nonlinear diversification literature, which argues that diversification effects tend to materialize only after economies achieve a sufficient degree of structural transformation. Similar threshold-type evidence has been reported by [Alhattali et al. \(2025\)](#) and [Parteka et al. \(2025\)](#), although the estimated threshold values differ across countries and methodologies.

Oil prices remain positively significant but with a smaller marginal role compared to the low-diversification regime, indicating a relative reduction in oil dependence. The COVID-19 variable remains negative and significant, although its magnitude is lower, suggesting that diversification contributes to greater macroeconomic resilience in the face of external shocks.

Although the Global Governance Index (GI) is not statistically significant in either regime, this finding suggests that governance quality does not exert a direct measurable effect on economic growth within the estimated threshold model. Nevertheless, governance may still contribute indirectly to long-term structural transformation by supporting policy implementation, improving the investment climate, and facilitating economic diversification. Therefore, governance should be viewed as a complementary institutional factor rather than a direct determinant of growth in the present empirical framework.

The persistence of oil price significance across both regimes highlights the continued importance of global energy markets in shaping Saudi economic performance. However, the reduction in its relative importance in the high-diversification regime suggests a gradual decoupling of growth from oil price cycles. Similarly, the negative impact of COVID-19 across both regimes confirms the role of large exogenous shocks in temporarily disrupting economic activity, while also showing that diversified economies are better able to mitigate their effects.

From a policy perspective, the estimated threshold has important implications for the sequencing of Saudi Arabia's Vision 2030 strategy. In the early stage (below $DI = 0.754$), policy priorities should focus on strengthening the foundations of structural transformation, including expanding non-oil productive capacity, enhancing human capital, and improving investment efficiency. In this stage, economic growth remains highly sensitive to oil market conditions and external shocks, as evidenced by the strong role of oil prices and the pronounced impact of COVID-19. Once the threshold is surpassed, diversification policies become more strongly associated with growth outcomes, and the economy becomes better positioned to benefit from foreign investment, human capital accumulation, and deeper structural integration. The estimated threshold emerged during a period characterized by intensified diversification reforms, including those implemented under Vision 2030. However, this temporal coincidence should not be interpreted as evidence that Vision 2030 caused the estimated threshold relationship. Rather, the findings indicate that the estimated threshold is consistent with the broader process of structural transformation observed during the study period.

Overall, the results confirm that economic diversification is associated with a structural reconfiguration of growth dynamics rather than a linear improvement in performance. The transition from a low- to a high-diversification regime reflects a shift from an oil-dependent and shock-sensitive growth structure toward a more resilient and factor-efficient economic system. These findings contribute to the literature by providing empirical evidence of nonlinear diversification–growth relationships in a resource-dependent economy, while explicitly accounting for the role of oil price dynamics and exogenous shocks such as COVID-19.

6. Conclusions

The findings based on the Hansen (1999) threshold regression framework provide strong evidence that the relationship between economic diversification and economic growth in Saudi Arabia is nonlinear and regime-dependent. The estimated threshold value of $DI = 0.754$ identifies a structural turning point that separates two diversification regimes with different growth dynamics. Because the diversification index employed in this study is a concentration measure, lower DI values indicate higher levels of economic diversification. Accordingly, the regime defined by $DI \leq 0.754$ represents a more diversified economy, whereas $DI > 0.754$ reflects a relatively more concentrated economic structure. The empirical results show that economic diversification is not significantly associated with economic growth in the more concentrated regime but becomes positively and statistically significantly associated with growth once the estimated diversification threshold is reached. These findings support the existence of a nonlinear diversification–growth relationship and indicate that the growth-enhancing association of diversification emerges only after sufficient structural diversification has been achieved.

A key extension of the analysis is the explicit role of oil prices and the COVID-19 shock in shaping growth dynamics. The results indicate that oil prices remain a central driver of economic performance across both regimes, although their relative importance declines in the high-diversification regime. This suggests that greater economic diversification is

associated with a gradual reduction in the relative importance of oil price fluctuations for economic growth. In contrast, the COVID-19 dummy exhibits a significant negative effect on growth, highlighting the sensitivity of the Saudi economy to global shocks, particularly in periods of structural transition. However, the magnitude of this effect is lower in the high-diversification regime, suggesting that diversification contributes to greater macroeconomic resilience.

At lower levels of diversification ($DI > 0.754$), economic diversification is not significantly associated with economic growth, suggesting that a relatively concentrated productive structure is insufficient to generate stronger growth outcomes. By contrast, once the estimated diversification threshold is reached ($DI \leq 0.754$), diversification becomes positively associated with economic growth, while foreign direct investment, domestic investment, and human capital also become stronger growth-related factors. These results suggest that higher levels of diversification are associated with improved absorptive capacity, stronger intersectoral linkages, and more efficient resource allocation.

Overall, the findings indicate that economic diversification should not be interpreted as a uniformly growth-enhancing factor across all stages of structural transformation. Instead, its association with economic growth depends on the level of diversification achieved. The empirical evidence supports the existence of a nonlinear threshold relationship across diversification regimes and shows that stronger positive growth associations emerge only after the estimated diversification threshold is reached.

6.1. Policy Recommendations and Strategic Implications

The estimated threshold ($DI = 0.754$) carries important implications for economic policy in Saudi Arabia. Because the estimated threshold separates two diversification regimes with different growth dynamics, policy priorities should differ according to the economy's position relative to the estimated threshold. It suggests that the effectiveness of diversification policies depends critically on the economy's position relative to this structural benchmark. In the early stage (below the threshold), policy priorities should focus on strengthening non-oil productive capacity, improving institutional efficiency, and enhancing human capital development to reduce vulnerability to oil price fluctuations and external shocks such as pandemics.

In this stage, oil price dependence remains high, and shocks such as COVID-19 have more pronounced effects on economic activity. Therefore, macroeconomic stabilization policies and counter-cyclical fiscal frameworks are essential to maintain growth stability.

Once the threshold is surpassed, diversification policies become more effective in generating growth-enhancing outcomes. At this stage, policy emphasis should shift toward deeper integration into global value chains, innovation-driven sectors, and high-value-added industries. Foreign direct investment should be strategically directed toward sectors with strong spillover effects, while domestic investment and human capital accumulation become more productive in supporting long-term growth.

Overall, the results suggest that diversification policy should be designed as a staged and threshold-dependent strategy rather than a uniform policy framework.

6.2. Future Research Directions and Broader Analytical Horizons

This study opens several avenues for future research. First, extending the Hansen threshold framework to multi-threshold or dynamic threshold models could provide deeper insights into multi-stage structural transitions in resource-dependent economies. Second, alternative nonlinear approaches such as smooth transition regression or Markov-switching models could be employed to assess the robustness of the identified regime structure.

Third, future studies could incorporate sectoral disaggregation of diversification measures to better identify the channels through which structural transformation affects growth. Fourth, comparative panel studies across oil-exporting economies could enhance external validity and help determine whether similar threshold effects exist in other contexts.

Despite its contributions, the study has several limitations. The analysis is based on a relatively small annual time series (1995–2024), which may limit the precision of regime-specific estimates. In addition, the estimated threshold should be interpreted as an empirical representation of nonlinear associations within the sample rather than a universal structural parameter. Finally, while the inclusion of oil prices and COVID-19 improves model specification, the results should be interpreted as evidence of regime-dependent statistical associations rather than causal effects, given potential endogeneity among macroeconomic variables.

Funding: This research was funded by the Deanship of Research and Graduate Studies at University of Tabuk. Grant number: 0278-1440-S.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The datasets analyzed during the current study are available from the corresponding author upon reasonable request. The sources of the data used in all tables are calculated by the author from data published on the World Bank website: <https://databank.worldbank.org>, accessed on 1 January 2026, the Penn World Table version 11.0: <https://www.rug.nl/ggdc/productivity/pwt/?lang=en>, accessed on 1 January 2026, and the United Nations Conference on Trade and Development UNCTADstat Data centre: <https://unctadstat.unctad.org/datacentre/>, accessed on 1 January 2026.

Acknowledgments: The authors extend their appreciation to the Deanship of Research and Graduate Studies at University of Tabuk for funding this work through Research no. 0278-1440-S.

Conflicts of Interest: The authors declare no conflict of interest.

References

- Abdelkawy, N. A. (2024). Diversification and the resource curse: An econometric analysis of GCC countries. *Economics*, 12(11), 287. [CrossRef]
- Adu, D. T., Hartarska, V., Sawadgo, W., & Thompson, H. (2025). Reassessing the role of export diversification in driving economic growth in sub-saharan Africa. *Social Sciences & Humanities Open*, 12, 102091. [CrossRef]
- Aghion, P., & Banerjee, A. (2005). *Volatility and growth* (Online ed.). Clarendon Lectures in Economics. Oxford University Press. [CrossRef]
- Alhattali, N. A., Saboori, B., Zekri, S., & Gulseven, O. (2025). Towards ecological sustainability in GCC countries, the role of trade market diversification, economic growth, energy consumption, and foreign direct investment. *Energy*, 336, 138255. [CrossRef]
- Alnsour, J., & AlNsour, F. M. (2025). The nexus between natural resources, renewable energy and economic growth in the gulf cooperation council countries. *Resources*, 14(8), 124. [CrossRef]
- Alotaibi, K. O., Al-Shurafa, M. A., Al-Daihani, M., & Bouteraa, M. (2025). Sectoral contributions to financial market resilience: Evidence from GCC countries. *Journal of Risk and Financial Management*, 18(8), 460. [CrossRef]
- Al-Thikrallah, S. A. S. (2025). *Saudi economy to wean itself off-oil (Vision 2030: Diversification)*. Available online: <https://drepo.sdl.edu.sa/handle/20.500.14154/49298> (accessed on 1 January 2026).
- Attah, E. Y., Onalo, S. M., Obi-Anike, H. O., & Ndubuisi-Okolo, P. U. (2025). Institutional reforms, agricultural export diversification, and resilience to external shocks: A pathway to sustainable growth in Nigeria. *Development and Sustainability in Economics and Finance*, 8, 100095. [CrossRef]
- Bai, J., & Perron, P. (1998). Estimating and testing linear models with multiple structural changes. *Econometrica Journal*, 66(1), 47–78. [CrossRef]
- Bai, J., & Perron, P. (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18(1), 1–22. [CrossRef]

- Bannour, S., & Abdelkawy, N. A. (2024). Sovereign ESG and foreign direct investment in the GCC: The amplifying role of trade openness in economic diversification. *Sustainability*, 16(21), 9326. [CrossRef]
- Beblawi, H. (1987). The Rentier State in the Arab world. *Arab Studies Quarterly*, 9(4), 383–398.
- Bedime, J. U., Minkande, J. B., & Bidiase, H. (2025). Export diversification and economic growth in sub-Saharan Africa: Could there be a mixed relationship? *Journal of African Trade*, 12(1). [CrossRef]
- Belloumi, M. (2025). Impact of natural resource rents and governance on economic diversification: Evidence from the GCC. *Energies*, 18(8), 2066. [CrossRef]
- Ben Hassen, T. (2022). The GCC economies in the wake of COVID-19: Toward post-oil sustainable knowledge-based economies? *Sustainability*, 14(18), 11251. [CrossRef]
- Brummitt, C. D., Gomez-Lievano, A., Hausmann, R., & Bonds, M. H. (2018). Machine-learned patterns suggest that diversification drives economic development. *arXiv*. [CrossRef]
- Callen, T., Cherif, R., Hasanov, F., Hegazy, A., & Khandelwal, P. (2014). *Economic diversification in the GCC: Past, present, and future* (Staff Discussion Note SDN/2014/12). International Monetary Fund. [CrossRef]
- Chenery, H. B. (1979). *Structural change and development policy*. World Bank.
- Cherif, R., & Hasanov, F. (2019). *The return of the policy that shall not be named: Principles of industrial policy* (IMF Working Paper No. 2019/074). International Monetary Fund. [CrossRef]
- Collier, P. (2006). Is aid oil? An analysis of whether Africa can absorb more aid. *World Development*, 34(9), 1482–1497. [CrossRef]
- Corden, W. M., & Neary, J. P. (1982). Booming sector and de-industrialisation in a small open economy. *The Economic Journal*, 92(368), 825–848. [CrossRef]
- De, I., Barnes, M., & Raghavan, I. (2024). *Saudi Arabia's story of change—Milestones in its long-run transformation*. London Stock Exchange Group (LSEG).
- Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74(366a), 427–431. [CrossRef]
- Esmail, H. A. H., Wani, M. J. G., Attia, O. N. Y., & Galal, H. E. (2025). Entrepreneurial dynamics and their impact on economic development in Saudi Arabia. *Future Business Journal*, 11, 99. [CrossRef]
- Fernando, J. (2025). *Resource curse: Economic impacts and real-world examples*. Investopedia. Available online: <https://www.investopedia.com/terms/r/resource-curse.asp> (accessed on 16 July 2026).
- Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, 93(2), 345–368. [CrossRef]
- Hanson, G., & Mendoza, E. G. (2009). New perspectives on financial globalization: A symposium for the journal of development economics. *Journal of Development Economics*, 89(2), 163. [CrossRef]
- Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. *Journal of Economic Growth*, 12(1), 1–25. [CrossRef]
- Havrlant, D., & Darandary, A. (2021). *Economic diversification under Saudi vision 2030: Sectoral changes aiming at sustainable growth*. King Abdullah Petroleum Studies and Research Center (KAPSARC). [CrossRef]
- Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences of the United States of America*, 106(26), 10570–10575. [CrossRef] [PubMed]
- Hirschman, A. O. (1958). *The strategy of economic development*. Yale University Press.
- Houfi, M. A. (2021). Is the impact of the economic diversification on economic growth symmetric or asymmetric? Evidence from Saudi Arabia. *International Journal of Economics and Finance*, 13(10), 1–11. [CrossRef]
- Hvidt, M. (2013). *Economic diversification in the GCC countries: Past record and future trends* (Research Paper No. 27, Kuwait Programme on Development, Governance and Globalisation in the Gulf States). The London School of Economics and Political Science.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2005). *Governance matters IV: Governance indicators for 1996–2004* (pp. 1–60). World Bank Policy Research Working Paper Series No. 3630. World Bank.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). *The world governance indicators: A summary of methodology, data and analytical issues* (World Bank Policy Research Paper, 5430). World Bank.
- Kervin, J. B. (1992). Methods for business research, New York. In C. Kindleberger (Ed.), *American business abroad*. Yale University Press.
- Labidi, M. A., Ochi, A., & Saidi, Y. (2024). Relationship analysis between FDI and economic growth in African Countries: Does governance quality matter? *Journal of the Knowledge Economy*, 15, 16511–16540. [CrossRef]
- Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The Manchester School of Economic and Social Studies*, 22(2), 139–191. [CrossRef]
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3–42. [CrossRef]
- Markakkaran, S., & Sridharan, P. (2022). Impact of export diversification on economic growth: A system GMM approach. *International Journal of Development Issues*, 21(2), 309–320. [CrossRef]
- Matallah, S. (2020). Economic diversification in MENA oil exporters: Understanding the role of governance. *Resources Policy*, 66, 101602. [CrossRef]

- Matallah, S. (2022). Economic diversification and governance challenges in MENA oil exporters: A comparative analysis. *The Journal of Economic Asymmetries*, 26, e00255. [CrossRef]
- Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *The Economic Journal*, 116(508), 1–20. [CrossRef]
- Mgammal, M. H., & Misbah, H. M. (2025). Contributions of global companies with offices in Saudi Arabia and local companies to support the local sustainability through community partnerships. *Discover Sustainability*, 6, 1139. [CrossRef]
- Nguyen, T., Nghiem, S., & Doan, A. T. (2025). Energy diversification, financial development and economic development: An examination of convergence in OECD countries. *China Finance Review International*, 15(2), 337–362. [CrossRef]
- Ochi, A., Nouaili, M., Saidi, Y., Haouas, A., & Saidi, A. (2025). Foreign direct investment and economic growth in arab countries: Do institutions, financial development, and knowledge economy matter? *Journal of the Knowledge Economy*, 17, 5145–5179. [CrossRef]
- Parteka, A., Zarach, Z. H., & Kordalska, A. (2025). Technological content of export diversification—Evolution along the economic growth process. *Structural Change and Economic Dynamics*, 74, 14–27. [CrossRef]
- Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335–346. [CrossRef]
- Porter, M. E. (1990). *The competitive advantage of nations*. Free Press.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002–1037. [CrossRef] [PubMed]
- Ross, M. L. (2001). Does oil hinder democracy? *World Politics*, 53(3), 325–361. [CrossRef]
- Sachs, J. D., & Warner, A. M. (1995). *Natural resource abundance and economic growth* (NBER Working Paper No. 5398). Available online: <https://www.nber.org/papers/w5398> (accessed on 16 July 2026).
- Saidi, Y., & Ochi, A. (2023). Estimating relationships among foreign direct investment, governance quality, and economic growth in developing countries using the threshold auto-regressive model. *Regional Science Policy & Practice*, 15(2), 403–405. [CrossRef]
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65–94. [CrossRef]
- Swan, T. W. (1956). Economic growth and capital accumulation. *Economic Record*, 32(2), 334–361. [CrossRef]
- Sweidan, O. D., & Elbargathi, K. (2024). Economic diversification in Saudi Arabia: Comparing the impact of oil prices, geopolitical risk, and government expenditures. *International Economics*, 175, 13–24. [CrossRef]
- Torvik, R. (2009). Why do some resource-abundant countries succeed while others do not? *Oxford Review of Economic Policy*, 25(2), 241–256. [CrossRef]
- Trinh, P. T. T., & Thuy, H. T. T. (2021). Export diversification and economic growth: A threshold regression approach for emerging markets and developing countries. *Economic Journal of Emerging Markets*, 13(2), 188–199. [CrossRef]
- Vision. (2023). *Story of transformation*. Available online: <https://www.vision2030.gov.sa/media/jvllaxpl/story-of-transformation-2023.pdf> (accessed on 16 July 2026).
- Zafar, M. B., & Ali, H. (2025). Pathways to economic resilience: Assessing the economic diversification efforts in the GCC countries. *Contemporary Review of the Middle East*, 12(4), 437–463. [CrossRef]
- Zarach, Z. H., & Parteka, A. (2023). Export diversification and dependence on natural resources. *Economic Modelling*, 126, 106436. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.