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IN THE NAME OF ALLAH,
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***** Saudi Economic Association (SEA)- King Saud University.***

Journal of Economic Studies

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Structural Impacts of the Resource Curse: Economic Challenges and Reform in Saudi Arabia

Nagwa A. Abdelkawy [(1)]

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Abstract : This study examines the dynamic relationship between macroeconomic variables and economic growth in Saudi Arabia from 1990 to 2022, focusing on oil revenues and key indicators such as stock market progression, the Human Development Index (HDI), the Consumer Price Index (CPI), and unemployment. Employing Johansen cointegration and Vector Error Correction Models (VECM), the analysis captures both short- and long-term interactions. The findings reveal that stock market progression has a marginal effect on long-term economic growth. At the same time, oil revenues exhibit a negative long-term correlation with GDP, reinforcing the presence of a resource curse in oil-dependent economies. Surprisingly, Human development shows a negative correlation with GDP, reflecting job market inefficiencies that hinder the translation of advancements in health and education into economic productivity. The job market imbalances and the dominance of the oil sector limit the utilization of human capital. Control variables like CPI and unemployment significantly influence economic growth, with unemployment demonstrating a robust negative relationship with GDP. These findings emphasize the need for financial market reforms and diversification efforts aligned with Vision 2030 to mitigate oil dependency and promote sustainable growth. This study contributes to the literature by highlighting the paradoxical relationship between human development and economic growth in an oil-dependent economy and addressing the structural challenges associated with the resource curse.
Keywords: Economic diversification, oil dependency, stock market progression, resource curse, Saudi Vision 2030, Human Development Index (HDI).

الآثار الهيكلية للعنة الموارد: التحديات الاقتصادية والإصلاح في المملكة العربية السعودية

د. نجوى أمين عبد القوي [(1)]

(قُدِّم للنشر: 6 ربيع الثاني، 1466هـ – وقُبِل للنشر: 28 جمادى الآخرة، 1446هـ

المستخلص: تتناول هذه الدراسة العلاقة الديناميكية بين متغيرات الاقتصاد الكلي والنمو الاقتصادي في المملكة العربية السعودية خلال الفترة من 1990 إلى 2022، مع التركيز على دور عائدات النفط ضمن متغيرات رئيسية تشمل تطور سوق الأسهم، مؤشر التنمية البشرية، مؤشر سعر المستهلك، والبطالة. باستخدام تقنيات الاقتصاد القياسي المتقدمة، مثل التكامل المشترك لجوهانسن ونماذج تصحيح الأخطاء، تم تحليل التفاعلات القصيرة والطويلة الأجل بين هذه المتغيرات. تشير النتائج الي أن تطور سوق الأوراق المالية له تأثير هامشي فقط على النمو الاقتصادي على المدى الطويل، بينما تظهر عائدات النفط علاقة سلبية طويلة الأجل الناتج المحلي الإجمالي، مما يعزز مفهوم لعنة الموارد في الاقتصادات المعتمدة على النفط. بشكل غير متوقع، تبين أن التنمية البشرية ترتبط سلبيا بالناتج المحلي الإجمالي، مما يعكس تشوهات سوق العمل التي تعيق استغلال رأس المال البشري بشكل كامل في المملكة. بالإضافة إلى ذلك، تفسر متغيرات التحكم مثل مؤشر أسعار المستهلك والبطالة تقلبات النمو الاقتصادي، حيث تظهر البطالة علاقة سلبية قوية مع الناتج المحلي الإجمالي. تؤكد النتائج على ضرورة اجراء إصلاحات شاملة للأسواق المالية وتعزيز جهود التنويع وفق رؤية 2030. تسلط الدراسة الضوء على العلاقة المتناقضة بين التنمية البشرية والنمو الاقتصادي، مع ابراز التحديات الهيكلية التي تفرضها لعنة الموارد.

الكلمات المفتاحية: التنويع الاقتصادي؛ الاعتماد على النفط؛ تطور سوق الأسهم؛ لعنة الموارد؛ رؤية السعودية 2030؛ مؤشر التنمية البشرية.

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Introduction

The dynamic interplay between macroeconomic variables and economic growth in oil-dependent economies, such as Saudi Arabia, has been a central focus of economic research. While financial markets in diversified economies typically contribute to economic development through mechanisms like capital mobilization and risk management, the dominance of oil revenues in countries like Saudi Arabia creates unique challenges. The "resource paradox" framework is frequently used to explain these challenges, where an over-reliance on a single natural resource—oil—hampers long-term economic growth and diversification efforts.

This dependence is further exacerbated during periods of oil price volatility, as demonstrated by the dramatic price collapse during the COVID-19 pandemic, which highlighted the fiscal vulnerabilities of oil-dependent economies (Lashitew, Ross, & Werker, 2020).

Saudi Arabia has been heavily reliant on oil rents for decades. Despite implementing significant economic reforms, including those outlined in Vision 2030, the economy continues to face structural imbalances. The oil sector's dominance has introduced volatility, which distorts the traditional dynamics of economic growth and hinders the development of other productive sectors, such as financial markets and human capital.

To address these issues, this study has the following objectives:

1. To examine the relationship between oil rents and economic growth in Saudi Arabia over the period 1990–2022.
2. To investigate the role of stock market progression in influencing economic performance within an oil-dependent economy.
3. To assess the impact of key macroeconomic variables, including the Human Development Index (HDI), Consumer Price Index (CPI), and unemployment rate, on economic growth.
4. To analyse the paradox of human development in Saudi Arabia, where advancements in education and health have not translated into proportional economic productivity, highlighting inefficiencies in the job market.
5. To explore the implications of economic reforms, notably Vision 2030, for reducing oil dependency and promoting economic diversification.

To guide the analysis, this study tests the following hypotheses:

H1: Oil revenues have a significant negative long-term impact on economic growth.

H2: Stock market progression has a limited effect on economic growth in an oil-dependent economy.

H3: Macroeconomic variables (HDI, CPI, and unemployment rate) have a significant influence on economic growth.

H4: The job market inefficiencies prevent advancements in human development from contributing to economic productivity.

By addressing these objectives and hypotheses, the study Arabia and offers a deeper understanding of the structural challenges faced by oil-dependent economies, such as Saudi Arabia, and explores pathways toward achieving sustainable economic growth.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature on resource dependence, financial market development, and economic growth. Section 3 outlines the methodology and data used in the study. Section 4 presents the empirical results and analysis, while Section 5 discusses the findings in the context of previous research. Finally, Section 6 concludes the study and offers policy recommendations.

Literature Review

The relationship between stock market development and economic growth has been extensively explored in economic literature. Foundational works by Levine and Zervos (1996) and Beck and Levine (2004) argue that robust financial markets facilitate economic expansion through improved capital allocation, risk diversification, and investment mobilization. These studies consistently demonstrate that well-developed stock markets positively contribute to economic growth by

lowering capital costs and enhancing investment efficiency. However, this body of research primarily focuses on diversified economies, where financial markets are central to economic activity and growth.

In contrast, oil-dependent economies such as Saudi Arabia face unique structural challenges, as their financial markets are deeply intertwined with the volatility and imbalances created by oil rents (Auty, 2001; Sachs & Warner, 2001). The overwhelming dependence on oil revenues often hampers the traditional roles that financial markets play in promoting growth. This dynamic can be understood through the lens of the "resource curse" theory, which suggests that countries rich in natural resources frequently experience slower long-term growth due to their over-reliance on a single export commodity. Sachs and Warner (2001) argue that oil dependency can crowd out other productive sectors, limiting the growth potential of financial markets and obstructing economic diversification.

In the context of Saudi Arabia, the resource paradox manifests as a long-term negative impact of oil rents on GDP growth. Existing studies suggest that poorly managed oil revenues and the over-reliance on oil rents can suppress financial market development, limiting its role in promoting broader economic growth (Sachs & Warner, 2001; Auty, 2001). Moreover, stock market progression in oil-dependent economies is often constrained by structural inefficiencies, reducing its impact on long-term growth. These dynamics underscore the importance of diversifying revenue sources and implementing reforms to address the structural challenges posed by oil dependency.

Despite the extensive literature on the resource paradox, few studies have explicitly examined its interaction with financial market , such as Saudi Arabia. Most existing studies focus either on the overall economic impact of oil dependency or on financial market development in more diversified economies. This leaves a significant gap in understanding how oil rents specifically affect stock market development and macroeconomic variables over time in oil-rich nations. For instance, while Rosser (2006) and Olayungbo (2019) explore the resource curse in various contexts, limited empirical research has been conducted to assess the specific long-term effects of oil rents on financial markets in Saudi Arabia.

While the resource paradox provides a strong framework for explaining the structural challenges posed by oil dependency, alternative theories can offer complementary perspectives on the observed economic phenomena. For instance, Dutch disease theory highlights how oil dependency can lead to an overvalued currency, reducing competitiveness in non-oil sectors and hindering economic diversification. Additionally, the rentier state theory suggests that economies reliant on resource revenues often face weakened institutions and limited incentives for economic reform, further exacerbating the underdevelopment of financial markets. For Saudi Arabia, these theories, alongside the resource paradox, provide a comprehensive framework for understanding the unique economic dynamics shaped by oil rents and their impact on financial markets and macroeconomic variables.

Building upon this, the dynamics of SMP in oil-dependent economies, particularly in Saudi Arabia, are a crucial area of study, especially in the context of ongoing economic diversification efforts, such as Vision 2030. Research has explored how economies heavily reliant on a single resource, such as oil, encounter unique challenges in developing their financial markets. Scholars like Rosser (2006) and Auty (2001) have analysed these economies, arguing that their stock markets are shaped by the oil sector, resulting in growth dynamics that differ from those of more diversified economies. This literature review examines various perspectives on SMP's role in economic expansion, with a focus on the distinct challenges faced by oil-dependent economies in achieving diversified growth.

In advanced economies, SMP has been linked to economic growth. Foundational studies by Atje and Jovanovic (1993), Demirguc-Kunt and Levine (1996), and King and Levine (1993) established a positive link between well-structured equity markets and economic expansion. These scholars highlighted that efficient financial markets lower capital costs and foster sustained growth by facilitating investment and more efficient capital allocation. Beck and Levine (2004)

expanded on this, assessing the contribution of both stock markets and banking sectors to economic growth. Using generalized-method-of-moments techniques, they found that both financial sectors significantly contribute to development, which is critical for understanding the interconnectedness of financial markets and economic performance in diverse contexts. While these findings applicable to advanced economies, oil-dependent countries like Saudi Arabia may not experience the same benefits due to the disproportionate influence of oil on the economy, which limits the traditional roles of financial markets in driving growth.

In oil-dependent economies, stock market dynamics are shaped in unique ways by the dominance of the oil sector. Rosser (2005) and Auty (2001) argue that these economies often face challenges in fostering diversified financial markets, as prices, which heavily influence capital and market activity. This dynamic is further explored by Li, J., Li, H., & Jiang (2023), whose analysis of financial markets in oil-dependent economies highlights how fluctuations in these markets significantly affect both the real economy and international crude oil markets. This reinforces the idea that the financial markets in countries like Saudi Arabia are inherently tied to the oil sector, complicating diversification efforts. Al-Malkawi and Abdullah (2011) and Al-Yousif (2002) provide fragmented views on the interplay between stock market growth and economic development in oil-dependent economies, underscoring the complexity of these relationships, particularly in countries where oil dominates the economic landscape.

Recent research emphasizes the interconnectedness of financial markets, commodity prices, and macroeconomic stability in oil-dependent economies. Li and Du (2024) investigate the asymmetric relationship between oil price volatility and financial market fluctuations, highlighting that external price shocks significantly influence commodity markets, such as gold, and broader economic performance. Their findings suggest that oil price volatility, particularly in resource-dependent economies, impacts market dynamics non-uniformly under varying market conditions. This research underscores the need to consider financial market volatility when assessing oil price impacts, as these fluctuations can disrupt market stability and complicate economic diversification efforts.

Empirical evidence suggests that stock market progression in resource-dependent economies is closely linked to diversification strategies and macroeconomic stability. For example, Azam et al. (2023) find that renewable energy growth contributes to both financial market development and broader economic gains in Asian economies.

Liquidity is a critical component of efficient financial markets, as it ensures smooth capital flows and reduces transaction costs. Levine and Zervos (1996, 1998) identified liquidity as essential for effective capital allocation and risk distribution, showing that liquid markets positively influence economic expansion by facilitating investments and lowering financing costs. However, in oil-dependent economies like Saudi Arabia, the relationship between liquidity and growth is more complex. Naceur and Ghazouani (2007) found that in the Middle East and North Africa (MENA) region, financial development, including liquidity, did not always lead to positive economic outcomes. This suggests that the volatility of oil-dependent markets, driven by external factors such as oil price fluctuations, may disrupt financial stability and weaken the impact of liquidity on long-term growth. However, Arestis et al. (2001) raised concerns about increased liquidity, suggesting that while it may enhance market performance, it can also lead to instability, especially in oil-dependent economies where fluctuations. This point is particularly relevant for Saudi Arabia, where oil market volatility influences financial markets, complicating efforts to develop a stable and diversified economy.

Recent studies highlight that while increased market liquidity can support capital flows, it may also amplify instability in resource-dependent economies (Arestis et al., 2001; Li et al., 2023). This is particularly relevant given the oil market volatility observed in Saudi Arabia.

The broader economic and institutional context is also crucial for understanding the role of financial markets in oil-dependent economies. Rajan and Zingales (1998) emphasized the importance of strong institutional frameworks and sound economic

policies in driving sustainable growth. They argue that effective institutions are essential for fostering diversified and resilient financial markets, particularly in economies that rely heavily on natural resources. In Saudi Arabia, institutional reforms play a key role in Vision 2030's objectives, which aim to diversify the economy and reduce oil dependency. Strengthening institutional quality is critical to ensuring that financial sector development positively influences long-term growth. Bayraktar et al. (2023) further highlight the importance of institutional quality, noting that in emerging markets, robust institutions enhance the positive effects of financial development on economic expansion.

Recent empirical findings, including those of Li et al. (2023) and Bayraktar et al. (2023), underscore the interconnectedness of oil rents, financial market efficiency, and institutional quality in oil-dependent economies. These studies provide updated perspectives that complement foundational theories, highlighting the evolving challenges and opportunities for achieving sustainable economic growth in Saudi Arabia.

Recent studies emphasize the importance of sustainable energy policies in achieving economic diversification and long-term growth in Saudi Arabia. For instance, Islam and Ali (2024) highlight the Kingdom's ambitious goal to achieve net-zero greenhouse gas emissions by 2060 and reduce CO_2 emissions by 278 million tonnes annually by 2030, as outlined in Vision 2030. Key initiatives such as the Saudi Energy Efficiency Centre's Action Plan, which targets a 30% reduction in power intensity, and the NEOM green hydrogen project, showcase Saudi Arabia's commitment to technological innovation and renewable energy development. However, Islam and Ali (2024) note that the absence of a comprehensive state-of-the-art energy policy framework remains a barrier to achieving a smooth and sustainable energy transition. Their study develops a conceptual policy framework that incorporates strategies like regional collaboration, human capital development, technological research, and environmental conservation, aligning these efforts with Vision 2030's social, economic, and environmental goals.

These insights offer critical policy implications for advancing Saudi Arabia's green energy transition, addressing key structural challenges such as oil dependency, institutional reforms, and human capital inefficiencies.

This study addresses the identified gaps by focusing on Saudi Arabia's financial market dynamics and analysing how oil rents interact with key financial and macroeconomic variables, including market capitalization, liquidity, HDI, CPI, and unemployment. Unlike prior studies that emphasize short-term economic relationships (Al-Moneef, 2006; Alkhareif & Alsadoun, 2017), this research applies advanced econometric techniques, such as Johansen cointegration and Vector Error Correction Models (VECM), to examine both short-term and long-term interactions. This approach enables a deeper understanding of the structural challenges impeding Saudi Arabia's financial markets in achieving sustained economic growth.

In summary, while existing literature offers valuable insights into the resource paradox, stock market development, and economic growth, notable gaps persist, particularly for oil-dependent economies like Saudi Arabia. Foundational studies (Auty, 2001; Sachs & Warner, 2001) highlight the negative effects of oil dependency on economic diversification and financial market progress. However, limited empirical research specifically investigates the long-term interplay between oil rents, stock market development, and macroeconomic variables—such as HDI, CPI, and unemployment—in Saudi Arabia. Furthermore, most studies provide generalized findings applicable to diversified economies, overlooking the unique structural challenges faced by oil-rich nations.

This study bridges these gaps by comprehensively analysing Saudi Arabia's financial markets using robust econometric methods to capture short-term and long-term interactions. The findings will provide critical insights for policymakers, aiding efforts to reduce oil dependency, foster economic diversification, and achieve sustainable long-term growth.

Methodology

1. Data Sources and Variables

This study employs a time-series econometric approach to investigate the relationship between stock market progression (SMP), oil rents, and economic growth in Saudi Arabia from 1990 to 2022. The dependent variable in this analysis is GDP per capita (GDPPC), while the independent variables include stock market size (SIZE), oil rents (OILRENT), Human Development Index (HDI), Consumer Price Index (CPI), stock market liquidity (LIQUIDITY), and unemployment (UN).

Data Sources and Quality:

The data used in this study were sourced from reliable and widely recognized databases to ensure accuracy and credibility. GDP per capita, CPI, and unemployment data were obtained from the World Bank and Saudi Central Bank (SAMA) publications. Data on oil rents as a percentage of GDP were sourced from the World Development Indicators (WDI) database. Stock market data, including SIZE (measured by market capitalization) and LIQUIDITY, were collected from the Saudi Stock Exchange (Tadawul) reports and SAMA bulletins. The HDI data were obtained from the United Nations Development Programme (UNDP) Human Development Reports. Each source provides verified and publicly accessible data, ensuring high-quality, consistent, and comparable datasets over time.

2. Econometric Model Specification

The econometric model used in the analysis is as follows:

$$GDPPC_i = \beta_0 + \beta_1 SIZE_i + \beta_2 OilRent_i + \beta_3 HDI_i + \beta_4 CPI_i + \beta_5 Liquidity_i + \beta_6 UN_i + \varepsilon_i$$

Where:

- SIZE represents stock market size, measured by market capitalization.
- Oil Rent captures oil rents as a percentage of GDP, reflecting the country's reliance on oil revenues.
- HDI measures human capital development, incorporating health, education, and income.
- CPI controls for inflationary pressures within the economy.
- LIQUIDITY represents the stock market's ability to facilitate transactions without significant price changes.
- UN represents the unemployment rate, capturing, job market inefficiencies.

These variables are selected based on both theoretical and empirical literature, reflecting key drivers of economic growth in oil-dependent economies. The inclusion of control variables, such as HDI, CPI, and UN, allows the model to isolate the specific effects of stock market progression and oil rents on GDP per capita, while controlling for other macroeconomic factors.

3. Justification for Johansen Cointegration and VECM

This study employs the Johansen cointegration test and the Vector Error Correction Model (VECM) to examine the dynamic relationships between oil rents and macroeconomic variables, including GDP, stock market performance, and unemployment. The decision to use these methods is grounded in their suitability for studying both long-term equilibrium relationships and short-term dynamics in economic systems characterized by volatility.

Following the framework established by Apergis and Miller (2009), the Johansen cointegration test is employed to determine whether a stable, long-term relationship exists among the variables. This approach is particularly well-suited for non-stationary time-series data, where variables become stationary only after differencing. Preliminary tests, including the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, confirm that the variables in this study are integrated of order one, I (1). The Johansen test extends this analysis by identifying cointegrating vectors that capture the long-term associations among GDP per capita, stock market progression, and oil rents, even in systems with multiple endogenous variables.

When cointegration is established, the VECM provides an effective tool for modelling both the short-term dynamics and long-term adjustments. The VECM is particularly valuable in this context because it captures deviations from the long-term equilibrium and estimates the speed of adjustment back to equilibrium following short-term shocks. This dual capability makes the VECM highly relevant for oil-dependent economies like Saudi Arabia, where external shocks and structural imbalances frequently disrupt economic stability.

Together, these methods create a robust analytical framework for examining the interplay between oil rents, stock market dynamics, and key macroeconomic indicators. By addressing both long-term structural relationships and short-term fluctuations, this approach offers a comprehensive understanding of the economic challenges and opportunities faced by oil-dependent economies.

4. Justification for Control Variables

- Human Development Index (HDI) is included to capture the importance of human capital in driving long-term economic growth. HDI measures a country's achievements in health, education, and income levels—critical indicators of sustainable development. In oil-rich economies like Saudi Arabia, advancements in human development often do not directly translate into corresponding gains in economic productivity due to structural inefficiencies (Lucas, 1988). This study aims to evaluate whether improvements in human capital, as reflected in HDI, have a positive effect on GDP growth or whether deeper structural reforms are required to unlock the potential of human capital.

- Consumer Price Index (CPI) is incorporated as a control variable to account for inflationary dynamics. Inflation, measured by CPI, can distort investment decisions, erode purchasing power, and impact economic stability. In oil-dependent economies, inflation tends to be volatile due to external shocks, such as fluctuations in oil prices (Naceur & Ghazouani, 2007). By including CPI in the model, we aim to isolate the effects of SMP and oil rents on GDP per capita from inflation-related distortions.

- Unemployment (UN) is included to reflect the job market's efficiency and its impact on economic growth. Despite high levels of economic growth fuelled by oil revenues, Saudi Arabia has struggled with persistent unemployment (Alotaibi, 2017). This study examines how unemployment, as a measure of job market inefficiency, affects GDP growth and how these inefficiencies align with the broader goals of Vision 2030's economic diversification and job market reforms.

5. Econometric Approach and Diagnostic Tests

To ensure the robustness and validity of the econometric model used in this study, several key assumptions were tested through diagnostic checks. These tests are essential to ensure that the results are reliable and provide meaningful interpretations of the relationship between stock market progression, oil rents, and economic growth in Saudi Arabia.

First, the model assumes a linear relationship between GDPPC and the independent variables. This assumption was confirmed by visually inspecting scatterplots of the independent variables against GDP growth. The linearity of these relationships is critical for the validity of the model's structure.

The normality of the residuals was assessed using the Jarque-Bera test, which evaluates whether the residuals follow a normal distribution. The test confirmed that the residuals are approximately normally distributed, with a high p-value indicating no significant deviation from normality. Ensuring residuals follow a normal distribution is key for making valid statistical inferences and confirming the reliability of the model's estimates.

Multicollinearity was checked to ensure that the independent variables were not highly correlated, as multicollinearity can inflate standard errors and distort estimates. The Variance Inflation Factor (VIF) was calculated for each independent variable, and all values were well below the threshold of 10, that multicollinearity is not a significant issue in this model.

Autocorrelation, or the presence of correlation between a variable and its past values, was tested using the Breusch-Godfrey

Serial Correlation Lagrange Multiplier (LM) Test. Autocorrelation can bias standard errors and reduce the efficiency of the model's estimates. The test detected potential autocorrelation at lag 2, which may affect the efficiency of the forecast, although there was no significant serial correlation at lag 1.

Finally, the presence of heteroscedasticity was tested using the Breusch-Pagan-Godfrey test. Heteroscedasticity, where the variance of the residuals is not constant across observations, can lead to inefficient estimates and affect the model's validity. The test showed no significant evidence of heteroscedasticity, indicating that the residuals exhibit constant variance, which strengthens the reliability of the model's results.

The diagnostic tests confirm that the model meets the necessary assumptions for valid statistical inference. The stationarity of the data was ensured using the ADF and PP tests, confirming that the variables become stationary after differencing. The Johansen cointegration test established the existence of long-term relationships between stock market size, oil rents, and GDPPC, affirming the long-term equilibrium dynamics in the model.

The tests for multicollinearity, autocorrelation, and heteroscedasticity validate that the model's estimates are not distorted by these issues, ensuring the reliability of the regression results. The VECM captures both short-term adjustments and long-term relationships, with the error correction term indicating the speed of adjustment toward equilibrium when deviations occur.

Results and Discussion

This section presents the empirical analysis of the relationship between stock market progression, oil rents, and economic growth in Saudi Arabia from 1990 to 2022. It also Human Development Index, Consumer Price Index, liquidity, and unemployment, providing both short-term and long-term insights.

Descriptive Statistics

The descriptive statistics in Table 1 offer valuable insights into key economic indicators over the observed period. The GDP per capita (GDPPC) shows a nearly symmetrical distribution, reflecting relatively stable and consistent economic growth in Saudi Arabia. This stability is crucial for long-term financial planning.

SIZE exhibits moderate variability, suggesting that market conditions have been stable without extreme fluctuations, which contributes to maintaining investor confidence. However, liquidity demonstrates high variability, indicating periodic surges in financial activity, possibly driven by government intervention or speculation. This highlights the need for careful financial regulation to mitigate risks.

The HDI shows a narrow range, reflecting consistent improvements in human development, while CPI reveals right-skewness, indicating occasional spikes in inflation likely influenced by oil price fluctuations. Oil rent displays high variability, underscoring the importance of diversifying the economy to reduce reliance on oil revenues and mitigate external shocks. Finally, unemployment exhibits moderate skewness, pointing to fluctuations in employment stability over time, emphasizing the need for the job market reforms.

Table 1: Descriptive Statistics for Key Variables

Statistic	GDPPC	SIZE	HDI	CPI	Oil Rent	Liquidity	Unemployment
Mean	9.504291	31.22906	0.785273	1.982472	34.00201	103.1398	5.783455
Median	9.605661	31.22221	0.787000	2.068840	31.34245	65.26532	5.640000
Maximum	10.32339	33.21964	0.875000	9.870248	54.08580	372.2599	7.450000
Minimum	8.877573	29.53568	0.678000	-2.093333	15.97891	12.10563	4.350000
Std. Dev.	0.494567	0.962302	0.066106	2.548843	10.40181	101.9128	0.739820
Skewness	0.030244	0.321263	-0.050982	0.857617	0.252179	1.545479	0.312040
Kurtosis	1.343835	3.317614	1.556157	3.982217	1.920283	4.164093	2.912360
Jarque-Bera	3.776496	0.706364	2.880734	5.371821	1.952730	15.00005	0.546089
Probability	0.151337	0.702449	0.236841	0.068159	0.376678	0.000553	0.761059
Observations	33	33	33	33	33	33	33

Data Source: Table compiled and prepared by the author, 2024.

Correlation Matrix

The correlation matrix in Table 2 sheds light on the relationships among key economic variables. A strong positive correlation between HDI and GDPPC underscores the link between improvements in education, health, and economic prosperity. Conversely, the weak correlations of oil rent and liquidity with GDPPC suggest limited direct influence on income levels. This reinforces the importance of diversifying revenue sources beyond oil.

Table 2: Correlation Matrix of Key Variables

	GDPPC	SIZE	HDI	CPI	Oil Rent	Liquidity	UN
GDPPC	1	0.636478	0.961261	0.356172	0.032228	-0.284813	0.061518
SIZE	0.636478	1	0.658352	0.095486	-0.396885	0.086387	0.277385
HDI	0.961261	0.658352	1	0.204333	-0.133751	-0.335710	-0.017385
CPI	0.356172	0.095486	0.204333	1	0.379387	0.011982	0.200394
Oil Rent	0.032228	-0.396885	-0.133751	0.379387	1	0.249519	-0.149295
LIQUIDITY	-0.284813	0.086387	-0.335710	0.011982	0.249519	1	0.306183
UN	0.061518	0.277385	-0.017385	0.200394	-0.149295	0.306183	1

Data Source: Table compiled and prepared by the author, 2024.

Stationarity Test

The stationarity tests at level, presented in Table 3, assess whether the time series variables exhibit unit root behaviour, which could indicate non-stationarity. Most variables, such as CPI and liquidity, were found to be non-stationary at level I (0), as they do not reject the null hypothesis. This suggests the need for further differencing to achieve stationarity.

Table 3: Stationarity Test Results (At Level) for Key Variables

Variable	ADF (p-value)	PP (p-value)	Decision	Critical Value (5%)	Stationary
GDP PC	0.2426 (0.9712)	0.9196 (0.9945)	Non-Stationary	-2.9571	No
SIZE	-0.0156 (0.9502)	0.0793 (0.9590)	Non-Stationary	-2.9571	No
HDI	-1.6094 (0.4663)	-1.2696 (0.6313)	Non-Stationary	-2.9571	No
CPI	-3.2496 (0.0261)	-3.2583 (0.0256)	Stationary	-2.9571	Yes
Oil Rent	-2.1735 (0.2193)	-2.1961 (0.2115)	Non-Stationary	-2.9571	No
Liquidity	-3.9391 (0.005)	-2.5293 (0.1182)	Non-Stationary	-2.9571	No
UN	-2.1730 (0.2194)	-2.2391 (0.1972)	Non-Stationary	-2.9571	No

Data Source: Table compiled and prepared by the author, 2024.

In Table 4, the First Difference Unit Root Test confirms that most key variables become stationary when differenced, achieving integration at order one, I(1). This ensures the reliability of the subsequent econometric modelling, including cointegration testing.

Table 4: Stationarity Test Results (At First Difference) for Key Variables

Variable	ADF (p-value)	PP (p-value)	Decision	Critical Value (5%)	Stationary
GDPPC	-4.5268 (0.0012)	-3.7022 (0.0091)	Stationary	-2.9639	Yes
SIZE	-5.7211 (0.0000)	-5.7211 (0.0000)	Stationary	-2.9639	Yes
HDI	-3.9425 (0.0025)	-4.2115 (0.0025)	Stationary	-2.9639	Yes
CPI	-9.3298 (0.0000)	-9.2137 (0.0000)	Stationary	-2.9639	Yes
Oil Rent	-6.2032 (0.0000)	-6.6211 (0.0000)	Stationary	-2.9639	Yes
Liquidity	-3.3539 (0.0208)	-3.2156 (0.0286)	Stationary	-2.9639	Yes
UN	-3.7919 (0.0074)	-5.0072 (0.0003)	Stationary	-2.9639	Yes

Data Source: Table compiled and prepared by the author, 2024.

Lag Selection and Information Criterion

The VAR Lag Order Selection Criteria, shown in Table 5, helps determine the optimal lag length for time series analysis. Selecting an appropriate lag length is critical, as it ensures the model captures the underlying dynamics of the variables while avoiding overfitting or model inefficiency. Based on the Akaike Information Criterion (AIC), Final Prediction

Error (FPE), and Hannan-Quinn Criterion (HQ), a lag length of 2 was selected as the most suitable for the model. This choice balances model complexity with the ability to capture underlying data patterns.

Based on these criteria, a lag length of 2 was selected as the most suitable for the model. The AIC, FPE, and HQ criteria consistently indicated by the asterisk (*) in Table 5. This choice strikes a balance between capturing the temporal relationships in the data and maintaining model parsimony. Selecting the correct lag length is essential for ensuring robust estimates, particularly when analyzing both short-term and long-term relationships in a Vector Autoregression (VAR) framework.

Table No. 5: VAR Lag Order Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-316.0430	NA	5.318730	21.53620	21.86315	21.64079
1	-139.7955	258.4964	0.001207	13.05303	15.66860	13.88978
2	-60.71996	79.07553*	0.000295*	11.04800*	15.95219*	12.61689*
3	89.07391	79.89006	3.05e-06	4.328406	11.52122	6.629449

Data Source: Table compiled and prepared by the author, 2024.
** Indicates lag order selected by the criterion.*

Johansen Cointegration Test

The Johansen Cointegration Test results in Figure No. 6 identify the presence of multiple cointegrating equations, indicating stable long-term relationships between key variables, such as GDP per capita (GDPPC), oil rents, and SIZE. The trace test identifies up to four cointegrating equations, while the maximum eigenvalue test suggests the presence of four cointegrating equations at the 5% significance level. These results confirm that while short-term fluctuations occur, the variables move together over time, reflecting the interconnectedness of the Kingdom's economy and the impact of oil dependency on its long-term growth.

Table 6: Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (0.05)	Prob.
None *	0.898261	219.4339	125.6154	0.0000
At most 1 *	0.802785	148.5883	95.75366	0.0000
At most 2 *	0.691127	98.26099	69.81889	0.0001
At most 3 *	0.590780	61.84143	47.85613	0.0014

Data Source: Table compiled and prepared by the author, 2024.

Notes: *- The trace test indicates the presence of 7 cointegrating relationships at the 5% significance level.*
- *The maximum eigenvalue test identifies four cointegrating equations at the 5% level.*
- *indicates rejection of the null hypothesis at the 5% significance level.*

Vector Error Correction Model (VECM)

The VECM results, detailed in Table 7, provide insights into the long-term equilibrium relationships. Surprisingly, SIZE shows a negative relationship with GDPPC(-0.044663), suggesting that financial market expansion does not necessarily contribute to economic growth. This may be due to structural inefficiencies, which aligns with Saudi Vision 2030's goal of reforming the financial sector.

Similarly, oil rents also display a negative long-term relationship with GDPPC (-0.013027), reinforcing the risks associated with over-reliance on oil revenues. These results highlight the necessity of diversifying the economy to mitigate the negative long-term effects of oil dependency. Another unexpected finding is the negative relationship between HDI and GDPPC (-7.470617), suggesting that improvements in human development have not yet translated into proportional economic growth. This points to structural challenges in integrating human capital into the productive sectors.

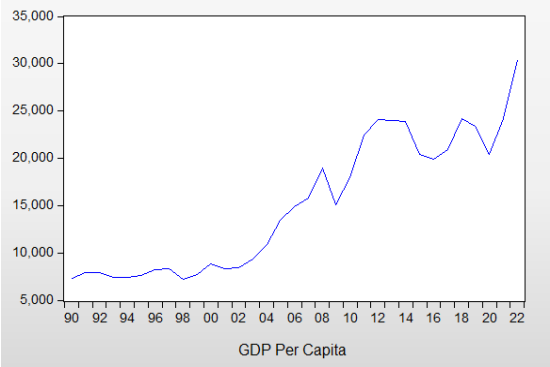
Economic Growth Trends

Figure No. 1 shows the trend in GDPPCin Saudi Arabia from 1990 to 2022, highlighting significant periods of growth, stagnation, and volatility. The sharp increases in GDPPC post-2003 are reflective of oil price

booms and growing government revenues during this time. However, the subsequent fluctuations in GDP per capita, particularly between 2015 and 2020, are indicative of the Kingdom's vulnerability to external shocks, such as the decline in global oil prices and economic impacts of the COVID-19 pandemic.

The overall upward trajectory in GDPPC demonstrates the Kingdom's resilience and efforts to foster economic growth. However, as noted in the empirical results, this growth has been heavily influenced by the volatility of oil rents, and the long-term sustainability of GDP growth remains uncertain without further diversification of the economy. This figure visually supports the findings that, while Saudi Arabia's economy has experienced periods of strong growth, its reliance on oil revenues has led to fluctuations, reinforcing the need for comprehensive economic reforms as outlined in Vision 2030.

Figure No. 1: GDP Per Capita in Saudi Arabia (1990–2022)

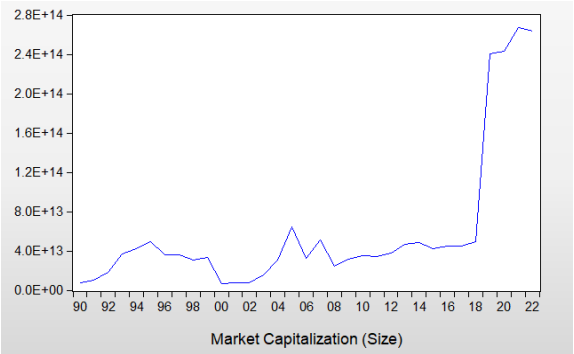


Stock Market Progression and Economic Growth

Figure No. 2 illustrates the evolution of Market Capitalization in Saudi Arabia from 1990 to 2022, providing key insights into the stock market's role in the Kingdom's broader economic landscape. The sharp increase observed after 2016 is particularly noteworthy, coinciding with the Kingdom's Vision 2030 reforms aimed at expanding the financial markets and diversifying the economy. Before this period, market capitalization exhibited periods of volatility and stagnation, reflecting the Kingdom's dependence on oil revenues and its vulnerability to external shocks such as global financial crises and fluctuations in oil prices.

The post-2016 surge in market capitalization underscores the effectiveness of recent financial reforms, suggesting a growing investor confidence and a more competitive financial market. This trend aligns with the findings of this study, which show that while SIZE has a modest impact on short-term GDP growth, it plays a more significant role in enhancing financial liquidity and attracting investment. However, the negative long-term correlation between SIZE and GDP, as indicated in the VECM analysis, suggests that structural inefficiencies remain, preventing the full potential of financial market expansion from contributing to sustainable economic growth.

Figure No. 2: Market Capitalization (Size) in Saudi Arabia (1990–2022)



Unexpected Findings: The HDI-GDP Relationship

One of the surprising results is the negative correlation between HDI and GDP per capita, contradicting traditional theories like those of Lucas (1988), which emphasize the positive role of human capital in economic growth. This could be due to the resource curse, where reliance on oil hinders the full utilization of human capital, leading to job market distortions. Moreover, a mismatch between the skills produced by the educational system and the needs of the economy might explain this unexpected result. Dutch disease and currency appreciation could also reduce the competitiveness of non-oil sectors, limiting the impact of human development on overall economic growth.

Marginal Impact of Inflation on Long-Term Economic Growth

The Consumer Price Index (CPI), with a small positive coefficient of 0.009968, suggests that inflation has only a marginal impact on long-term GDP growth. While inflation management remains essential for maintaining economic stability, its relatively

minor influence on GDP in the long run implies that price stability alone is not a major driver of economic growth. This finding is consistent with studies in other oil-dependent economies, such as Nigeria, where Chimobi (2010) also found that inflation did not exhibit a significant long-term relationship with GDP growth. The study demonstrated that while inflation impacts growth in the short term, its effect diminishes over time, indicating that other structural factors—such as investment, productivity, and economic diversification—play a more critical role in fostering sustained economic expansion.

The Role of Liquidity in Economic Growth

The stock market liquidity, with a modest coefficient in this study, suggests a limited role in driving long-term GDP growth in Saudi Arabia. While Levine & Zervos (1998) initially posited that stock market liquidity could significantly promote economic development, subsequent research by Zhu, Ash, & Pollin (2004) challenged this view. Their study showed that once outliers, particularly the contributions of the Asian Tigers, were controlled for, stock market liquidity no longer exerted any statistically observable influence on GDP growth. This aligns with the results in Saudi Arabia, indicating that liquidity alone may not be sufficient to drive significant long-term economic expansion in an oil-dependent economy. Structural factors, such as investment in diversified sectors and institutional reforms, may play a more critical role in fostering sustainable growth.

Unemployment and Economic Growth

The relationship between unemployment and GDP growth in Saudi Arabia, as highlighted in this study, reflects challenges commonly seen in other developing economies, particularly those that rely heavily on a single sector. In line with Okun's Law, the findings indicate a strong negative correlation between unemployment and GDP growth in Saudi Arabia, suggesting that reducing unemployment is vital for improving economic performance. A similar dynamic was found in Nigeria, where both short- and long-term relationships between unemployment and output growth were demonstrated, as noted by Akeju and Olanipekun (2014). Their research emphasizes the necessity of job market reforms in oil-dependent economies, where economic diversification and sectoral development are essential to absorbing new job market entrants and addressing joblessness.

In Saudi Arabia, rising unemployment continues to undermine economic growth, underscoring that economic expansion alone is insufficient for job creation. As noted in the Nigerian context, targeted fiscal policies and incentives to attract foreign direct investment (FDI) are critical to promoting employment and alleviating the structural constraints that hinder job creation. Similarly, in Saudi Arabia, these findings reinforce the need for job market reforms and comprehensive employment strategies aligned with the goals of Vision 2030, which seeks to reduce oil dependency and foster sustainable economic growth through diversification.

Unemployment in Saudi Arabia shows a strong negative long-term relationship with GDP, with a coefficient of -0.247517. This result aligns with established economic theory, which posits that higher unemployment rates typically hamper economic growth. Therefore, reducing unemployment and improving job market efficiency is crucial for long-term economic performance. The high significance of this relationship, as indicated by the large t-statistic, underscores the critical importance of job market reforms in supporting sustainable growth in the kingdom. In the short term, the positive coefficient associated with reductions in unemployment suggests that immediate improvements in employment levels have a positive impact on GDP growth.

Table 7: Vector Error Correction Model (VECM) Estimates for Economic Variables Cointegrating Equation

Variable	Coefficient	t-Statistic
SIZE (-1)	-0.044663	[-2.43216]
HDI (-1)	-7.470617	[-33.1377]
CPI (-1)	0.009968	[1.93935]
Oil Rent (-1)	-0.013027	[-8.06111]
LIQUIDITY (-1)	0.000431	[3.19949]
UN (-1)	-0.247517	[-14.2601]
C	-0.428132	-

Data Source: Table compiled and prepared by the author, 2024.

Short-Term Dynamics of the VECM

The short-run dynamics of the VECM, as shown in Table 8, provide key insights into how shocks to various economic variables affect the economy before the system adjusts back to its long-term equilibrium. These effects shed light on the interactions among key indicators such as SIZE, oil rents, liquidity, CPI, and unemployment, and their influence on the broader economic landscape.

SIZE plays a significant role in the short run, particularly in its relationship with oil rents, liquidity, and unemployment. The positive effect of SIZE on oil rents (coefficient 6.990477*) indicates that increases in financial market activity enhance oil sector revenues, indicating strong structural interdependence between these sectors. However, the positive relationship between SIZE and unemployment (coefficient 0.557755*) highlights potential structural inefficiencies, where financial market growth does not immediately translate into job creation. This underscores the need to align financial market expansion with job market reforms to address this disconnect.

Oil rents show a complex relationship with economic variables. The significant negative short-run relationship between oil rents and SIZE (coefficient -0.011416*) supports the resource curse hypothesis, as highlighted by Rosser (2006) and Auty (2001), where the dominance of oil revenues crowds out financial market development by diverting resources and attention. While the relationship between oil rents and GDPPC (coefficient 0.001472) is positive, its weak significance indicates minimal direct impacts on short-term economic growth. These findings underscore the structural challenges faced by oil-dependent economies in developing diversified financial markets. Additionally, oil rents exhibit no significant effects on unemployment or HDI, reinforcing their limited influence on job market outcomes and human development in the short run.

Inflation (CPI) exhibits a notable self-correcting dynamic in the short term, as reflected by its significant negative coefficient (-0.442292*). While inflation stabilizes over time, its short-run influence on GDPPC and other key variables remains limited. However, consistent with Ahmad, Afzal, and Khan (2017), who find CPI negatively impacts economic growth in Pakistan, the need for effective inflation management is underscored. While their study attributes CPI's adverse effects to macroeconomic instability, our findings suggest that, in the Saudi context, inflation's short-term dynamics are less disruptive but still critical for maintaining long-term investment confidence and macroeconomic stability.

Unemployment (UN) demonstrates strong persistence in the short term, with a significant positive coefficient (0.51632*). This persistence reflects structural challenges in quickly reducing joblessness, such as job market inefficiencies or mismatches between skills and demand. Addressing these challenges requires comprehensive job market reforms, including education and training programs aligned with market needs.

In summary, the VECM's short-term dynamics reveal that while SIZE influences financial variables, such as oil rents and liquidity, it does not significantly affect GDPPC. Oil rents negatively impact SIZE, reflecting resource curse dynamics, but their effects on GDPPC and unemployment are minimal. Consistent with the findings of Rosser (2006), Auty (2001), and Heidarian and Green (1989), this underscores the persistent challenges of structural inefficiencies in economies heavily reliant on oil. Inflation tends to stabilize, and unemployment persists, emphasizing the need for targeted policies to address job market inefficiencies and enhance the connection between financial market growth and employment outcomes.

Table 8: Short-Term Dynamics:

Dependent Variable	Independent Variable	Coefficient	Std. Error	t-Statistic
D(GDP_PC)	CointEq1	-0.254983	0.21487	-1.18668
D(SIZE)	SIZE (-1)	-0.236881	0.2548	-0.92969
D(SIZE)	Oil Rent (-1)	6.990477*	3.3392	2.09346
D(LIQUIDITY)	SIZE (-1)	77.55234*	27.471	2.82307

Dependent Variable	Independent Variable	Coefficient	Std. Error	t-Statistic
D(UN)	SIZE (-1)	0.557755*	0.20726	2.69115
D(SIZE)	Oil Rent (-1)	-0.011416*	0.02609	-0.43755
D(GDP_PC)	CPI (-1)	-0.442292*	0.1928	-2.29404
D(UN)	UN (-1)	0.516320*	0.23715	2.17715

Data Source: Table compiled and prepared by the author, 2024.

- *Coefficients marked with an asterisk (*) indicate statistical significance at the 5% level.*
- *Only significant results and relevant relationships are included to maintain focus on key insights.*

The VECM analysis reveals the complex, interconnected nature of the kingdom's economy, with notable distinctions between short-run dynamics and long-term equilibrium. In the short run, SIZE significantly affects liquidity and oil rents, but its long-term contribution to GDP growth is negative. Similarly, while oil rents offer short-term benefits, these effects are largely insignificant. However, the long-term impact of oil rents is negative for sustainable economic growth, reinforcing the complexities associated with an oil-dependent economy. Unemployment persists as a critical issue across both time frames, while inflation (CPI) self-corrects in the short run with minimal long-term impact.

These findings underscore the necessity for comprehensive reforms that address financial market inefficiencies, reduce the country's dependency on oil, and better integrate human capital into the economy. Such reforms are crucial for achieving the sustained and balanced economic growth envisioned in Vision 2030.

The overall model diagnostics show moderate explanatory power, with R-squared values ranging between 0.214 and 0.494 for different equations. The F-statistic values suggest that the model fits adequately, although the relatively low R-squared values indicate the complexity of the Saudi economy. These results imply that while the economy does tend to move toward equilibrium, it does so slowly, requiring sustained and coordinated policy efforts to address structural challenges and promote long-term stability.

The error correction term for GDP in table 9, with a value of -0.254983, indicates that about 25% of any short-term deviation from the long-term equilibrium is corrected in the following period. This relatively slow adjustment reflects the structural challenges within the kingdom economy, particularly in relation to its dependence on oil revenues. Although the economy moves toward equilibrium, the persistence of deviations emphasizes the need for ongoing policy efforts aimed at reducing dependency on oil and fostering economic diversification.

Table 9: Error Correction Term (Adjustment to Equilibrium):

Variable	Coefficient	Standard Error	t-Statistic
CointEq1 (D (GDP PC))	-0.254983	0.21487	[-1.18668]
CointEq1 (D (SIZE))	-1.049385	1.00960	[-1.03941]
CointEq1 (D (HDI))	0.009862	0.00575	[1.71519]
CointEq1 (D (CPI))	-5.235736	-4.42495	[-1.18323]
CointEq1 (D (Oil Rent))	13.79005	-13.2312	[1.04223]
CointEq1 (D (Liquidity))	95.34527	-108.851	[0.87593]
CointEq1 (D (UN))	2.188751	0.82123	[2.66522]

Data Source: Table compiled and prepared by the author, 2024.

Model Summary

The VECM applied to the Kingdom's economic data provides valuable insights into the short- and long-term interactions between key variables. However, the model's performance, as reflected by metrics such as R-squared and Adjusted R-squared, as shown in Table 10, suggests that the country's heavy reliance on oil revenues may contribute to the model's mixed explanatory power. This aligns with the resource curse phenomenon, where resource-rich countries, especially those reliant

on oil, experience slower or more volatile economic growth due to structural inefficiencies and an over-reliance on a single commodity.

The R-squared values for the dependent variables range from 0.214 to 0.494, meaning the model explains between 21.4% and 49.5% of the variance. While these values suggest that the model performs reasonably well in some areas, such as explaining liquidity (R-squared of 0.494815), the relatively low R-squared for SIZE (0.214019) may be indicative of the oil curse dynamics. In an oil-dependent economy, the financial sector may not effectively translate into diversified economic growth because oil revenues tend to dominate other sectors. Thus, fluctuations in SIZE may not capture the broader economic health, leading to weak explanatory power.

The Adjusted R-squared values, which account for the number of predictors, are generally lower, and some are even negative. This further highlights the challenges in using the model to explain short-term variations in economic indicators. These weak results are consistent with the resource curse, where oil wealth can lead to misallocation of resources, inefficiencies in governance, and lack of economic diversification, all of which dampen the model's ability to capture economic growth dynamics in the kingdom fully.

Table 10: Model Summary:

Variable	R-squared	Adjusted R-squared
GDPPC	0.252	-0.02
SIZE	0.214	-0.072
HDI	0.373	0.145
CPI (Inflation)	0.369	0.139
Oil Rent	0.269	0.003
Liquidity	0.495	0.311
Unemployment (UN)	0.434	0.228

Data Source: Table compiled and prepared by the author, 2024.

Log Likelihood and Akaike Information Criterion (AIC)

Higher Log Likelihood values in Table 11 indicate better model fit, with D(HDI) having the highest log-likelihood (139.5998). The Akaike Information Criterion (AIC) and Schwarz Criterion (SC) also suggest a better fit for HDI. However, the negative long-term relationship between HDI and GDPPC highlights inefficiencies in leveraging human capital in an oil-driven economy. This again reflects the resource curse, where investments in human development may not lead to productivity gains if the economy remains concentrated in resource extraction sectors.

Table 11: Log Likelihood and Akaike Information Criterion (AIC)

Lag	Log Likelihood (Log L)	Akaike Information Criterion (AIC)
0	-316.043	21.5362
1	-139.7955	13.053
2	-60.71996	11.048
3	89.07391	4.3284

Data Source: Table compiled and prepared by the author, 2024.

Diagnostic Tests

To ensure the reliability of the results, a series of diagnostic tests were conducted to evaluate the key assumptions underlying the VECM model, focusing on autocorrelation, heteroscedasticity, multicollinearity, and the normality of residuals.

Autocorrelation

The Breusch-Godfrey Serial Correlation LM Test in Table 12 revealed the presence of autocorrelation, with significant results (F-statistic: $p = 0.0367$; Chi-Square: $p = 0.0188$). This suggests that the residuals exhibit serial correlation, meaning they are not fully independent, which could impact the efficiency of the model's estimates by leading to biased standard errors. Additionally, the VECM Serial Correlation LM Tests showed weak evidence of autocorrelation at lag 2($p = 0.0993$), although lag 1 indicated no significant serial correlation. These findings highlight the need to interpret the results with caution, as autocorrelation may influence the statistical significance of the coefficients.

Table 12: Breusch-Godfrey Serial Correlation LM Test

Statistic	Value	Degrees of Freedom (df)	Probability (p-value)
F-statistic	3.8062	2	0.0367
Obs*R-squared	7.9465	2	0.0188

Data Source: Compiled and prepared by the author, 2024.

Heteroscedasticity

In contrast to the autocorrelation findings, the Breusch-Pagan-Godfrey Test in Table 13 confirmed that the residuals exhibit constant variance, indicating no significant heteroscedasticity (p = 0.1493). However, the VECM Heteroscedasticity Test detected significant heteroscedasticity in specific residual components, particularly in res7*res7, indicating that some variables may not maintain constant variance. While heteroscedasticity in some components suggests the presence of volatility, it does not severely impact the overall model validity.

Table 13: Heteroscedasticity Test: Breusch-Pagan-Godfrey

Statistic	Value	Degrees of Freedom (df)	Probability (p-value)
F-statistic	1.7495	6	0.1493
Obs*R-squared	9.4902	6	0.1478
Scaled Explained SS	8.9292	6	0.1776

Data Source: Table compiled and prepared by the author, 2024.

Multicollinearity

To assess potential multicollinearity among the predictor variables, the Variance Inflation Factor (VIF) test was employed. As shown in Table 14, all variables exhibit VIF values well below the threshold of 10, confirming that multicollinearity is not a concern in the model. This ensures that the model's estimates are not distorted by inflated standard errors due to highly correlated independent variables, further enhancing the reliability of the results.

Table 14: Variance Inflation Factor (VIF)

Variable	VIF	1 / VIF
SIZE	2.58	0.388
HDI	3.12	0.321
CPI (Inflation)	1.75	0.571
Oil Rent	2.06	0.485
Liquidity	1.85	0.541
Unemployment	1.92	0.521

Data Source: Table compiled and prepared by the author, 2024.

Residual Analysis and Model Validity

As shown in Figure 3, the residuals from the VECM model exhibit a nearly normal distribution, as confirmed by the Jarque-Bera test (p-value = 0.472). This high p-value supports the null hypothesis of normality, indicating that the residuals are normally distributed and that the model does not suffer from bias. The mean of the residuals is very close to zero, further reinforcing the model's accuracy in predicting the data. Additionally, the skewness value, near zero, indicates a symmetrical distribution. In contrast, the kurtosis value (4.03) suggests only a slight deviation from perfect normality, which does not raise significant concerns about outliers.

Serial Correlation Analysis

The results of the VEC Residual Serial Correlation LM Tests in Table 15(Table: VEC Residual Serial Correlation LM Test Results) provide further insight into serial correlation in the model. At lag 1, the p-values for both the LRE statistic (p = 0.4090) and the Rao F-statistic (p = 0.4832) are well above the 0.05 significance level, supporting the null hypothesis that no serial correlation exists. At lag 2, the LRE statistic's p-value (p = 0.0993) suggests a weak indication of possible serial correlation, but this is not sufficient to reject the null hypothesis. When testing for serial correlation across lags 1 to 2, the calculated p-value for the LRE statistic is 0.0852, which remains above the significance threshold. The Rao F-statistic (p = 0.2033) also indicates no significant serial correlation across these lags. Therefore, the residuals appear free from substantial autocorrelation, ensuring that the model's estimates remain unbiased and reliable

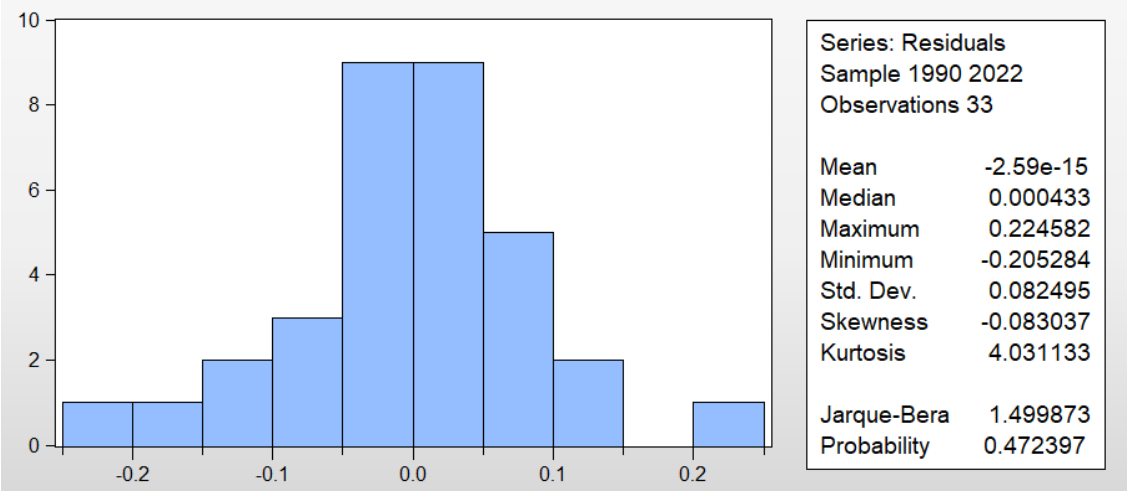
Table 15: VEC Residual Serial Correlation LM Test Results (Lags 1 and 2)

Lag	*LRE Statistic**	Degrees of Freedom (df)	Probability (p-value)	Rao F-stat	Probability (p-value)
1	50.6312	49	0.409	1.0118	0.4832
2	62.083	49	0.0993	1.3543	0.1442

Data Source: Table compiled and prepared by the author, 2024.

This analysis complements the earlier tests for autocorrelation and heteroscedasticity. Although autocorrelation was identified as a potential issue through the Breusch-Godfrey test, the normality of the residuals and the lack of significant autocorrelation in the VECM tests reinforce the overall reliability of the model. Consequently, the VECM is considered a robust tool for analysing the complex dynamics of Saudi Arabia's economy. By confirming that the residuals meet key assumptions of both normality and the absence of significant autocorrelation, this analysis further supports the validity of the VECM results. As a result, the conclusions drawn from the model are statistically reliable, ensuring that the insights provided can be trusted for informing economic policy and strategic analysis.

Figure No. 3: Histogram of Residual Values from the Regression Model with Key Statistical Measures



Diagnostic Tests for Model Robustness

To validate the robustness of the Vector Error Correction Model (VECM), diagnostic tests for serial correlation and heteroscedasticity were conducted. These tests confirm that the model meets critical econometric assumptions, enhancing the reliability of the results.

The VEC Residual Serial Correlation LM Tests (Table 16) indicate no evidence of serial correlation at lag 1 (p-value = 0.4090), confirming that residuals are independent. While marginal concerns arise at lag 2 (p-value = 0.0993), these do not significantly affect the model's validity for short-term dynamics. The Null Hypothesis: No Serial Correlation at Lags 1 to h test (Table 17) similarly supports the absence of autocorrelation at key lags, reinforcing the stability of the model for short- and long-term relationships.

The VEC Residual Heteroskedasticity Tests (Levels and Squares) (Table 18) confirm that the residuals exhibit homoscedasticity, with the joint test yielding a p-value of 0.2703. This finding ensures that the variance of the residuals is constant, a critical assumption for unbiased estimations. While minor variance issues are observed in individual components (e.g., res7*res7, p-value = 0.0385), they do not compromise the overall reliability of the model.

These diagnostic results validate the econometric integrity of the VECM, supporting the conclusions drawn from the short- and long-term dynamics presented in this study.

Table 16: VEC Residual Serial Correlation LM Tests

Lag	*LRE Statistic**	df	p-value	Rao F-stat	p-value
1	50.63117	49	0.409	1.011811	0.4832
2	62.08296	49	0.0993	1.354263	0.1442

Data Source: Table compiled and prepared by the author, 2024.

Table 17: Null Hypothesis: No Serial Correlation at Lags 1 to h

Lag	*LRE Statistic**	df	p-value	Rao F-stat	p-value
1	50.63117	49	0.409	1.011811	0.4832
2	137.6149	98	0.0052	1.370982	0.2033

Data Source: Table compiled and prepared by the author, 2024.

Table 18: VEC Residual Heteroskedasticity Tests (Levels and Squares)

- ***Joint Test:***

Statistic	*df*	p-value
465.8853	448	0.2703

- ***Individual Components:***

Component	*R-squared*	F-stat	p-value	Chi-sq	p-value
res1*res1	0.683813	1.892351	0.1185	21.19821	0.171
res7*res7	0.879905	6.410896	0.0006	27.27705	0.0385
res5*res3	*0.761124*	2.787993	0.0303	23.59485	0.0987

Data Source: Table compiled and prepared by the author, 2024.

Discussion

This study provides critical insights into the intricate dynamics between oil dependency, stock market progression, and economic growth in Saudi Arabia, supporting the resource curse framework. The results reveal a significant negative long-term correlation between oil rents and GDP, aligning with previous research that highlights the adverse effects of oil dependency on sustainable development. This underscores the need for comprehensive reforms to diversify the economy, as outlined in Vision 2030.

Saudi Arabia's Vision 2030 prioritizes several diversification strategies to reduce reliance on oil revenues and foster sustainable growth. For instance, the National Industrial Development and Logistics Program (NIDLP) focuses on promoting the manufacturing, mining, and logistics sectors to drive non-oil GDP growth. Additionally, significant investments in the renewable energy sector, such as the Sakaka Solar Power Plant and NEOM's plans for green hydrogen production, aim to position Saudi Arabia as a global leader in clean energy. The tourism and entertainment sectors are also central to Vision 2030, with initiatives like the Red Sea Project and the development of Qiddiya transforming the non-oil economy and creating new employment opportunities. By implementing these reforms, Saudi Arabia seeks to reduce economic volatility and unlock the potential of underutilized sectors. This aligns with the findings of Alkhareif, Barnett, and Alsadoun (2017), who highlight that fiscal expenditures and economic diversification efforts have significantly contributed to narrowing the output gap in Saudi Arabia, particularly in the non-oil sector. Their analysis emphasizes the critical role of aligning fiscal policy with structural reforms to enhance economic stability and maximize potential output.

Furthermore, the findings of this study align with those of Samargandi, Fidrmuc, and Ghosh (2014), who demonstrate that financial development in Saudi Arabia disproportionately benefits the non-oil sector. This underscores the need for sector-specific financial reforms, as outlined in Vision 2030, to bolster non-oil sector growth and reduce dependency on oil revenues. Together, these insights highlight the importance of integrating fiscal, structural, and financial strategies to achieve sustainable economic diversification.

A key finding is the human development paradox, where improvements in education and health have not translated into higher productivity due to job market inefficiencies. The misalignment between educational outcomes and the demands of the economy, exacerbated by the dominance of the oil sector, limits the full utilization of human capital. This highlights the need for job market reforms to ensure that human capital contributes more effectively to economic growth, particularly in high-growth non-oil sectors such as technology and renewable energy. Addressing the skills mismatch requires targeted policy changes, including the introduction of industry-aligned education and vocational training programs that equip graduates with skills demanded by emerging sectors. For example, expanding partnerships between universities and private sector companies can provide practical training opportunities and improve employability. Additionally, upskilling and reskilling initiatives for the existing workforce, particularly in digital technologies, renewable energy, and advanced manufacturing, can bridge the gap between job market needs and current skillsets. Policymakers could also promote STEM-focused curricula in education to align with the needs of technology-driven industries while offering incentives for companies to invest in employee training. These measures will not only address the skills mismatch but also ensure that human capital development aligns with Saudi Arabia's Vision 2030 goals for economic diversification and sustainable growth.

The negative long-term impact of oil rents on GDP growth emphasizes the risks of oil dependency. Diversification efforts must be accelerated to mitigate the effects of global oil price fluctuations, as the pace of reform under Vision 2030 remains critical. Moreover, the study highlights that stock market progression has a marginal effect on long-term growth, indicating that Saudi financial markets are underdeveloped. To enhance market efficiency, several concrete steps can be recommended. First, policymakers could promote greater market transparency and regulatory reforms to increase investor confidence and attract both domestic and foreign investments. Second, diversifying financial instruments—such as the introduction of more derivatives, bonds, and green financial products—could broaden market participation and improve liquidity. Additionally, fostering Initial Public Offerings (IPOs) from high-growth non-oil sectors, such as technology and renewable energy, would strengthen market depth and diversity. Encouraging fintech innovation through supportive policies and infrastructure can also streamline trading processes and expand market access. These measures collectively can enhance the efficiency and role of financial markets in driving sustainable economic growth, in line with the Vision 2030 agenda. This underscores the need for financial market reforms to improve efficiency, liquidity, and sectoral diversity, particularly by expanding into emerging industries like technology and renewable energy.

Autocorrelation, detected in the residuals, raises some concerns about the accuracy of the model estimates. While the findings provide valuable insights, future studies should address this limitation using more advanced econometric techniques to enhance the robustness of the results.

Control variables , such as the Consumer Price Index (CPI) and unemployment, significantly explain fluctuations in economic growth. Unemployment has a robust negative relationship with GDP, indicating inefficiencies in the job market. High youth unemployment, in particular, underscores the need for targeted reforms to create opportunities in the private sector. Programs such as vocational training and career development will be crucial in bridging the gap between human capital improvements and economic productivity.

Sectoral diversification is essential for reducing Saudi Arabia's reliance on the oil sector. Establishing Special Economic Zones (SEZs) could promote export-oriented industries, attract private investment, and foster growth in high-tech sectors.

Conclusion

This study provides a comprehensive examination of the relationship between oil rents, stock market progression, and economic growth in Saudi Arabia from 1990 to 2022. The findings reveal significant structural challenges tied to oil dependency, supporting the resource curse theory. The negative long-

term relationship between oil rents and GDP growth highlights the urgent need for economic diversification, as emphasized in Vision 2030. While stock market progression has a marginal impact on long-term growth, it indicates that the financial markets are not yet mature enough to drive diversified economic development. Reforms aimed at improving market efficiency, enhancing liquidity, and broadening sectoral diversity are essential for ensuring that the stock market contributes more effectively to economic growth. Policymakers should incentivize Initial Public Offerings (IPOs) in emerging sectors such as technology and renewable energy, aligning with the goals of Vision 2030.

Moreover, the study highlights the human development paradox, where improvements in health and education have not translated into higher economic productivity due to job market inefficiencies. Addressing youth unemployment and fostering private-sector employment are critical for ensuring that human capital is fully utilized in sectors that support diversified growth.

The presence of autocorrelation in the residuals suggests that caution should be exercised when interpreting the results. Future research should focus on refining the econometric model and exploring alternative variables, such as institutional quality and foreign direct investment (FDI), to provide a more nuanced understanding of Saudi Arabia's economic dynamics.

In conclusion, this study underscores the need for comprehensive reforms to enhance financial market efficiency, reduce oil dependency, and better integrate human capital into the economy. Policymakers should prioritize innovation, education, and investment in high-growth sectors, such as renewable energy and technology, to achieve the goals of Vision 2030 and ensure sustainable economic growth. This can be achieved through specific targeted measures. For instance, investing in renewable energy infrastructure, such as NEOM's green hydrogen projects and the Sakaka Solar Power Plant, can create employment opportunities while reducing oil dependency. Similarly, fostering innovation ecosystems by supporting research and development (R&D) hubs and tech incubators would attract private-sector investments and encourage technological advancement.

In addition, aligning education and training programs with job market needs is essential to address the existing skills mismatch. Expanding vocational education and STEM-focused curricula can equip the workforce with skills tailored for emerging sectors, such as renewable energy, fintech, and advanced manufacturing. Financial incentives, such as tax breaks or subsidies for companies that invest in workforce development, can accelerate this process. Furthermore, improving financial market efficiency through regulatory reforms, transparency, and diversification of financial products will strengthen investor confidence and mobilize capital for non-oil sectors. Encouraging Initial Public Offerings (IPOs) from technology startups and renewable energy companies can broaden market participation and promote sustainable economic diversification.

These targeted policies would directly address the structural challenges identified in the study, ensuring that Saudi Arabia transitions toward a resilient, diversified economy, as envisioned in Vision 2030.

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A Spatial Analysis of Point-of-Sale Activity in Saudi Arabia

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Abstract: Point-of-sale (POS) data provides valuable insights into consumer spending habits and economic activity across various sectors. This study examines trends and regional variations in POS transactions and sales values in Saudi Arabia from 2016 to 2023. The research analyzes data from the Saudi Central Bank and the General Authority for Statistics. Utilizing descriptive statistical analysis and comparative analysis using Multivariate Analysis of Variance (MANOVA) to analyze sales values and transaction volumes across Saudi Arabian regions, the F-statistics for the Corrected Model confirmed that the estimated General Linear Model (GLM) is statistically valid and appropriate. Statistical significance among regions indicates differences in transaction volumes and sales values, which stem from regional disparities. Specifically, Partial Eta Squared (η^2) and coefficient of determination (R^2) values reveal that regional differences account for 86.9% of the variance in sales values and 54.6% of the variance in transaction volumes. To compare sales values and transaction volumes between regions and categorize them into groups, we employed Scheffé's post-hoc test. The study findings reveal substantial annual growth rates in both transaction numbers and sales values across these sectors nationwide. Additionally, the study highlights regional disparities in POS performance, shedding light on localized economic dynamics.

Keywords: Spatial analysis, comparative analysis, point of sale, multivariate analysis of variance, Scheffe test, Saudi Arabia.

التحليل المكاني لأنشطة نقاط البيع في المملكة العربية السعودية

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المستخلص: تعتبر بيانات نقاط البيع (POS) مؤشر مهم يتبين من خلاله عادات إنفاق المستهلكين والنشاط الاقتصادي عبر مختلف القطاعات الاقتصادية، حيث تهدف هذه الدراسة إلى فحص الاتجاهات والتباينات المناطقية في معاملات نقاط البيع وقيم المبيعات في المملكة العربية السعودية خلال الفترة من 2016 إلى 2023. وقد تم الاعتماد على عدد من المصادر لجمع بيانات الدراسة شملت البنك المركزي السعودي والهيئة العامة للإحصاء، وتم استخدام التحليل الإحصائي الوصفي والتحليل المقارن باستخدام تحليل التباين المتعدد (MANOVA) لتحليل قيم المبيعات وحجم المعاملات عبر مختلف مناطق المملكة. وأكدت إحصائيات F للنموذج المعدل أن النموذج الخطي العام (GLM) المقدر يُعتبر دقيقاً ومناسب إحصائياً، كما أشارت النتائج إلى وجود اختلافات في حجم المعاملات وقيم المبيعات بين مناطق المملكة، كما كشف تحليل التباين ANOVA باستخدام Partial Eta Squared (η^2) ومعامل التحديد (R^2) أن الاختلافات بين المناطق تفسر 86.9% من التباين في قيم المبيعات و 54.6% من التباين في حجم المعاملات. ولمقارنة قيم المبيعات وحجم المعاملات بين المناطق وتصنيفها إلى مجموعات، تم استخدام اختبار Scheffé's post-hoc وأظهرت نتائج الدراسة معدلات نمو سنوية كبيرة في كل من عدد المعاملات وقيم المبيعات عبر هذه القطاعات على مستوى المملكة. وبناء على ذلك فإن هذه التباينات بين مناطق المملكة في أداء نقاط البيع تكشف عن تأثرها بالعمليات والتفاعلات الاقتصادية التي تحدث على مستوى كل منطقة، من خلال عدد من العوامل والقوى التي تؤثر على الأنشطة الاقتصادية فيها.

الكلمات المفتاحية: التحليل المكاني، التحليل المقارن، نقطة البيع، تحليل التباين المتعدد، اختبارScheffé ، المملكة العربية السعودية.

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Introduction

Point-of-sale (POS) data, encompassing both physical and digital transactions, provides essential insights into consumer spending habits and economic activity. POS systems play an important role in the operations of all sectors, performing functions such as recording sales, managing inventory, generating invoices, and calculating profits. These systems considerably enhance service delivery and operational efficiency. The evolution of POS systems has been driven by the demand for improved data management and security, particularly in businesses that previously depended on manual or paper-based processes. The implementation of POS systems has contributed to increased efficiency in terms of time and energy from an operational standpoint, alongside enhanced safety and accuracy (Dewi et al., 2021; Widjaja et al., 2021).

Previous literature underlines the pivotal role of e-commerce and e-payment methods in driving online shopping and sales growth. Empirical evidence suggests that e-payment systems considerably contribute to the expansion of online sales (Alzoubi et al., 2022). Hood and colleagues examined changes in consumer behavior and preferences for e-commerce within the grocery retail sector in Great Britain, emphasizing the impact of the growing availability of new online shopping options (Hood et al., 2020).

Furthermore, research underlines the importance of e-payment adoption for fostering economic growth, business development, and productivity (Kurniawan et al., 2024). E-payment systems also positively affect consumer behavior (Ghaith & Ghaith, 2022). Factors such as system oversight, security, and infrastructure policies within a country can further encourage the adoption of e-payment systems (Machoka et al., 2015; Kafley & Chandrasekaran, 2021).

The Saudi Arabian economy has experienced substantial transformation in recent years, fueled by Vision 2030 and a strong commitment to economic diversification. Within this framework, the sales sector has emerged as a critical economic indicator, reflecting the growing reliance on electronic technology as an alternative to traditional methods. By leveraging a robust digital infrastructure, the sales sector has become a cornerstone in supporting the digital economy and advancing financial inclusion, aligning with the nation's strategic goals for sustainable growth and modernization.

The adoption of electronic payment systems through Points of Sale (POS) has grown considerably alongside Saudi Arabia's accelerating economic growth. Between 2016 and 2023, the total sales volume transacted through POS terminals surged from approximately 180 billion Saudi Riyals to over 600 billion Saudi Riyals (Figure 1) (Saudi Central Bank, 2024). For example, the food and beverage sector, including restaurants and cafes, has exhibited substantial growth, with sales volume via POS increasing sevenfold during this period, from around 9.5 billion Saudi Riyals to over 89 billion Saudi Riyals. Similarly, the broader food and beverage sector has nearly quintupled in sales volume, rising from approximately 21.5 billion Saudi Riyals to about 96 billion Saudi Riyals (Figure 2) (Saudi Central Bank, 2024). These trends reflect a notable shift in consumer preferences and increased reliance on these sectors, underscoring their growing importance within the Saudi economy.

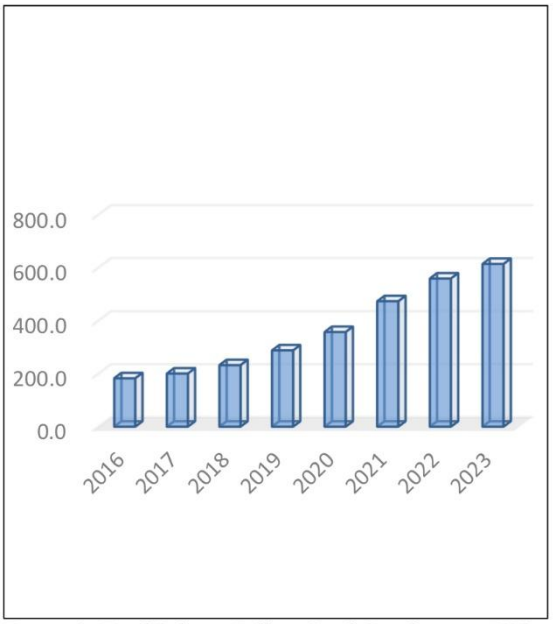

Figure 1: Total Sales in Billion Saudi Riyals using POS

Source: Saudi Central Bank (2024)

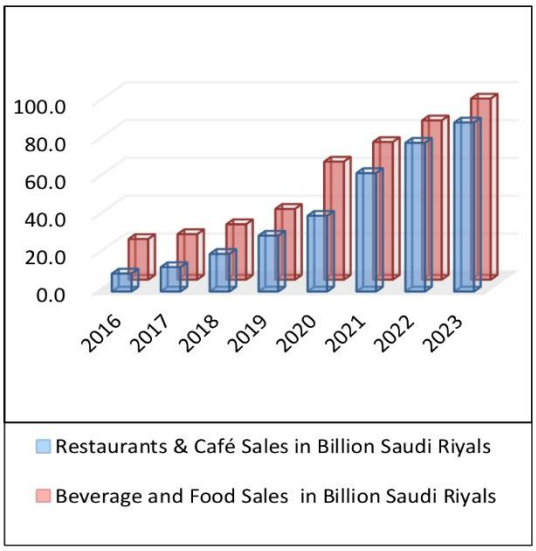

Figure 2: Sales in Billion Saudi Riyals using POS in Restaurants & Café and Beverage and Food
Source: Saudi Central Bank (2024)

This rapid adoption of electronic payment systems, particularly through Points of Sale (POS) in Saudi Arabia, is supported by numerous studies that explore various aspects of this shift. Traditional payment systems have declined in prominence, contributing negligibly to the overall payment infrastructure, while modern systems such as Debit Cards, E-payment platforms, and POS terminals have emerged as dominant players. However, challenges such as security concerns and traceability issues persist, highlighting areas for improvement to enhance user trust and satisfaction (Ali and Salameh, 2023; Alsuhaibany, 2024).

From an entrepreneurial perspective, Khan (2023) confirms that digital payments, including POS systems, significantly enhance financial efficiency and market access in Saudi Arabia. Nevertheless, these systems are hindered by inadequate technological infrastructure and ongoing security concerns, particularly affecting small and medium-sized enterprises (SMEs). This underscores the necessity for policy measures to address these structural gaps and ensure equitable access to advanced payment technologies.

The global trend toward contactless payments, accelerated by the COVID-19 pandemic, is reflected in Saudi Arabia's point-of-sale (POS) landscape. During the pandemic, health safety and hygiene became primary motivators for adopting contactless POS payments (Shishah and Alhelaly, 2021). Collectively, these studies illustrate the transformative role of POS systems in Saudi Arabia, showcasing both substantial advancements and pressing challenges. To ensure inclusivity and sustainability in the country's evolving digital economy, comprehensive strategies for optimization are essential.

Limited research has focused on the geographic variations in market dynamics, such as understanding the geodemographics of e-commerce. One study examined the demographic and geodemographic profiles of online grocery shoppers in the UK, identifying factors like age, social class, and residential location as key attributes (Kirby-Hawkins et al., 2019). Through a comprehensive spatial analysis of e-commerce sales for a major UK grocery retailer, the study revealed spatial patterns affected by urban density and geodemographics, finding that online grocery shopping is more prevalent in rural areas and regions with limited access to physical stores. Another study examined consumer preferences for local food and their willingness to pay premiums based on the marketing channel (Printezis & Grebitus, 2018). Findings revealed that while consumers generally value local food and are willing to pay a premium for it, this premium diminishes or disappears when local food is sold at farmers' markets. Additionally, consumers tend to discount local food purchased directly from urban farms. These results emphasize the critical role of the sales channel in shaping consumer perceptions of value for local food products, highlighting the need to consider the sales context when evaluating consumer willingness to pay.

The rapid adoption of electronic payment systems through Points of Sale (POS) in Saudi Arabia has transformed the country's economic landscape. While previous studies have highlighted the general trends and benefits of digital payments, a notable gap remains in understanding the regional disparities in POS activity across different regions of Saudi Arabia. This disparity is crucial for policymakers, businesses, and researchers as it provides insights into how digital payment systems are influencing consumer behavior, market dynamics, and economic growth. This study seeks to fill this gap by providing a

comprehensive spatial analysis of POS activity across different regions of the country.

Therefore, this study aims to examine the performance of POS activity in Saudi Arabia from 2016 to 2023. By analyzing an extensive dataset of POS transactions from the Saudi Central Bank and the General Authority for Statistics, the research aims to uncover regional disparities in POS activity across the country.

Research Methodology and Data Sources

The research analyzes and interprets the data using descriptive statistical methods, including mean calculations, relative significance, general trend equations, and variability analysis. Additionally, the study employs multivariate analysis of variance (MANOVA) to compare the number and value of sales across sectors by region in Saudi Arabia (Warne, 2014). MANOVA is used to analyze the variations in multiple dependent variables—number of transactions and value of sales—caused by a single independent variable, the regions of Saudi Arabia. For MANOVA to be valid, several assumptions must be met, such as the assumption of the natural distribution of both the independent and dependent variables. The analysis is sensitive to the violation of this requirement. Therefore, the natural distribution of the data is tested using the Kolmogorov-Smirnov test and the Shapiro-Wilk test (Mishra et al., 2019). In addition, the Mahalanobis test is recommended for identifying multivariate outliers by comparing its values against the Chi-squared (X^2) distribution table, with degrees of freedom equal to the number of associated variables (Etherington, 2021). To detect extreme values impacting the natural distribution, an alpha level of 0.001 is suggested. The consistency of variances across groups will be assessed using Levene's test for equality of variances (Mishra et al., 2019). Additionally, the homogeneity of the variance-covariance matrices of multiple variables is tested using Box's M test, which should yield an insignificant result to satisfy the assumption of homogeneity.

Finally, comparative analysis is conducted using the Scheffe test, which categorizes the regions into groups based on statistically significant differences in average sales values and transaction numbers (Scheffe, 1999). This study utilizes quarterly time series data from Q1 2016 to Q2 2023, published by the Saudi Central Bank and the General Authority for Statistics. The data includes a key variable that is represented by the value of sales. These values are derived from debit card transaction records provided by the Saudi Central Bank, enabling a detailed analysis of sales trends within these sectors over the study period.

Discussion of the Results

First: The General Time Trend of the Transactions and the Sales for POS

An analysis of the current status of transactions and sales values for POS sectors during the period Q1 2016 to Q4 2023 shows a statistically significant annual growth trend. Table 1 shows the general time trend equation for all sectors, indicating an annual growth rate of 11% in the number of transactions and 4.7% in sales value. These findings highlight consistent growth in POS activities across sectors during the study period. Furthermore, the general time trend equation indicates a statistically significant annual growth in the number of transactions and sales value for the restaurant and café sector, with growth rates of 12.9% and 8.45%, respectively. The equation also reveals an increase in the relative importance of this sector within total transactions and sales value, with annual growth rates of 1.9% and 3.71%, respectively. These findings underscore the expanding role of the restaurant and café sector in the overall POS market. For the food and beverages sector, the general time trend equation shows a statistically significant annual growth rate of 1.09% in the number of transactions and 5.9% in sales value. Additionally, the equation shows a slight annual decrease in the relative importance of this sector within the total number of transactions, with a statistically insignificant decrease of 0.003%. However, the relative importance of the sector's sales value exhibited a statistically significant annual growth rate of 1.16%. These results highlight steady growth in sales value despite a minor decline in transaction share. During the study period, the general time trend equation shows a statistically significant annual growth rate of 6.98% in the number of POS devices. Additionally, the equation indicates a

statistically significant annual growth rate of 3.1% in total credit card loans. These findings reflect the steady expansion of POS infrastructure and credit card usage, contributing to the broader adoption of electronic payment systems. The results of the general time trend equations collectively highlight an overall increase in the total number of transactions and sales values across all sectors and selected sectors, alongside the growth in the number of POS devices and total credit card loans. These findings clearly show the expanding adoption of POS systems for transactions in Saudi Arabia between 2016 and 2023, reflecting the country's transition toward a more digitalized economy.

Table (1): Time trend equations for POS across sectors and some related variables (Q1 2016 - Q4 2023)

Variables		Annual growth rate %	F	R^2	Equations
All Sectors	Number of transactions	11.0	1751.2**	0.98	Lny1=4.50+ 0.11 T
	Sales value	4.7	975.4**	0.97	Lny2=3.63+0.047 T
Restaurant and Café Sector	Number of transactions	12.9	1275.5**	0.98	Y3=2.77+ 0.129T
	Sales value	8.45	881.2**	0.97	Y4=0.69 +0.845 T
	% of total transactions	1.90	43.41**	0.59	Lny5=2.876+ 0.019T
	% of total sales value	3.71	226.0**	0.88	Lny6=1.667+ 0.0371T
Beverage and Food Sector	Number of transactions	1.09	1420.6**	0.98	Lny7=3.097+ 0.109 T
	Sales value	5.9	665.9**	0.95	Lny8=1.469+0.059 T
	% of total transactions	0.003	0.04ns	0.01	Y9=3.203 – 0.0003T
	% of total sales value	1.16	34.8**	0.54	Lny10= 2.447+ 0.0116T
Number of POS devices		6.98	660.8**	0.96	Y11=5.193 + 0.0698T
Total credit card loans		3.1	358.5**	0.92	Y12= 2.309+0.031T

Source: Calculated from data of POS transactions from the Saudi Central Bank

Second: Multivariate Analysis of POS Across Saudi Regions:

This study aims to analyze the impact of regional factors on the number and value of sales across various sectors, providing insights into regional variations in sales performance. Unlike traditional methods that assess sales metrics—namely, the number of transactions and sales value—independently, this research employs MANOVA to evaluate the impact of regions on both metrics simultaneously. This approach offers a more comprehensive and nuanced understanding of regional sales dynamics. By applying MANOVA, the study will determine whether statistically significant differences exist in the mean values of the dependent variables (number of transactions and sales value) across different regions.

Normality and Homogeneity of Variance of the Independent and Dependent Variables:

The results of the normality test show that the significance levels of the Kolmogorov-Smirnov and Shapiro-Wilk tests are greater than 0.05 (Table 2). This supports the acceptance of the null hypothesis, confirming that the data follow a normal distribution. However, the results of the homogeneity of variance test, shown in Table 3, reveal that the significance level of the Levene Statistic test is lower than 0.05. This leads to the acceptance of the alternative hypothesis, indicating that the variances are not homogeneous. This issue must be addressed to ensure the validity of the analysis of variance. To address the issue of non-homogeneous variances, methods such as applying the natural logarithm or square root transformations to the data were employed. The results, presented in Table 4, show that the significance level of the Levene Statistic test is now greater than 0.05, leading to the acceptance of the null hypothesis and confirming that the variances are

homogeneous. To further ensure the reliability of the multivariate analysis, the Mahalanobis test was used to check for outliers that could affect the normal distribution. The maximum Mahalanobis value was found to be 6.491. According to the chi-square distribution table, the critical value at a significance level of 0.001 is 13.816, which is higher than the observed maximum Mahalanobis value. This indicates that the multivariate variables are free from outliers, ensuring the robustness of the analysis.

Table (2): Normality Test for the Data of the Number of Transactions and Sales Value Between Regions of Saudi Arabia During 2016-2023

Variables	Region	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Sales value	Riyadh	.169	8	.200*	.915	8	.394
	Jeddah	.175	8	.200*	.873	8	.160
	Dammam	.168	8	.200*	.897	8	.272
	Madinah	.176	8	.200*	.905	8	.320
	Makkah	.275	8	.076	.855	8	.107
	Burayda	.173	8	.200*	.904	8	.312
	Tabuk	.175	8	.200*	.909	8	.347
	Hail	.182	8	.200*	.903	8	.306
	Abha	.183	8	.200*	.894	8	.254
	Jazan	.170	8	.200*	.927	8	.492
	Najran	.186	8	.200*	.912	8	.366
	Sakaka	.182	8	.200*	.889	8	.228
	Arar	.191	8	.200*	.879	8	.186
	Al Bahah	.205	8	.200*	.897	8	.269
Number of transactions	Riyadh	.206	8	.200*	.877	8	.174
	Jeddah	.225	8	.200*	.845	8	.085
	Dammam	.208	8	.200*	.874	8	.163
	Madinah	.228	8	.200*	.858	8	.114
	Makkah	.240	8	.195	.839	8	.074
	Burayda	.210	8	.200*	.886	8	.217
	Tabuk	.224	8	.200*	.861	8	.123
	Hail	.227	8	.200*	.861	8	.124
	Abha	.226	8	.200*	.858	8	.114
	Jazan	.233	8	.200*	.844	8	.082
	Najran	.224	8	.200*	.851	8	.098
	Sakaka	.230	8	.200*	.859	8	.118
	Arar	.243	8	.182	.837	8	.071
	Al Bahah	.245	8	.171	.834	8	.065
**** This is a lower bound of the true significance.***							
a. Lilliefors Significance Correction							

Table (3): Test of homogeneity of variances for the data on the number of transactions and sales value between regions of Saudi Arabia during 2016-2023

		Levene Statistic	df1	df2	Sig.
Sales value	Based on the Mean	19.682	13	98	.000
	Based on the Median	11.447	13	98	.000
	Based on Median and with adjusted df	11.447	13	10.586	.000
	Based on the trimmed mean	18.116	13	98	.000
Number of transactions	Based on the Mean	18.090	13	98	.000
	Based on the Median	7.460	13	98	.000
	Based on Median and with adjusted df	7.460	13	11.074	.001
	Based on the trimmed mean	15.891	13	98	.000

Table (4): Results of the test of homogeneity of variances for study data after solving the problem of non-homogeneity of variances.

		Levene Statistic	df1	df2	Sig.
Sales value	Based on the Mean	1.340	13	98	.203
	Based on Median	1.234	13	98	.267
	Based on Median and with adjusted df	1.234	13	85.029	.270
	Based on the trimmed mean	1.336	13	98	.206
Number of transactions	Based on the Mean	.542	13	98	.893
	Based on the Median	.536	13	98	.897
	Based on Median and with adjusted df	.536	13	94.311	.897
	Based on the trimmed mean	.542	13	98	.893

Table (5): Results of the test of absence of outliers in the study variables.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1.3063-	12.8139	7.5000	3.81549	112
Std. Predicted Value	-2.308-	1.393	.000	1.000	112
Standard Error of Predicted Value	.129	.355	.217	.056	112
Adjusted Predicted Value	-1.4730-	12.8088	7.4858	3.82694	112
Residual	-2.37965-	2.93529	.00000	1.35590	112
Std. Residual	-1.739-	2.145	.000	.991	112
Stud. Residual	-1.756-	2.200	.005	1.007	112
Deleted Residual	-2.42459-	3.08782	.01420	1.39955	112
Stud. Deleted Residual	-1.773-	2.240	.005	1.011	112
Mahal. Distance	.002	6.491	1.982	1.576	112
Cook's Distance	.000	.084	.011	.016	112
Centered Leverage Value	.000	.058	.018	.014	112

a. Dependent Variable: Region

After confirming the assumptions for the MANOVA test, the analysis measured the degree of difference and variance in the number of transactions and sales values across different regions of Saudi Arabia. MANOVA was employed to assess the impact of regions (independent variable) on these two dependent variables. The results, presented in Table 6, include four tests to evaluate the overall significance of the model. As the statistical significance level for all tests is below 0.05, it indicates a significant effect of the independent variable (regions) on the variance in one or more of the dependent variables (number of transactions and sales values).

The results of the general linear model (GLM) analysis indicate that the F-statistic for the corrected model is approximately 49.82, which is statistically significant. This confirms that the linear model is statistically sound and appropriate for the analysis (Table 7). Additionally, the statistical significance of the regions is below the 0.05 threshold, demonstrating significant differences and variances in the number of transactions and sales values attributable to regional differences. The analysis further reveals that regions account for 86.9% of the variance in sales values and 54.6% of the variance in the number of transactions, as shown by the values of partial eta squared and the coefficient of determination (R^2). These differences may stem from variations in the number of POS devices, differences in e-commerce adoption and buying culture, or differences in social and consumer habits across regions.

Table (6): Overall Significance Tests for Analysis of Variance.

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.964	1301.303a	2.000	97.000	.000
	Wilks' Lambda	.036	1301.303a	2.000	97.000	.000
	Hotelling's Trace	26.831	1301.303a	2.000	97.000	.000
	Roy's Largest Root	26.831	1301.303a	2.000	97.000	.000
Region	Pillai's Trace	.999	7.517	26.000	196.000	.000
	Wilks' Lambda	.012	60.918a	26.000	194.000	.000
	Hotelling's Trace	82.103	303.149	26.000	192.000	.000
	Roy's Largest Root	82.092	618.848b	13.000	98.000	.000

a. Exact statistic
b. The statistic is an upper bound on F that yields a lower bound on the significance level.
c. Design: Intercept + Region

Table (7): Results of the General Linear Model (GLM) for comparing the number of transactions and the value of sales of points of sale in the regions of Saudi Arabia during the period (2016-2023)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Sales value	166.923a	13	12.840	49.821	.000	.869
	Number of transactions	161.825b	13	12.448	9.052	.000	.546
Intercept	Sales value	433.890	1	433.890	1683.514	.000	.945
	Number of transactions	1687.752	1	1687.752	1227.286	.000	.926
Region	Sales value	166.923	13	12.840	49.821	.000	.869
	Number of transactions	161.825	13	12.448	9.052	.000	.546
Error	Sales value	25.257	98	.258			
	Number of transactions	134.769	98	1.375			
Total	Sales value	626.070	112				
	Number of transactions	1984.345	112				
Corrected Total	Sales value	192.181	111				
	Number of transactions	296.594	111				

a. R Squared = .869 (Adjusted R Squared = .851)
b. R Squared = .546 (Adjusted R Squared = .485)

Third: Post-hoc Analysis of Regional Variations in Sales and Transaction Numbers:

The findings of the MANOVA analysis highlight regions with significantly different sales performance across sectors. To identify specific regional disparities, a post-hoc analysis using the Scheffe test was conducted. This analysis investigates variations in sales value and transaction numbers across regions in Saudi Arabia. The results, presented in Table 8, reveal significant heterogeneity in sales performance among the regions, underscoring notable differences in market dynamics. For sales value, three distinct groups were identified based on sales value:

Group 1: This group comprises the majority of regions, including Al-Bahah, Arar, Sakaka, Najran, Jazan, Abha, Hail, Tabuk, Buraydah, Makkah, Madinah, and Dammam. Within this group, no statistically significant differences in sales values were observed among its members, indicating relative homogeneity in sales performance across these regions.

Group 2: This group is represented solely by Jeddah, which exhibited significantly higher sales values compared to the regions in Group 1. The average sales value in Jeddah was approximately 58.56 billion Saudi Riyals, highlighting its standout performance in sales among the analyzed regions.

Group 3: This group consists exclusively of Riyadh, which demonstrated the highest sales values, significantly surpassing those of regions in both Group 1 and Group 2. The average sales value in Riyadh was approximately 117.74 billion Saudi Riyals, solidifying its position as the leading region in sales performance.

For transaction numbers, two distinct groups were identified based on transaction numbers:

Group 1: Similar to its composition in terms of sales values, this group includes regions such as Al-Bahah, Arar, Sakaka, Najran, Jazan, Abha, Hail, Tabuk, Buraydah, Makkah, Madinah, and Dammam. In terms of sales values, this group encompasses regions such as Al-Bahah, Arar, Sakaka, Najran, Jazan, Abha, Hail, Tabuk, Buraydah, Makkah, Madinah, and Dammam. Within this group, no statistically significant differences in transaction numbers were identified among its constituent regions, indicating uniformity in transaction activity.

Group 2: This group consists of Jeddah and Riyadh, both of which demonstrated significantly higher transaction numbers compared to the regions in Group 1. However, no statistically significant differences in transaction numbers were found between Jeddah and Riyadh, indicating comparable transaction activity levels within this group.

The findings from the Scheffe test highlight significant regional variations in both sales values and transaction numbers across Saudi Arabia. These disparities likely reflect underlying economic and socio-demographic factors that affect regional market dynamics and consumer behavior.

Table (9) Results of Scheffe Test for Pairwise Comparisons of Sales Values and Transaction Numbers between Regions of Saudi Arabia

Region	N	Sales value			Number of transactions	
		Subset			Subset	
		1	2	3	1	2
Al-Bahah	8	1.50	-	-	16.38	-
Arar	8	1.67	-	-	21.38	-
Sakaka	8	2.23	-	-	23.00	-
Najran	8	3.61	-	-	42.88	-
Jazan	8	4.18	-	-	42.88	-
Abha	8	5.20	-	-	57.50	-
Hail	8	5.80	-	-	64.63	-
Tabuk	8	6.35	-	-	74.00	-
Burayda	8	9.21	-	-	91.50	-
Makkah	8	13.11	-	-	137.50	-
Madinah	8	13.48	-	-	148.63	-
Dammam	8	19.93	-	-	166.38	-

Region	N	Sales value			Number of transactions	
		Subset			Subset	
		1	2	3	1	2
Jeddah	8		58.56		470.38	470.4
Riyadh	8			117.74		1028
Sig.		.95	1.00	1.00	.63	.26

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square (Error) = 76540.509.

a. Uses Harmonic Mean Sample Size = 8.000.

b. The group sizes are unequal. Therefore, the harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Conclusion

Point-of-sale (POS) data provides valuable insights into consumer spending patterns and economic activity across various sectors. The growing adoption of POS systems has transformed business operations by streamlining tasks such as recording sales, managing inventory, and calculating profits. This study examines trends and regional variations in POS transactions and sales values within Saudi Arabia from 2016 to 2023, utilizing data from the Saudi Central Bank and the General Authority for Statistics. Previous research highlights the critical role of e-payment methods in driving growth within the retail sector. E-payment systems have been shown to significantly expand online sales, affect consumer behavior, and contribute to economic growth. However, limited studies have examined the impact of geographic location on e-payment systems, suggesting a need for further investigation, particularly in the context of Saudi Arabia. This study utilizes MANOVA to analyze POS data on transactions and sales values across various regions in Saudi Arabia. Descriptive statistical analysis is employed to assess general trends, followed by MANOVA to examine the regional impact on POS performance. The findings reveal significant annual growth rates in transaction numbers and sales values nationwide. Additionally, the research identifies regional variations in POS performance. By applying Scheffe's test, regions are grouped based on statistically significant differences in average sales values and transaction numbers. These results highlight substantial heterogeneity in market performance across Saudi Arabia's regions.

This research offers valuable insights into consumer behavior and economic activity. By identifying regional variations in point-of-sale (POS) performance, the study enhances our understanding of the economy and consumer spending patterns. The findings offer actionable information for policymakers, businesses, and researchers interested in the evolving dynamics of economic activities using POS data in Saudi Arabia. Further research is recommended to explore the underlying factors driving these regional variations, including economic development, population density, and consumer preferences.

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Analyzing the Impact of Interest Rate Changes on Saudi REIT Returns during Various Monetary Policy Cycles: A Panel Data Analysis

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Abstract: The recent proliferation of Saudi real estate investment trusts (REITs), catalyzed by serious economic reforms as part of Saudi Vision 2030, has garnered global interest in accessing the Saudi real estate market, which has emerged as a leading investment hub in the Middle East. This study focuses on gauging the sensitivity of REITs' returns to interest rate movements using the two-index model of equity and debt market returns. The dataset is based on monthly data of individual REITs, equity market index, and short- and long-term interest rates, spanning the period 2016M12 to 2024M10, which coincides with three monetary policy cycles. In our econometric analysis, we initially estimate the two-index model for each REIT and test whether all REITs exhibit an equivalent exposure to market and interest rate risks. The test results fail to reject the cross-sectional homogeneity among Saudi REITs, leading us to continue the analysis using pooled ordinary least squares (OLS). The results show, on the one hand, that short- and long-term interest rates exert a statistically significant negative impact on REITs' returns over the entire sample period. On the other hand, the results based on subsamples corresponding to the prevailing monetary policy regime unveil the time-dependent nature of the REIT-interest rate nexus. Interest rates seem to exert a stronger influence on REITs' returns during the falling interest rate cycle induced by the COVID-19 pandemic. This influence, however, is substantially weakened during the ongoing monetary tightening, rendering the long-term interest rate impact statistically insignificant.
Keywords: REIT; interest rate; monetary policy cycles; panel data; Saudi Arabia

تحليل تأثير تغيرات أسعار الفائدة على عوائد صناديق الاستثمار العقاري المتداولة في سوق الأسهم السعودية خلال دورات السياسة النقدية المختلفة باستخدام بيانات السلاسل الزمنية المقطعية

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المستخلص: لقد شهدت صناديق الاستثمار العقارية المتداولة (الريتس) في سوق الأسهم السعودي نموًا متسارعًا في الآونة الأخيرة، مدعومة بالإصلاحات الاقتصادية الجادة ضمن رؤية المملكة 2030، مما أدى إلى جذب اهتمام عالمي للاستثمار في سوق العقارات السعودي، الذي برز كمركز استثماري رائد في منطقة الشرق الأوسط. تركز هذه الدراسة على قياس حساسية عوائد صناديق الريتس لتحركات أسعار الفائدة باستخدام نموذج المؤشرين لعوائد سوق الأسهم والديون. تشمل عينة الدراسة بيانات شهرية لصناديق الريتس ومؤشر سوق الأسهم، بالإضافة إلى أسعار الفائدة قصيرة وطويلة الأجل، والتي تمتد للفترة من شهر ديسمبر 2016 إلى أكتوبر 2024. وتأتي هذه الفترة بالتزامن مع ثلاث دورات للسياسة النقدية. وتستخدم الدراسة أسلوباً قياسياً يقوم ابتداءً على تقدير نموذج المؤشرين لكل صندوق على حدة، ثم اختبار ما إذا كانت جميع الصناديق تظهر تعرضًا متكافئًا لمخاطر السوق وأسعار الفائدة. وقد أشارت نتائج الاختبار إلى عدم وجود أدلة كافية لرفض فرض التجانس المقطعي بين صناديق الريتس السعودية، مما دفعنا إلى مواصلة التحليل باستخدام طريقة المربعات الصغرى العادية المجمعة (OLS) لتحليل السلاسل الزمنية المقطعية، وبالرغم من أن النتائج القائمة على بيانات فترة العينة بأكملها تشير إلى أن أسعار الفائدة القصيرة والطويلة الأجل تؤثر سلبيًا وبشكل معنوي إحصائيًا على عوائد صناديق الريتس، إلا أن النتائج المستندة إلى العينات الفرعية الناجمة عن تقسيم العينة الرئيسة لفترات فرعية تعكس كل منها التوجه السائد للسياسة النقدية في حينه تميط اللثام عن ديناميكية العلاقة بين صناديق الريتس وأسعار الفائدة؛ حيث يبدو جلياً أن أسعار الفائدة تملك تأثيرًا أقوى على عوائد صناديق الريتس خلال دورة أسعار الفائدة المنخفضة الناجمة عن جائحة كورونا، بينما يضمحل هذا التأثير بشكل كبير خلال السياسة النقدية الانكماشية السائدة حالياً؛ حيث تلاشى تأثير سعر الفائدة طويل الأجل إلى الحد الذي أفقده دلالته الإحصائية.

الكلمات المفتاحية: صناديق الريتس؛ سعر الفائدة؛ دورات السياسة النقدية؛ بيانات السلاسل الزمنية المقطعية؛ المملكة العربية السعودية.

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1. Introduction

Securitized real estate vehicles, in the form of a real estate investment trust (REIT), which first emerged in the US in the 1960s, remain among the most remarkable financial innovations. Over the past three decades, REITs have witnessed tremendous growth globally in terms of both the number of listings and market values, displaying a remarkable performance that outpaced other asset classes.[1] This resounding success is achieved because REITs facilitate the flow of funds to real estate (Glascock et al., 2000) by alleviating some of the complexities associated with direct real estate investment, such as low liquidity, high transaction costs, large denomination, and lack of diversification that arise when investing in large-scale commercial real estate properties (Hoesli & Oikarinen, 2012; Wong & Reddy, 2018). Furthermore, these vehicles also enjoy a tax "pass-through" status that exempts them from paying corporate taxes. They attain this status by pooling funds and investing at least 75% of these funds in a variety of income-generating properties and adhering to the legally mandated dividend payout policy by distributing at least 90% of their taxable income as dividends annually. Indeed, REITs generally adopt a highly leveraged capital structure given the predominantly tangible nature of their assets, which are more likely to be financed by debt compared to intangible assets held more often by corporations in other industries.[2]

The business model of REITs and the regulations that govern their operations render them responsive to changes in economic fundamentals, particularly the interest rate as determined by monetary policy. The theoretical underpinning of the REITs-interest rate relationship, as elucidated by Giliberto and Shulman (2017), is rooted in the notion that the widely acknowledged direct inverse relationship between the changes in the yield of risk-free securities and the valuation of fixed-income securities may transcend, albeit to a lesser extent, to the valuation of equity REITs. This is because of the distinctive features of equity REITs that we discussed earlier, which differentiate them from typical equities, rendering them more sensitive to interest rate changes. According to this conjecture, an increase in the risk-free yield is expected to decrease the valuation of equity REITs and vice versa. However, Allen et al. (2000) maintain that the relationship between equity REITs' returns and interest rates relies more on the economic fundamentals that determine the direction and the pace of monetary policy decisions that ultimately produce a change in interest rates, rather than the direction of the interest rate change, *per se*. For example, an increase in interest rates may signal inflationary expectations that may translate to an increase in real estate prices and rents, offsetting Giliberto and Shulman's (2017) hypothesized inverse interest rate effect on real estate valuation. Case and Wachter (2011) endorse this argument both on theoretical and empirical grounds, illustrating that REITs act as strong hedges against inflation. Indeed, monetary policy contractionary cycles in the US had varying impacts on commercial real estate, the primary underlying of REITs, with the recent monetary tightening leading to the sharpest price drops in the past five decades.[3] Of course, the drop in demand for specific commercial properties (offices and retail) as a result of technological advancements catalyzing the spread of e-commerce and working from home has exacerbated the ongoing drastic decline in commercial real estate prices (International Monetary Fund. European Dept., 2024).

These differing perspectives vis-à-vis the direction and the strength of the relationship between the returns of REITs and interest rate changes, combined with the changes in the fundamentals of the commercial real estate market, have always fueled a renewed interest in reexamining this intricate relationship in different contexts (Akimov et al., 2020; Allen et al., 2000; Chen & Tzang, 1988; Giliberto & Shulman, 2017; Ito, 2016; Lin et al., 2022; Reddy & Wong, 2018; Rosa, 2024; Weis et al.,

[1] *See* https://www.reit.com/investing/global-real-estate-investment ***and*** https://www.spglobal.com/spdji/en/documents/research/the-impact-of-rising-interest-rates-on-reits.pdf.

[2] *See* https://www.reit.com/news/blog/market-commentary/looking-at-reit-leverage-versus-other-stock-market-sectors.

[3] *See* https://www.imf.org/en/Blogs/Articles/2024/01/17/us-commercial-real-estate-remains-a-risk-despite-investor-hopes-for-soft-landing.

2021; Wong & Reddy, 2018; Yong & Singh, 2015). However, the empirical evidence emerging from these studies remains inconclusive, varying across countries, econometric techniques, interest rate proxies, and sample periods. Furthermore, prior studies are predominantly based on REITs listed in advanced markets; nonetheless, studies addressing the REIT-interest rate nexus in emerging markets remain scarce. While REITs enjoy a long history in advanced economies, they remain in the early stage of development in most emerging markets. Emerging markets lag their advanced counterparts in terms of regulations, transparency, and the degree of institutional and international investment. That said, emerging markets REITs are making notable progress on these fronts, offering promising growth potential and valuable diversification benefits as these emerging economies continue their economic and population growth path (Marzuki & Newell, 2021, 2025; Newell, 2021). We believe that the structural differences between advanced and emerging markets can yield new insights into the REIT-interest rate nexus, warranting research endeavors that revisit this long-standing relationship in a new context. Indeed, the limited empirical evidence generated within an emerging market context on the REITs' relationship with interest rates is based on research conducted within an East Asian context (Ito, 2016; Sukor et al., 2020). However, this relationship remains widely untapped in West Asian economies. Indeed, the GCC region, particularly Saudi Arabia, enjoyed unprecedented economic growth over the past few decades, witnessing serious economic reforms as part of Saudi Vision 2030. Besides, the tight monetary policy stance that followed the ultra-loose monetary policy during the COVID-19 pandemic renders revisiting the REIT-interest rate nexus even more timely. To this end, we elected to address this research gap by exploring the REIT-interest rate nexus in Saudi Arabia, the largest REIT market in the Middle East (Marzuki & Newell, 2025), during different monetary policy cycles. This boils down to two research questions regarding the REIT-interest rate relationship:

RQ1: Are the returns of Saudi REITs sensitive to interest rate changes?

RQ2: Does the sensitivity of Saudi REITs' returns to interest rate changes vary during different monetary policy cycles?

Indeed, few studies examined other aspects of the workings of Saudi REITs, inter alia, REITs' efficiency (Alsharif, 2021); the determinants of REITs' IPO underpricing (Albarrak et al., 2023); and the risk-adjusted performance and diversification benefits (Marzuki & Newell, 2025). Nonetheless, the research questions we put forward remain unanswered for the time being.

The Saudi market is conducive to furthering our understanding of the REIT-interest rate nexus for several reasons. First, the real estate sector occupies a central role in the Saudi economy, acting as a key pillar in the country's economic diversification plan, Vision 2030. The sector is witnessing a major transformation fueled by the construction of mega projects, the hosting of significant international events, and the expanding tourism, entertainment, and accommodation and food services sectors.[4]

Second, the growth in the real estate sector transcended into the securitized real estate vehicles that proliferated in terms of the number of listings and assets under management. The Capital Market Authority (CMA) approved the first Saudi REIT listing in 2016 to stimulate private investment in the real estate sector as part of the national transformation program. Since then, REITs have grown enormously both in terms of the number of listings and asset value, from only one REIT with an asset value of SAR

[4] *This unprecedented growth in the real estate sector is facilitated by government reforms in real estate regulations, creating a conducive investment climate for domestic and international investors (Hadchity, 2024). Based on Data Saudi (2025), in 2023, the contribution of real estate activities to the Gross Domestic Product (GDP), measured in real terms, stands at SAR 229.2 billion, compared to SAR 131.5 billion in 2010—constituting a share of 6.6% of total GDP. The sector exhibited a strong growth in foreign direct investment (FDI) stock since 2015, reaching a peak of SAR 56.19 billion before experiencing a dramatic decline in the wake of the COVID-19 pandemic, ending at a trough of SAR 18.7 billion in 2021. Since then, the FDI in the sector has resumed steady growth, reaching SAR 21.7 billion by the end of 2023.*

555 million in 2016 (CMA, 2016, p. 72) to 19 REITs with a combined asset value of SAR 27.72 billion by the end of 2023—constituting more than 22% of the investment fund industry, succeeding money and stock markets' funds with a narrow margin (CMA, 2023, p. 112). This highlights the increased importance of REITs in the Saudi investment landscape, attracting more retail and institutional investors. Third, the international prominence of Saudi REITs attained in 2019 upon their inclusion in the FTSE EPRA/Nareit Global Real Estate Index (Argaam, 2019), attracting significant allocations from international money managers, including BlackRock, Vanguard, and Mitsubishi UFJ (Marzuki & Newell, 2025, p. 101), aiming to gain exposure to the largest real estate market in the Middle East. This can potentially increase the linkages with international markets.

Fourth, the Saudi market is exclusively dominated by equity REITs whose interest rate linkages are less understood than their mortgage-based counterparts that share more similarities with fixed-income securities. Fifth, the long-lived riyal-dollar peg limits the monetary policy autonomy of the Saudi central bank (SAMA), leading to a close alignment with the Federal Reserve's (the Fed's) decisions regarding interest rates. Such a setting offers a rare opportunity to examine the impact of monetary policy changes on REITs' returns when monetary policy is not determined domestically. Sixth, the sample period coincides with the COVID-19-induced aggressive expansionary monetary policy employed by the Fed, slashing the fed funds rates to a range between 0% and 0.25% (Milstein & Wessel, 2022), which comes between two monetary tightening cycles (Blinder, 2023). These circumstances offer a rare opportunity to reexamine the dynamics of the REIT-interest rate nexus across different monetary cycles. Seventh, the level of financial leverage widely varies among Saudi REITs, ranging from zero to about 50%, a maximum mandated by the CMA bylaws, which can shed light on the potential cross-sectional differences in the sensitivities of REITs to interest rate movements. Finally, despite the strong growth in the number of Saudi REITs and their asset value, their stock market performance has been less impressive. Albarrak et al. (2023) show that 8 of the 17 Saudi REITs they examine closed below their IPO price on the first trading day, which warrants an attempt to model their return-generating process.

The primary contribution of this study lies in providing new empirical evidence on the relationship between REITs' returns and interest rate movements in the Saudi market, thereby offering fresh insights into the REIT-interest rate nexus in a unique context. Moreover, we consider both short- and long-term interest rates, for they may be perceived differently by investors. On the one hand, the short-term interest rates directly reflect the changes in monetary policy that affect the cost of short-term funding in the money market. On the other hand, the long-term interest rate reflects the implied expectations of interest rates and anticipated inflation in the future (Allen et al., 2000). Furthermore, we estimate the Stone (1974) two-index model using a refined econometric analysis approach that explicitly incorporates the potential cross-sectional heterogeneity across Saudi REITs and the time-varying nature of their return-interest rates nexus. The cross-sectional heterogeneity is modeled utilizing the no-common-effect model (see Hurn et al., 2021, p. 321), through which we explicitly model and test the heterogeneity of the REITs' exposures to interest rate and market risks and other unobservable features as we consider individual REITs rather than the aggregated sectoral index. To inspect the time-varying REITs' return-interest rates nexus, we divide the sample period into three phases based on the Fed's prevailing monetary policy cycle as defined by Blinder (2023). This will enable us to ascertain to what extent the REIT return-generating process changes during differing monetary policy cycles.

The remainder of this study is organized as follows: the second section presents a detailed review of related studies, the third section introduces the research design, the fourth section defines the dataset and summarizes its main features, the fifth section reports and discusses results considering prior studies the sixth section concludes the study by summarizing the main findings, highlighting their policy implications and suggests plausible further research extensions.

2. Literature review

This section reviews prior studies examining the sensitivity of returns to interest rate changes. To this end, we divided this section according to the chronological progression of the literature in this realm into two main sections: the first section examines the return-interest rate relationship predominantly in financial institutions, while the second section examines the return-interest rate relationship predominantly in financial institutions. In contrast, the second provides a detailed review of this relationship exclusively in the context of REITs. The second section is divided into three subsections based on the equity markets in which the examined REITs are listed (the US, advanced, and emerging markets).

2.1. The relationship between interest rates and returns of financial institutions

The debate on the relationship between the changes in interest rates and equity returns is not new, dating back to the 1970s. This literature can be traced back to the work of Stone (1974), who extended the renowned market-index model of the return-generating process to capture the impact of movements in the interest rate. Controversies arose regarding the strength and the direction of this relationship and whether it's of particular importance only in specific industries like financial institutions and utilities due to their special asset-liability structure and dividend policy (Chance & Lane, 1980). By and large, subsequent studies predominantly find evidence for the presence of an inverse relationship between the stock returns of financial institutions and changes in interest rates (Bae, 1990; Dinenis & Staikouras, 1998; Elyasiani & Mansur, 1998; Flannery & James, 1984; Yourougou, 1990).

2.2. The relationship between interest rates and returns of REITs

The literature naturally progressed to discuss the sensitivity of REITs to interest rate movements in the late 1980s. The attention to REITs stems from their relatively heavy reliance on debt in their capital structure and their legally mandated dividend payout policy, which renders them acceptable substitutes to fixed-income securities that are, by definition, sensitive to interest rates.

2.2.1. Empirical evidence from the US market

Early studies in this strand of literature predominantly focus on the US market. These studies include Chen and Tzang (1988), who examine the effect of the changes in short- and long-term US treasury yields on equity and mortgage REITs based on monthly data from 1973 to 1985. Using a two-factor regression, they find, on the one hand, that both categories of REITs are exposed to market risk, recording higher betas during the 1970s that dropped substantially during the 1980s. On the other hand, they observe an inverse relationship between treasury yields' changes and the returns of both REIT categories, which is more persistent with long-term yields. Using a different proxy for interest rates, that is, investment-grade bond returns rather than yields, Giliberto (1990) applied the two-factor regression based on quarterly data from 1978 to 1989. In line with Chen and Tzang (1988), he found that equity REITs exhibit a similar market risk exposure. On the contrary, he reported a positive relationship between bond returns and the returns on equity REITs, perhaps because he used bond returns rather than the change in yield. Mueller and Pauley (1995) analyze the REITs-interest rate relationship over different rising and falling interest rate cycles. Using a simple regression based on monthly REITs' data and yields of long- and short-term US treasuries from 1972 to 1993, they find a weak negative relationship between REITs and interest rates that strengthens during falling interest rate regimes.

In a subsequent study, Allen et al. (2000) examine whether the REITs' operating features affect their sensitivity to interest rate movements. They construct equity and mortgage REITs' portfolios using monthly data from 1992 to 1996 and use the yields on short- and long-term US treasuries to proxy for interest rates. Based on a two-factor time series regression, they arrived at a surprising finding showing that equity REITs have no significant exposure to market risk, which is at odds with the results of prior studies. This outcome is possibly due to using residuals

from an auxiliary regression of market return against the interest rate proxies rather than the actual market returns. The results about interest rate risk are, however, in accordance with Chen and Tzang (1988), indicating that both equity and mortgage REITs exhibit significant negative responses to changes in short- and long-term interest rates, with slightly more sensitivity to long-term interest rates. Based on the cross-sectional regression results, Allen et al. (2000) show that REITs' operating features, notably leverage and management strategy, can alter their exposure to the market but not interest rate risk. In an attempt to reconcile the findings of prior studies, He et al. (2003) employ several interest rate proxies encompassing both the returns and the changes in yields on US treasuries and high-grade corporate bonds. They revisit the REIT-interest rate relation using equity and mortgage REIT indices from 1972 to 1998. On the one hand, they show that equity REITs exhibit a significant negative reaction to changes in the yield of government and corporate bonds while being insensitive to bonds' returns. On the other hand, mortgage REITs are found to be sensitive to all proxies of interest rate, showing a negative response to changes in yield and a positive response to returns. Furthermore, they show that the sensitivity of REITs' returns to interest rate movements varies over time. In a recent study, based on daily data from 1995 to 2016, Giliberto and Shulman (2017) confirm the time-varying relationship between REITs' returns and bond returns, showing that it can be positive, negative, and insignificant depending on the sample period.

2.2.2. Empirical evidence from other advanced markets

While early studies in literature focused exclusively on the US market, a growing number of studies have explored a wider range of advanced markets. Empirical evidence in the UK context is provided by Stevenson et al. (2007), who used a GARCH-M specification of the two-factor model based on daily data from 1993 to 2003 to examine the impact of interest rate changes on the returns and volatility of property companies.[5] The real estate proxy is the FTSE real estate index, while the FTSE All Share index represents the broad equity market. The interest rate proxies are the one-month LIBOR rate and the yield on both ten- and fifteen-year government bonds. An interesting finding that emerges from their analysis is that returns of property companies exhibit a significant positive relation with the short-term interest rate, diverging from the findings of most prior studies. However, they find a negative relation with long-term rates, aligning with most existing research. The exposure of these companies to market risk is positive and significant in line with other studies.

Studies that explore the Australian REIT sector include Yong and Singh (2015) and Wong and Reddy (2018). Using a sample of monthly data on 73 Australian equity REITs over the period 1980 to 2013, Yong and Singh (2015) examine whether the REITs' management structure and level of debt have any bearing on the sensitivity of REITs' returns to interest rate movements. The ASX100 index represents the broad equity market, while interest rates are proxied by the yields of 90-day bank-accepted bills and ten-year treasury bonds. Like most prior studies, the authors employ a two-factor regression, albeit on a panel data structure with fixed and random effects, and the quantile regression. To trace out the influence of the REITs' management structure and level of debt, the equity REITs are segmented into two groups based on management structure—externally or internally managed—and two other groups based on the level of debt: high or low-to-medium. Two other groups were constructed by combining these two criteria. The results about the exposure to market risk show that the highly leveraged and internally managed REITs have higher market risk (higher beta). Besides, not only do the results show that the sensitivity of REITs to interest rates varies between groups, but also across market conditions and interest rate maturities in line with some of the findings of other studies, including Chen and Tzang (1988) and Giliberto and Shulman (2017). The adverse impact of short-term interest rates on REITs' return is only

[5] *Property companies differ from REITs in several aspects including taxation and regulatory restriction on the leverage, dividend policy and asset structure (see, Stevenson et al., 2007, pp. 705-706).*

present during bearish market phases. However, the negative impact of long-interest rates is more evident, particularly during bullish market conditions, with highly leveraged and internally managed REITs showing higher exposures.

Wong and Reddy (2018) examine a more recent sample spanning the period 1995 to 2016 and comprising 30 Australian REITs. Based on the sampled REITs, the authors formed five portfolios, two of which are constructed based on the level of debt, while the remaining three portfolios are size-based, in addition to a portfolio that includes all 30 REITs. They use a multifactor OLS regression estimated for three subsamples: pre-, during, and post-GFC. The results obtained over the entire sample show that all portfolios except large REITs are positively related to short-interest rate changes. In contrast, they find a negative relation with long-interest rate changes for all portfolios, which is largely consistent with the findings of Stevenson et al. (2007). Furthermore, the starkest finding that emerges from subsample analysis is the jump in stock market beta during the GFC. In a similar vein, Ito (2016) provides fresh evidence regarding the relationship between the REIT interest rate in the Japanese context during the Abenomics era. His dataset consists of daily data on the TSE REIT and the TOPIX indices in addition to the Japanese government bond yields and swap rates with maturities of 5 and 10 years from 2010 to 2015. He employs a two-factor OLS regression using the logs of the series rather than the returns on two subsamples divided based on the launch of Abenomics. The results based on the entire sample show that all interest rates negatively impact REITs' prices. The subsample results show that the introduction of Abenomics had strengthened the impact of interest rates, and the swap rates became more influential. At the same time, the stock market beta declined, which is evidence of the activation of the wealth effect.

More recent studies tend to have a cross-country focus on advanced economies (Akimov et al., 2020; Lin et al., 2022; Weis et al., 2021). Akimov et al. (2020) examine the sensitivity of REITs to interest rate changes in seven European markets, namely, Belgium, France, Germany, the Netherlands, Sweden, Switzerland, and the UK. Using daily data on the respective REITs' indices and long- and short-interest rates in addition to the term spread in each market, they employ a GARCH-M specification of the two-factor model from 1990 to 2013. The market risk results are similar across markets, showing a positive and significant exposure as usual. Nonetheless, interest rate sensitivities differ across markets, interest rate maturities, and sample periods. The mean equation finds evidence for a negative relation with interest rates in all markets except for the Netherlands, where REITs display a rather weak positive response to interest rate changes, and in Switzerland, where no significant relation is documented. Using a broader sample, Weis et al. (2021) examine the sensitivity of REITs and real estate operating companies to interest rate movements. Their analysis is based on monthly data on 352 of the constituents of the FTSE EPRA/NAREIT Global Real Estate Index, operating in 12 countries from 2005 to 2014. Their dataset also comprises data on the four risk factors proposed by Carhart (1997), i.e., RM, SMB, HML, and WML, in addition to several interest rate proxies, including the one-year deposit rate, ten-year government bond yield, redemption yield of quality (investment-grade) corporate bonds, default spread, and the term spread. The authors employ an augmented version of the Carhart (1997) model, estimated using a panel data structure while including fixed effects. Their results show that short interest rates have a weak positive impact on real estate companies in general; however, value stocks are affected more negatively by short interest rates compared to growth stocks. On the flip side, they find that long interest rates have a strong negative impact on real estate companies, particularly growth stocks. To ascertain whether the nature of the assets underlying the REITs has any bearing on their interest rate exposure, Lin et al. (2022) calculated sector-specific value-weighted indices for office, retail, industrial, residential, specialty, and diversified REITs based on daily data from the Australian, Japanese, Singaporean, and US markets over the period 2006 to 2018. The interest rate proxies used include the yield on the 10-year Treasury bonds and three-month T-bills for the US, while 10-year government bonds and three-month interbank (or Bank Accepted Bill for Australia) rates are used for the remaining countries. The authors employ a GARCH-M

specification of the two-factor model and arrive at the following main findings: The interest rate sensitivity varies across interest rate maturities, countries, and REIT sectors, with some sector-specific REITs showing less vulnerability to changes in their domestic interest rates compared to their diversified counterparts. In fact, among the specialized REITs, retail and residential REITs exhibit the highest sensitivity to domestic interest rates. Moreover, the movements in the US interest rates are shown to significantly impact Singaporean residential and retail REITs and Australian residential REITs.

2.2.3. Empirical evidence from emerging markets

The sparse evidence concerning the relationship between real estate return and interest rates in the context of emerging markets includes studies performed by Al Dohaiman (2017) and Sukor et al. (2020) for the Saudi and Malaysian markets, respectively. Al Dohaiman (2017) examined the impact of macroeconomic variables on the return of real estate companies before the introduction of REITs in the Saudi market. The sample comprises monthly data on the S&P Saudi Arabian real estate index, the Tadawul All Share Index (TASI), broad money, CPI, crude oil, and interest rates as represented by the Saudi interbank offering rate (SAIBOR) over the period 2008 to 2012. Using quantile regression, the author finds that neither the interest rate nor the money supply appears to significantly impact real estate return, regardless of the considered quantile. On the other hand, the broad equity market and crude oil, to a lesser extent, seem to account for most of the variation in real estate returns. Sukor et al. (2020) use quarterly data from the Malaysian market over the period 2011 to 2017. Their sample consists of 13 REITs from which they construct four portfolios: based on market cap into small and large, and Sharia compliance into Islamic and conventional. The KLCI index represents the broad equity market, and CPI is a gauge of inflation, while interest rates are proxied by the three-month Treasury Bill and 10-year government bonds. Using a multifactor OLS regression, they obtain results showing no significant impact of short-interest rates on the returns of REITs. In contrast, a significant negative impact is found for long-term interest rates on the returns of all but Islamic REITs. Two of the four REITs' portfolios display a significant positive exposure to market risk, whereas inflation did not significantly impact REITs' returns.

On balance, it can be inferred that shortcomings remain in prior studies regarding the following issues: First, the impact of recent monetary policy developments on the sensitivity of REIT returns to interest rate changes remains largely unexplored. Second, studies in the context of West Asian emerging economies are sparse. Third, many prior studies ignored the possibility of cross-sectional heterogeneity and simply used a broad sectoral index. Therefore, the present study aims to address these gaps in the literature by examining the return-interest rate relationship in the leading REIT market in West Asia (i.e., Saudi Arabia). This is achieved empirically via an intricate analysis that enables us to explicitly test for the presence of cross-sectional heterogeneity instead of taking it for granted. Moreover, we segment the sample period according to the prevailing monetary policy regime to examine the impact of the recent monetary policy decisions on the REIT-interest rate nexus.

3. Research design

3.1. Econometric model

Following Allen et al. (2000), among others, we employ the two-index model of the return-generating process proposed by Stone (1974), which is given by

$$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta i_t + \varepsilon_{jt}, \quad \varepsilon_{jt} \sim (0, \sigma_j^2), \tag{1}$$

where R_{jt} represents the simple return, which is equivalent to the percentage change in the closing price of REIT j at the end of month t ($R_{jt} = \frac{REIT_{jt} - REIT_{jt-1}}{REIT_{jt-1}} \times 100$), R_{mt} is the simple return for the stock market index i.e. the Tadawul All Share Index (TASI) at the end of month t ($R_{mt} = \frac{TASI_t - TASI_{t-1}}{TASI_{t-1}} \times 100$), $\%\Delta i_t$ is the

percentage change in interest rate at the end of month t ($\%\Delta i_t = \frac{i_t - i_{t-1}}{i_{t-1}} \times 100$), α is the intercept parameter representing the component of the REITs' returns that are independent of the stock market performance and interest rate changes, while the slope parameters β_1 and β_2 measure the responsiveness of the REIT's returns to the movement in the stock and debt markets, respectively. Indeed, all the regression parameters defined above are assumed to be the same across all the sampled REITs. However, the error term ε_{jt} captures the REIT j idiosyncratic risk at the end of month t, thereby allowing for differing idiosyncratic risk for each individual REIT, σ_j^2.

3.2. Estimation techniques

3.2.1. The no-common-effect model vs. the common-effect model

Several studies in the extant literature use REIT sector-level indices or construct equally weighted portfolios of REITs in their analysis of the determinants of REITs' returns (for example, Akimov et al., 2020; Chen & Tzang, 1988; Giliberto & Shulman, 2017; Ito, 2016). Thereby, these studies implicitly assume that the constituents of sectorial indices and/or portfolios share the same risk characteristics. However, Allen et al. (2000) show that the level of leverage increases the exposure of REITs to market risk, while Yong and Singh (2015) find that the level of leverage affects the REITs' exposure to both market and interest rate risks. Therefore, rather than assuming full homogeneity, we start with the most unrestricted model, the no-common-effect model (see, Hurn et al., 2021, p. 321) in which the regression parameters are allowed to vary over cross sections (REITs) without imposing any restrictions as follows:

$$R_{jt} = \alpha_j + \beta_{j1} R_{mt} + \beta_{j2} \%\Delta i_t + \varepsilon_{jt}, \quad \varepsilon_{jt} \sim (0, \sigma_j^2), \tag{2}$$

To illustrate, the model is separately specified for all REITs $j = 1, 2, \dots, N$ as follows:

$$R_{1t} = \alpha_1 + \beta_{11} R_{mt} + \beta_{12} \%\Delta i_t + \varepsilon_{1t}, \quad \varepsilon_{1t} \sim (0, \sigma_1^2),$$

$$R_{2t} = \alpha_2 + \beta_{21} R_{mt} + \beta_{22} \%\Delta i_t + \varepsilon_{2t}, \quad \varepsilon_{2t} \sim (0, \sigma_2^2),$$

$$\vdots \qquad \vdots \qquad \vdots$$

$$R_{Nt} = \alpha_N + \beta_{N1} R_{mt} + \beta_{N2} \%\Delta i_t + \varepsilon_{Nt}, \quad \varepsilon_{Nt} \sim (0, \sigma_N^2),$$

We then test whether the regression parameters vary across REITs by imposing the following restrictions:

$$H_0: \alpha_1 = \alpha_2 = \cdots = \alpha_N, \beta_{11} = \beta_{21} = \cdots = \beta_{N1} \text{ and } \beta_{12} = \beta_{22} = \cdots = \beta_{N2}$$

H_1: at least one restriction fails.

These restrictions are tested using the F statistic that is defined as follows:

$$F = \frac{SSR_r - SSR_{ur}}{SSR_{ur}} \times \frac{N(T-k-1)}{q} \sim F(q, N(T-k-1)) \tag{3}$$

where SSR_r is the sum of squared residuals from the restricted model, SSR_{ur} is the sum of squared residuals from the unrestricted model obtained by summing the SSR of the separate regressions pertaining to each of the 17 REITs, N is the number of cross-sections (REITs), T is the number of time series observations, k represents the number of independent variables, and q is the total number of restrictions imposed by the common effect model which can be obtained by $(k+1)N - (k+1)$ whereby $(k+1)N$ represents the number of unknown parameters in the no common effect model and the number of unknown parameters in the common effect model, $(k+1)$.[6]

If we fail to reject these restrictions, then we can proceed to estimate a common-effect model (Hurn et al., 2021, pp. 322-325) as

[6] *In the case of unbalance sample, the length of the time series of REITs differs. Therefore, the equation (3) can be adjusted to be* $F = \frac{SSR_r - SSR_{ur}}{SSR_{ur}} \times \frac{(\sum_{j=1}^{N} T_j) - (k+1)N}{q} \sim F(q, (\sum_{j=1}^{N} T_j) - (k+1)N)$.

expressed in equation (1) using pooled OLS. In his seminal book, Hsiao (2014, p. 4) states that panel data provides a greater number of observations, offering a higher degree of freedom and mitigating collinearity among regressors, which ultimately improves the efficiency of econometric estimates and enables more accurate inference of the model's parameters.

4. Data definitions and descriptive statistics

The independent variable data comprises the monthly closing prices of the REITs listed in the main Saudi stock market. The Riyad REIT Fund was the first Saudi REIT to be listed, started trading on 13/11/2016, while Alistithmar REIT was the latest, beginning secondary market trading on 04/09/2024. The number of REITs listed in the Saudi main market enjoyed steady growth over the past 8 years, standing at 19 funds at the time of writing this paper. Following Allen et al. (2000), we limit our sample to REITs with adequate data of at least 60 months of historical prices starting from the inception month of the first REIT to the end of October 2024. As shown in Table 1, the inception dates of the REITs are different. Therefore, we end up with an unbalanced panel of 17 funds, with only two funds being excluded due to their short historical data span of less than 60 monthly observations. The total observations of the unbalanced panel is attained by summing the number of time series observations for each individual REIT across the 17 cross-sections (REITs) as $\sum_{j=1}^{N} T_j = 1383$. Indeed, we are aware of the disadvantages of extracting a balanced panel from an unbalanced dataset in terms of the loss of efficiency. Nonetheless, we elected to estimate a balanced panel and compare the results against those obtained from the unbalanced panel estimation to check for any traces of selection bias (see, Kennedy, 2008, p. 289). The longest possible balanced panel that can be extracted from our dataset consists of 67 monthly observations uniformly for each REIT, leading to a total number of observations of 1139, which is simply obtained by $N \times T = 17 \times 67 = 1139$.

For the sake of comparing the aggregated performance of the REIT sector with the stock market in general, we include the Tadawul REITs Index (TRTI) measures the performance of the REIT sector in Saudi Arabia. Of course, while we report the descriptive statistics for the REIT index, we do not include this index in our panel regression analysis to avoid collinearity.

The data on the independent variables is available over the entire sample period. The independent variables we use include the Tadawul All Share Index, TASI, as a proxy for the Saudi stock market performance in addition to two interest rate variables: the one-year Saudi interbank rate (SAIBOR) to proxy for short-term interest rates, while we use the 10-year US Treasury bond yield to proxy for long-term interest rates. The use of the 10-year US Treasury bond as the long-term interest rate proxy is dictated by the unavailability of a continuous series of a long-term Saudi interest rate proxy. Besides, SAMA employs a fixed exchange rate regime whereby the Saudi Riyal has been pegged to the US dollar since 1986 (Al-Jasser & Banafe, 1999; Bhatti & Al-Nassar, 2021, 2023). The adoption of the fixed exchange rate system limits the independence of monetary policy, which is reflected in the riyal interest rate movements that closely follow the changes in dollar interest rates with a risk premium, which is higher for long-term rates (Al-Jasser & Banafe, 1999, p. 210). In addition, SAMA is among the top holders of U.S. treasury securities (Arab News, 2024). These securities are also routinely held by Saudi financial institutions. Therefore, the US 10-year treasury bond yield is an acceptable surrogate to its Saudi counterpart as a proxy for long-term interest rates. All data series are obtained from the Eikon database. Table 1 summarizes the key features of the REITs we analyze in our study.

Table 1. Key features of Saudi REITs

RIC	REIT name	IPO Date	Net asset value	Debt-to-assets ratio (%)
4330.SE	Riyad REIT	13/11/2016	1,467.11	47.18
4331.SE	AlJazira REIT	15/02/2017	88.01	0.00
4332.SE	Jadwa REIT Al Haramain	30/04/2017	504.51	29.54
4333.SE	Taleem REIT	30/05/2017	549.81	34.63
4334.SE	Al Maather REIT	22/08/2017	513.66	26.71
4335.SE	Musharaka REIT	01/10/2017	784.76	48.61
4336.SE	Mulkia Gulf Real Estate REIT	05/11/2017	790.84	36.39
4337.SE	SICO Saudi REIT	18/01/2018	357.96	28.41
4338.SE	AlAhli REIT 1	08/01/2018	1,237.88	33.24
4339.SE	Derayah REIT	26/03/2018	884.48	40.17
4340.SE	Al Rajhi REIT	20/03/2018	2,213.74	28.58
4342.SE	Jadwa REIT Saudi	11/02/2018	1,830.56	9.81
4344.SE	SEDCO Capital REIT	01/05/2018	1,533.22	33.26
4345.SE	Alinma Retail REIT	16/04/2018	865.35	6.57
4346.SE	MEFIC REIT	16/04/2018	513.16	44.64
4347.SE	Bonyan REIT	15/04/2018	1,384.34	13.78
4348.SE	Alkhabeer REIT	20/03/2019	1,045.61	40.43

Source: The data is retrieved from the LSEG Eikon database.

Notes: The net asset value is expressed in millions of Saudi Riyals. The net asset value and debt-to-assets ratio are based on the financial statements for the year ended December 31, 2023.

We compute the descriptive statistics for all series under investigation to get a preliminary insight into the main features of the dataset. Because the economic fundamentals that generated the returns series may change across different sample periods, we calculate the same set of descriptive statistics for all series based on both an individual (unbalanced) and a common (balanced) sample to allow for a better comparison against the broad market returns. The descriptive statistics are reported in Table 2. Based on Table 2, we can see that 11 out of the 17 REITs that we examine show a negative mean monthly return, averaging at -0.37% based on the market-weighted REIT sectorial index, which falls below the broad stock market index mean returns over the entire sample period. When we consider the balanced sample, we observe an improvement in the average performance of REITs based on the REIT index, which amounted to -0.08%. Besides, the average performance of individual REITs has generally improved, as only 9 out of the 17 REITs exhibit negative mean returns based on the balanced sample. The statistics pertaining to median returns paint a similar story.

Regarding the measures of dispersion, the individual REITs seem to fluctuate widely. However, the REITs index shows a lower standard deviation than the broad stock market index across both samples. These findings align with those of Marzuki and Newell (2025), who find that the Saudi REITs index exhibits lower risk than its broad stock market counterpart. Strikingly, across the two samples, the REITs' returns are predominantly positively skewed with only a few exceptions, whereas the broad stock market return shows, as usual, a negative skewness. This outcome aligns with the findings of Stevenson et al. (2007, p. 709) for UK property companies, Yong and Singh (2015, p. 83) for most of the REIT groups they analyze, and the results pertaining to the Belgian REITs, as reported by Akimov et al. (2020, p. 141). The positive skewness implies that most returns are relatively low, albeit a few higher returns increase the mean, as evidenced by the wider range for REITs relative to the stock market index. Indeed, most REITs and stock market index return series show high kurtosis, consistent with the stylized facts of returns data and results reported elsewhere in the literature.

Turning to the debt market variables, we find that the averages of the SAIBOR rate and the bond yield are 3.14% and 2.56% (3.35% and 2.54%) for the unbalanced (balanced) sample, respectively, with the SAIBOR rate showing a higher standard deviation given the various monetary policy cycles during the sample period.

Table 2. Descriptive statistics for the unbalanced and balanced sample periods.

Series	Mean (%)		Median (%)		Max (%)		Min (%)		Std. Dev. (%)		Skewness		Kurtosis		Obs.	
	Unbal	Bal	Unbal	Bal	Unbal	Bal	Unbal	Bal	Unbal	Bal	Unbal	Bal	Unbal	Bal	Unbal	Bal
Riyad	-0.44	-0.10	-0.38	-0.25	15.00	15.00	-11.72	-11.60	5.52	5.55	0.27	0.26	3.43	3.31	95	67
AlJazira	0.32	0.78	-1.14	-0.83	45.49	45.49	-23.17	-23.17	9.96	10.51	1.29	1.32	7.05	7.09	92	67
Jadwa Al Haramain	-0.43	-0.11	-1.19	-1.16	31.96	31.96	-19.33	-19.33	7.18	7.59	1.46	1.40	9.13	8.87	90	67
Taleem	0.05	0.30	-0.40	-0.18	17.55	17.55	-16.06	-16.06	5.73	5.83	0.12	0.07	3.96	3.95	89	67
Al Maather	-0.15	0.50	-0.05	0.12	34.63	34.63	-19.28	-18.69	5.77	5.86	1.71	2.34	18.86	20.00	86	67
Musharaka	-0.67	-0.61	-0.34	-0.25	14.39	14.39	-16.71	-16.71	4.65	5.01	-0.13	-0.15	5.57	5.11	84	67
Mulkia Gulf Real Estate	-0.52	-0.49	-0.50	-0.55	16.30	16.30	-13.95	-13.95	4.22	4.61	0.34	0.32	8.13	7.11	83	67
SICO Saudi	-0.74	-0.62	-1.30	-1.37	43.09	43.09	-11.62	-11.62	7.27	7.81	3.01	2.89	18.23	16.42	81	67
AlAhli 1	-0.10	0.12	-0.12	0.20	21.04	21.04	-16.73	-16.73	6.10	6.62	0.50	0.39	5.24	4.51	81	67
Derayah	-0.32	-0.35	-0.62	-0.80	13.33	13.33	-9.53	-9.53	3.92	4.15	0.63	0.65	4.54	4.24	79	67
Al Rajhi	0.03	0.12	-0.23	-0.11	14.44	14.44	-11.46	-11.46	4.47	4.74	-0.05	-0.09	4.38	4.05	79	67
Jadwa Saudi	0.33	0.58	-0.35	-0.25	12.28	12.28	-14.48	-14.48	5.40	5.82	0.12	0.00	3.07	2.70	80	67
SEDCO Capital	0.18	0.24	-0.13	0.00	19.92	19.92	-13.93	-13.93	5.72	5.87	0.89	0.87	5.33	5.39	77	67
Alinma Retail	-0.61	-0.53	-1.02	-1.01	37.75	37.75	-20.69	-20.69	6.77	7.08	2.16	2.05	16.04	14.73	74	67
MEFIC	-0.66	-1.00	-1.37	-1.55	31.99	31.99	-20.63	-20.63	6.96	6.69	1.41	1.38	10.11	11.45	71	67
Bonyan	0.21	0.12	0.23	0.23	11.68	11.68	-13.97	-13.97	4.19	4.15	-0.42	-0.60	4.80	5.10	75	67
Alkhabeer	-0.67	-0.67	-0.13	-0.13	23.74	23.74	-14.23	-14.23	5.36	5.36	0.97	0.97	8.73	8.73	67	67
Market index	0.69	0.60	0.90	1.41	10.61	10.61	-14.72	-14.72	4.83	5.28	-0.46	-0.55	3.20	2.93	95	67
REIT index	-0.37	-0.08	-0.56	-0.10	15.84	15.84	-13.18	-11.55	4.61	4.26	0.31	0.43	5.15	5.79	95	67
SAIBOR	3.14	3.35	2.65	2.77	6.26	6.26	0.91	0.91	1.84	2.14	0.49	0.16	1.85	1.31	95	67
T-bonds	2.56	2.54	2.43	2.14	4.88	4.88	0.54	0.54	1.14	1.34	0.09	0.12	2.09	1.53	95	67

Notes: Unbal = the unbalanced sample period (2016M12 2024M10); Bal = the balanced sample period (2019M04 2024M10). The descriptive statistics for the individual REITs and the REIT and market indices are calculated based on their respective simple returns, while those pertaining to interest rate proxies, namely the SAIBOR rate and T-bond yield, are calculated based on the levels of these variables without any transformations.

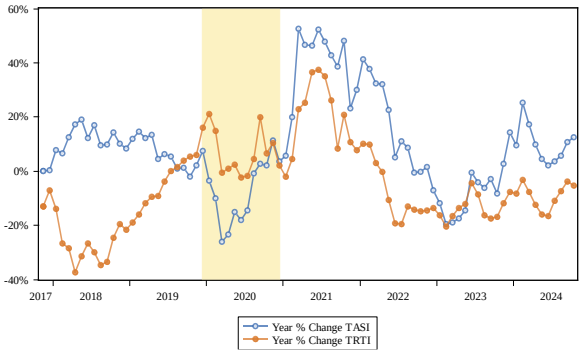

Figure 1. Time series plot of yearly percentage change (simple returns) of the Tadawul All Share Index (TASI) and the Tadawul REITs index.

To gain a visual perspective of the performance dynamics of the REIT sector relative to the broad stock market, we plot the yearly percentage changes of the Tadawul REITs index against those of its stock market counterpart in Figure 1. A look at Figure 1 reveals that the REITs index predominantly underperformed the broad market, except for the beige-shaded area that represents the midst of the COVID-19 pandemic, in which REITs showed a conspicuous resilience. The decoupling between REITs and the broad stock market can be tentatively justified on the grounds of the notion that REITs' long-run performance is more linked to the performance of the direct real estate market than the broad stock market (Giliberto, 1990; Hoesli & Oikarinen, 2012). This outcome is hardly surprising given the unique operating features of REITs that set them apart from the average industrial company.

Table 3. Unit root tests

Series	ADF		PP	
	Level	%Δ	Level	%Δ
Riyad	-1.55	-9.48***	-1.51	-9.49***
AlJazira	-1.94	-10.16***	-1.93	-10.14***
Jadwa Al Haramain	-2.23	-10.78***	-2.13	-10.74***
Taleem	-2.28	-10.19***	-2.23	-10.19***
Al Maather	-4.74***	-9.56***	-4.75***	-9.58***
Musharaka	-0.33	-8.53***	-0.32	-8.53***
Mulkia Gulf Real Estate	-0.53	-9.06***	-0.50	-9.06***
SICO Saudi	-1.24	-8.87***	-1.24	-8.87***
AlAhli 1	-1.55	-8.82***	-1.52	-8.85***
Derayah	-0.03	-6.87***	-0.35	-6.86***
Al Rajhi	-1.63	-8.34***	-1.63	-8.33***
Jadwa Saudi	-1.54	-7.46***	-1.54	-7.60***
SEDCO Capital	-1.63	-8.68***	-1.76	-8.68***
Alinma Retail	-1.57	-9.56***	-1.50	-9.52***
MEFIC	-1.21	-9.94***	-1.02	-9.88***
Bonyan	-3.34**	-10.68***	-3.27**	-11.50***
Alkhabeer	-0.76	-9.57***	-1.05	-10.62***
Market index	-1.15	-10.26***	-1.12	-10.27***
REIT index	-1.58	-8.88***	-1.58	-8.85***
SAIBOR	-0.87	-5.31***	-0.76	-5.24***
Bond	-0.52	-7.54***	-0.66	-7.52***

*Notes: %Δ is monthly percentage change (simple returns); ADF = Augmented Dickey and Fuller unit root test statistics; PP = Phillips and Perron unit root test statistics; the unit root test equation includes an intercept only; the lag lengths for the ADF test are based on the Schwarz Information Criterion (SIC). *** and ** denote statistical significance at the 1% and 5% levels.*

As a precursor to regression analysis, we conduct the Dickey and Fuller (1981) and Phillips and Perron (1988) unit root tests for each series to ensure that all series we use in the regression analysis are stationary. The results of the unit root tests are presented in Table 3. As per Table 3, both tests confirm that the percentage changes (simple returns) are stationary, as the null hypothesis that these series have a unit root is rejected at the 1% level across the board. Therefore, we can safely proceed to regression analysis in the sequel.

5. Results and discussion

5.1. The no-common-effect model

As a starting point, we estimate the no-common effect model, as per equation (2), using OLS to obtain the model parameters' estimates for each REIT separately. Similarly, to prior studies, we run two regressions, each of which uses one of our two interest rate proxies: the SAIBOR rate and the 10-year US Treasury bond yield. Furthermore, we include an impulse dummy in both regressions to absorb the impact of the COVID-19-induced stock market collapse in March 2020, the month in which the outbreak was declared a global pandemic by the World Health Organization. The inclusion of this impulse dummy variable is justified not only from a statistical perspective to enhance the model's fit but also due to the unprecedented impact of the COVID-19 pandemic on the fundamentals of the REIT sector.[7] Furthermore, the COVID-19 outbreak can be viewed as a one-off event that is unlikely to repeat in the foreseeable future under normal circumstances (see, Brooks, 2014, pp. 210-214).

The estimates of the regression parameters based on the unbalanced and balanced samples are reported in Tables 4 and 5. Although the COVID-19 dummy's parameter estimates are jointly different from zero in all cases, at least at the 5% level, we did not report their estimates to conserve space. These results, however, will be made available upon request.

A review of Tables 4 and 5 reveals that the intercept parameter estimates are predominantly negative, albeit generally higher for the balanced sample, with only two exceptions, which corroborates the slight improvement in REITs' performance as shown in the summary statistics. The stock market and interest rate slope parameters display the expected signs across the board, with a positive relation with the stock market and a negative one with interest rates, both short and long. Indeed, the stock market slopes show an increase when considering the balanced sample, reflecting the concentration of market turbulences, which are amplified due to the shorter sample, albeit all market slopes remain statistically significant, at least at the 5% level. On the other hand, while the size of the interest rate slope parameters' estimates is comparable across the two samples, the statistical significance slightly varies.

The bottom of Tables 4 and 5 contains six test statistics for each regression, corresponding to the joint Wald-parameter restriction tests for the no-common-effect model's intercept parameters, each of its two slopes' parameters, the COVID-19 dummy parameters, the intercept and slopes excluding the COVID-19 dummy parameters, and all the reported regression's parameters, respectively. We can see that regardless of the regression model specification (short or long interest rate) and the sample used (unbalanced or balanced), we fail to reject all sets of restrictions except for those imposed on the stock market slopes highlighted in bold. While this restriction is marginally rejected at the 10% level in the unbalanced sample case, it's strongly rejected at the 1% level when we employ a balanced sample. Although we can proceed to estimate a common effect model because the joint Wald-parameter restriction test of all the no-common effect model's parameters cannot be rejected in any case, we had a closer look at the stock market slope estimates. One can clearly see that the stock market slope parameters' estimates for a single REIT (namely, AlJazira) appear to be substantially higher than the rest. This REIT is tiny relative to the remaining REITs, as indicated in Table 1. So, we re-estimated the no-common-effect model without AlJazira REIT to ascertain whether it's driving the results we obtained earlier. The estimation results show that the joint Wald parameter restriction test for the stock market slope parameters based on the model excluding AlJazira REIT cannot be rejected in any case. These results are not reported here for the sake of brevity; however, the author will make them available upon request. In the sequel, we can safely move on to estimate the common effect model.

[7] *For more on the impact of the COVID-19 pandemic on the GCC sector, see* https://www.marmoremena.com/en/insights/impact-of-covid-19-on-gcc-reits/

Table 4. OLS estimates for the no-common effect regression model with COVID-19 dummies based on an unbalanced sample

	$R_{jt} = \alpha_j + \beta_{j1}R_{mt} + \beta_{j2}\%\Delta Interbank_t + \delta_j D_t + \varepsilon_{jt}$						$R_{jt} = \alpha_j + \beta_{j1}R_{mt} + \beta_{j2}\%\Delta Bond_t + \delta_j D_t + \varepsilon_{jt}$					
	α_j	t-State	β_{j1}	t-State	β_{j2}	t-State	α_j	t-State	β_{j1}	t-State	β_{j2}	t-State
Riyad	-0.79	-1.48	0.53***	4.67	-0.02	-0.36	-0.73	-1.38	0.55***	4.86	-0.07	-1.43
AlJazira	-0.10	-0.10	0.91***	4.41	-0.12	-1.05	-0.17	-0.18	0.92***	4.43	-0.09	-1.03
Jadwa Al Haramain	-0.67	-0.94	0.57***	3.85	-0.04	-0.56	-0.58	-0.83	0.60***	4.10	-0.11*	-1.80
Taleem	-0.29	-0.53	0.64***	5.73	-0.12**	-1.96	-0.44	-0.81	0.63***	5.52	-0.04	-0.79
Al Maather	-0.10	-0.17	0.36***	2.97	-0.07	-1.17	-0.13	-0.23	0.37***	3.02	-0.06	-1.25
Musharaka	-0.71	-1.47	0.34***	3.38	-0.07	-1.29	-0.77	-1.60	0.34***	3.37	-0.04	-1.01
Mulkia Gulf Real Estate	-0.60	-1.45	0.38***	4.47	-0.06	-1.36	-0.62	-1.52	0.39***	4.59	-0.06*	-1.76
SICO Saudi	-0.80	-1.02	0.54***	3.36	-0.13	-1.59	-0.88	-1.14	0.55***	3.43	-0.11*	-1.77
AlAhli 1	-0.26	-0.42	0.59***	4.83	-0.07	-1.16	-0.28	-0.48	0.60***	4.93	-0.08	-1.56
Derayah	-0.38	-0.89	0.31***	3.54	-0.07	-1.62	-0.44	-1.04	0.31***	3.55	-0.05	-1.34
Al Rajhi	-0.19	-0.43	0.52***	5.87	-0.08*	-1.64	-0.20	-0.47	0.54***	6.12	-0.08**	-2.29
Jadwa Saudi	0.40	0.74	0.45***	4.01	-0.14**	-2.46	0.17	0.30	0.43***	3.69	-0.03	-0.55
SEDCO Capital	0.18	0.30	0.41***	3.22	-0.08	-1.24	0.26	0.44	0.44***	3.63	-0.14***	-2.85
Alinma Retail	-0.77	-1.02	0.55***	3.67	-0.11	-1.44	-0.86	-1.15	0.56***	3.67	-0.07	-1.10
MEFIC	-0.89	-1.21	0.66***	4.58	-0.10	-1.41	-0.88	-1.23	0.69***	4.78	-0.11**	-2.03
Bonyan	0.13	0.32	0.40***	4.92	-0.04	-0.84	0.18	0.46	0.42***	5.28	-0.07**	-2.25
Alkhabeer	-0.69	-1.09	0.31**	2.51	-0.02	-0.28	-0.59	-0.96	0.34***	2.70	-0.06	-1.29
Parameter Restriction												
Intercept	0.39	(16, 1315)	[0.99]				0.37	(16, 1315)	[0.99]			
Stock market slopes	1.51	(16, 1315)	[0.09]				1.51	(16, 1315)	[0.09]			
SAIBOR/Bond market slopes	0.31	(16, 1315)	[1.00]				0.35	(16, 1315)	[0.99]			
COVID-19 dummy parameters	0.62	(16, 1315)	[0.87]				0.85	(16, 1315)	[0.63]			
All except COVID-19	0.73	(48, 1315)	[0.91]				0.74	(48, 1315)	[0.90]			
All parameters	0.73	(64, 1315)	[0.94]				0.75	(64, 1315)	[0.93]			

*Notes: The parameters' restrictions are denoted as follows: the intercepts' restrictions $\alpha_1 = \alpha_2 = \cdots = \alpha_N$; the stock market slopes' restrictions $\beta_{11} = \beta_{21} = \cdots = \beta_{N1}$; the SAIBOR/Bond market slopes' restrictions $\beta_{12} = \beta_{22} = \cdots = \beta_{N2}$; COVID-19 dummy parameters' restrictions $\delta_1 = \delta_2 = \cdots = \delta_N$; all the parameters except COVID-19 restrictions $\alpha_1 = \alpha_2 = \cdots = \alpha_N, \beta_{11} = \beta_{21} = \cdots = \beta_{N1}$ and $\beta_{12} = \beta_{22} = \cdots = \beta_{N2}$; the restrictions imposed on all parameters $\alpha_1 = \alpha_2 = \cdots = \alpha_N, \beta_{11} = \beta_{21} = \cdots = \beta_{N1}, \beta_{12} = \beta_{22} = \cdots = \beta_{N2}$ and $\delta_1 = \delta_2 = \cdots = \delta_N$. The parameters' restrictions are tested using the Wald F-statistics with $F(q, (\sum_{j=1}^{N} T_j) - (k+1)N)$ degrees of freedom and their corresponding p-values are in [ ]. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.*

Table 5. OLS estimates for the no-common effect regression model with COVID-19 dummies based on a balanced sample

	$R_{jt} = \alpha_j + \beta_{j1}R_{mt} + \beta_{j2}\%\Delta Interbank_t + \delta_j D_t + \varepsilon_{jt}$						$R_{jt} = \alpha_j + \beta_{j1}R_{mt} + \beta_{j2}\%\Delta Bond_t + \delta_j D_t + \varepsilon_{jt}$					
	α_j	t-State	β_{j1}	t-State	β_{j2}	t-State	α_j	t-State	β_{j1}	t-State	β_{j2}	t-State
Riyad	-0.50	-0.85	0.63***	5.48	-0.01	-0.20	-0.38	-0.67	0.66***	5.73	-0.07	-1.46
AlJazira	0.34	0.29	1.10***	4.87	-0.12	-1.06	0.30	0.26	1.12***	4.89	-0.09	-1.04
Jadwa Al Haramain	-0.33	-0.40	0.70***	4.22	-0.05	-0.57	-0.22	-0.27	0.73***	4.44	-0.10	-1.53
Taleem	-0.03	-0.05	0.74***	6.41	-0.12**	-2.15	-0.20	-0.33	0.73***	6.10	-0.04	-0.75
Al Maather	0.66	1.00	0.35***	2.70	-0.08	-1.20	0.64	0.99	0.36***	2.78	-0.07	-1.30
Musharaka	-0.65	-1.17	0.41***	3.74	-0.05	-0.98	-0.67	-1.20	0.42***	3.77	-0.04	-0.97
Mulkia Gulf Real Estate	-0.54	-1.12	0.44***	4.59	-0.06	-1.17	-0.53	-1.11	0.45***	4.73	-0.06	-1.56
SICO Saudi	-0.69	-0.75	0.58***	3.16	-0.12	-1.32	-0.67	-0.74	0.60***	3.31	-0.12*	-1.70
AlAhli 1	-0.03	-0.04	0.64***	4.60	-0.06	-0.93	0.03	0.04	0.67***	4.81	-0.09*	-1.67
Derayah	-0.42	-0.88	0.36***	3.76	-0.07	-1.57	-0.47	-0.98	0.36***	3.75	-0.04	-1.20
Al Rajhi	-0.05	-0.10	0.52***	5.25	-0.08	-1.55	-0.03	-0.07	0.54***	5.47	-0.08**	-2.08
Jadwa Saudi	0.71	1.13	0.47***	3.80	-0.14**	-2.32	0.51	0.79	0.46***	3.55	-0.04	-0.74
SEDCO Capital	0.28	0.41	0.43***	3.28	-0.09	-1.31	0.38	0.59	0.47***	3.67	-0.13***	-2.62
Alinma Retail	-0.62	-0.76	0.58***	3.60	-0.12	-1.48	-0.69	-0.84	0.59***	3.61	-0.08	-1.24
MEFIC	-1.12	-1.56	0.66***	4.67	-0.09	-1.29	-1.09	-1.56	0.68***	4.84	-0.10*	-1.74
Bonyan	0.03	0.06	0.44***	5.47	-0.03	-0.74	0.11	0.27	0.46***	5.88	-0.07**	-2.18
Alkhabeer	-0.69	-1.09	0.31**	2.51	-0.02	-0.28	-0.59	-0.96	0.34***	2.70	-0.06	-1.29
Parameters' Restrictions												
Intercept	0.55	(16, 1071)	[0.92]				0.51	(16, 1071)	[0.94]			
Stock market slopes	1.98	(16, 1071)	[0.01]				1.98	(16, 1071)	[0.01]			
SAIBOR/Bond market slopes	0.33	(16, 1071)	[0.99]				0.27	(16, 1071)	[1.00]			
COVID-19 dummy parameters	0.69	(16, 1071)	[0.81]				0.92	(16, 1071)	[0.54]			
All except COVID-19	0.96	(48, 1071)	[0.56]				0.95	(48, 1071)	[0.58]			
All parameters	0.90	(64, 1071)	[0.69]				0.90	(64, 1071)	[0.71]			

*Notes: The parameters' restrictions are denoted as follows: the intercepts' restrictions $\alpha_1 = \alpha_2 = \cdots = \alpha_N$; the stock market slopes' restrictions $\beta_{11} = \beta_{21} = \cdots = \beta_{N1}$; the SAIBOR/Bond market slopes' restrictions $\beta_{12} = \beta_{22} = \cdots = \beta_{N2}$; COVID-19 dummy parameters' restrictions $\delta_1 = \delta_2 = \cdots = \delta_N$; all the parameters except COVID-19 restrictions $\alpha_1 = \alpha_2 = \cdots = \alpha_N, \beta_{11} = \beta_{21} = \cdots = \beta_{N1}$ and $\beta_{12} = \beta_{22} = \cdots = \beta_{N2}$; the restrictions imposed on all parameters $\alpha_1 = \alpha_2 = \cdots = \alpha_N, \beta_{11} = \beta_{21} = \cdots = \beta_{N1}, \beta_{12} = \beta_{22} = \cdots = \beta_{N2}$ and $\delta_1 = \delta_2 = \cdots = \delta_N$. The parameters' restrictions are tested using the Wald F-statistics with $F(q, N(T-k-1))$ degrees of freedom and their corresponding p-values are in [ ]. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.*

5.2. The common-effect model

We estimate the common-effect model, as presented in Equation (1), using pooled OLS that includes all REITs. The estimation results are reported in Table 6 for all model specifications and samples (unbalanced and balanced).

Table 6. Pooled OLS estimates for the common effect regression model

$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta Interbank_t + \delta D_t + \varepsilon_{jt}$				$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta Bond_t + \delta D_t + \varepsilon_{jt}$			
α	β_1	β_2	δ	α	β_1	β_2	δ
Unbalanced sample: 2016M12 2024M10							
-0.38	0.50***	-0.08***	-8.07***	-0.41	0.51***	-0.07**	-7.17***
(-1.03)	(6.32)	(-3.23)	(-5.71)	(-1.21)	(6.22)	(-2.62)	(-5.88)
Adj R^2	0.21	Obs.	1383	Adj R^2	0.21	Obs.	1383
Balanced sample: 2019M04 2024M10							
-0.22	0.55***	-0.08***	-7.43***	-0.21	0.57***	-0.07**	-6.59***
(-0.49)	(6.38)	(-3.29)	(-5.01)	(-0.52)	(6.24)	(-2.49)	(-5.19)
Adj R^2	0.25	Obs.	1139	Adj R^2	0.26	Obs.	1139

*Notes: The t-statistics in parentheses are calculated based on White two-way cluster standard errors and covariance (degree of freedom corrected), as well as standard errors and t-statistic p-values adjusted for clustering. *** and ** denote statistical significance at the 1% and 5% levels.*

Based on Table 6, we can see that the intercepts are negatively signed, lacking statistical significance across all specifications and samples, nonetheless. The generally poor performance of Saudi REITs is in accordance with the findings of Albarrak et al. (2023). The stock market slopes, as expected, are positive and statistically significant at the 1% level across the board with a modest magnitude of around 0.5, slightly differing across model specifications and samples. The relatively low stock market slope is typical for defensive companies with stable share prices and dividends and closely resembles those reported by He et al. (2003) and Chen and Tzang (1988) in the later sample period. Moving to the interest rate slope, we can see that REITs exhibit a negative relationship with short and long interest rates in all cases, at least at the 5% level of significance, in accordance with the Giliberto and Shulman (2017) conjecture and the findings of several prior studies, *inter alia*, Chen and Tzang (1988), Allen et al. (2000), He et al. (2003), and Ito (2016), while the exposure to the US T-bonds is consistent with the findings of Lin et al. (2022) that show that Singaporean residential and retail REITs and Australian residential REITs are susceptible to US interest rates. Given the absence of an autonomous monetary policy on the part of the Saudi central bank due to the Saudi riyal/dollar peg, our results lend support to the premise that regardless of whether monetary policy is formulated domestically or not, REITs' returns remain susceptible to interest rate changes, thereby highlighting the relevance of US monetary policy to the public real estate market (see, Akimov et al., 2020, p. 149).

While statistical significance is strongly established, a word on the economic significance of the REIT-interest rate nexus is warranted. The slopes on the SAIBOR rate and (T-bond yield) are -0.07 and (-0.08), implying that a hike in the SAIBOR rate (T-bond yield) of as high as 40% will be associated, on average, with a moderate fall in REITs prices of 2.8% (3.2%), ceteris paribus. Indeed, the impact of interest rates seems to be fairly small, even in response to sharp changes in interest rates. To put these findings in context, we compare them to the findings of He et al. (2003), who use a similar interest rate metric and document a slope of -0.18 on the percentage changes in long-term

government bond yields. Our reported interest rate slopes are less than half of that figure. The relatively lower exposure of Saudi REITs to interest rate changes is perhaps due to the relatively low leverage and/or hedging interest rate risk by entering long-term financing with banks.

Considering the COVID-19 estimated parameter, we can clearly see the significant negative impact of the pandemic declaration news on REITs' returns. The magnitude of the COVID-19 estimated parameter as per Table 6 reaches about -8% and -7% for the first and second specifications, respectively, confirming the negative consequences of the pandemic news on the REITs' returns. Indeed, when we compared our findings to those of Yong and Singh (2015), who included a GFC dummy, we found that both crises had a comparable negative impact on the return of REITs. Regarding the goodness of fit, both specifications display an adjusted R^2 of 0.21 over the unbalanced sample, which increases to about 0.25 over the balanced sample. The explanatory power of our regression models is comparable to that reported by Allen et al. (2000), exceeds that of Yong and Singh (2015), yet remains lower than the levels observed in the studies by Chen and Tzang (1988) and He et al. (2003).

To check the robustness of our baseline model (pooled OLS), we run fixed- and random-effects regressions and report their results in Table 7.

Strikingly, the results obtained using the fixed-effects model are remarkably the same as those attained using pooled OLS, with only negligible differences in the t-statistics and R^2. Moreover, applying the redundant fixed effects test, we failed to reject the absence of fixed effects. What is even more surprising is that the random-effects regression produced estimates identical to those of pooled OLS. A look at the lower panel in Table 7 pertaining to the random-effects results reveals the reason behind this finding. The estimated standard deviation of the cross-section error component is zero $\sigma_u = 0$, implying that all REITs had the same intercept. Therefore, the random effects estimator reduces to the OLS estimator (see, Kennedy, 2008, p. 293).

Table 7 The common-effect regression model estimates with fixed and random effects

Fixed effects							
$R_{jt} = \alpha_j + \beta_1 R_{mt} + \beta_2 \%\Delta Interbank_t + \delta D_t + \varepsilon_{jt}$				$R_{jt} = \alpha_j + \beta_1 R_{mt} + \beta_2 \%\Delta Bond_t + \delta D_t + \varepsilon_{jt}$			
α	β_1	β_2	δ	α	β_1	β_2	δ
Unbalanced sample: 2016M12 2024M10							
-0.38	0.50***	-0.08***	-8.06***	-0.41	0.51***	-0.07**	-7.15***
(-1.06)	(6.29)	(-3.21)	(-5.68)	(-1.24)	(6.19)	(-2.60)	(-5.85)
Adj R2	0.20	Obs.	1383	Adj R2	0.21	Obs.	1383
Redundant Fixed Effects Test				Redundant Fixed Effects Test			
0.404	(16,1363)	[0.98]		0.403	(16,1363)	[0.98]	
Balanced sample: 2019M04 2024M10							
-0.22	0.55***	-0.08***	-7.43***	-0.21	0.57***	-0.07**	-6.59***
(-0.51)	(6.34)	(-3.27)	(-4.99)	(-0.54)	(6.19)	(-2.47)	(-5.18)
Adj R2	0.24	Obs.	1139	Adj R2	0.25	Obs.	1139
Redundant Fixed Effects Test				Redundant Fixed Effects Test			
0.579	(16,1119)	[0.90]		0.584	(16,1119)	[0.90]	
Random effects							
$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta Interbank_t + \delta D_t + w_{jt}$				$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta Bond_t + \delta D_t + w_{jt}$			
Unbalanced sample: 2016M12 2024M10							
-0.38	0.50***	-0.08***	-8.07***	-0.41	0.51***	-0.07**	-7.17***
(-1.03)	(6.32)	(-3.23)	(-5.71)	(-1.21)	(6.22)	(-2.62)	(-5.88)
Adj R2	0.21	Obs.	1383	Adj R2	0.21	Obs.	1383
σ_u	0.00			σ_u	0.00		
σ_ε	5.39			σ_ε	5.37		

Balanced sample: 2019M04 2024M10							
-0.22	0.55***	-0.08***	-7.43***	-0.21	0.57***	-0.07**	-6.59***
(-0.49)	(6.38)	(-3.29)	(-5.01)	(-0.52)	(6.24)	(-2.49)	(-5.19)
Adj R2	0.25	Obs.	1139	Adj R2	0.26	Obs.	1139
σ_u	0.00			σ_u	0.00		
σ_ε	5.42			σ_ε	5.40		

*Notes: The t-statistics in ( ) are calculated based on the White two-way cluster standard errors & covariance (degree of freedom corrected) and standard errors and t-statistics p-values adjusted for clustering. The composite error term w_{jt} is $w_{jt} = u_j + \varepsilon_{jt}$ with standard deviations σ_u and σ_ε . *** and ** denote statistical significance at the 1% and 5%.*

5.2.1. Subsample analysis

Despite obtaining similar results using both unbalanced and balanced samples for the Stone (1974) two-index model, we decided to segment our sample period into three subsamples according to the Fed's prevailing monetary policy cycle as defined by Blinder (2023). This subsample analysis explores to what extent does monetary policy influence the relationship between REITs' returns and the movements in interest rates? Using Figure 2, we illustrate the three monetary policy cycles that coincide with our sample period.

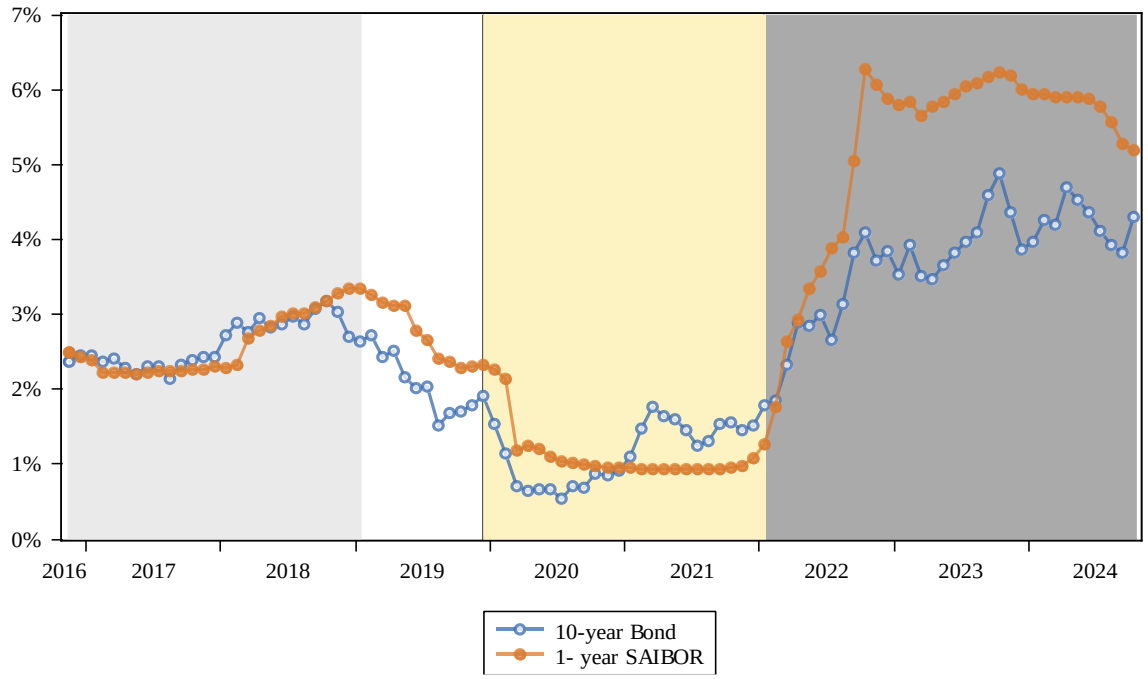

Figure 2. Time series plot of the monthly 10-year US treasury bond yield and the one-year Saudi interbank rate (SAIBOR)

Figure 2 presents the time plot of the one-year SAIBOR and the 10-year US T-bond yield series over the entire sample. The period pertaining to each of the three monetary cycles is shaded with a different color within the time plot. The light-gray-shaded area represents the first subperiod (2016M11 to 2019M01) that corresponds to part of the 11th Fed tightening cycle that spanned the period 2015M11 to 2019M01 (see, Blinder, 2023, p. 119). The second subperiod (2019M02 to 2021M12) comprises the year preceding COVID-19 (the white-shaded area), when the Fed signaled to stop raising rates amid economic uncertainty[8],

[8] *See https://edition.cnn.com/2019/01/30/economy/federal-reserve-january-rate-meeting/index.html*

and the COVID-19 period that induced sharp rate cuts up to the beginning of the present tightening cycle (the beige-shaded area). The darker gray shaded area represents the present tightening cycle that started from 2022M01 through the end of the sample. Table 8 reports the estimation results of the common effect model, as presented in equation (1), by means of pooled OLS including all REITs based on the abovementioned three sample periods.

Table 8. Pooled OLS estimates for the common-effect regression model across monetary policy cycles

$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta Interbank_t + \delta D_t + \varepsilon_{jt}$				$R_{jt} = \alpha + \beta_1 R_{mt} + \beta_2 \%\Delta Bond_t + \delta D_t + \varepsilon_{jt}$			
α	β_1	β_2	δ	α	β_1	β_2	δ
First subsample period: 2016M12 2019M01							
-0.94	0.09	-0.14*		-1.18**	0.09	-0.21***	
(-1.63)	(0.71)	(-2.00)		(-2.56)	(0.71)	(-4.01)	
Adj R2	0.001	Obs.	212	Adj R2	0.05	Obs.	212
Second subsample period: 2019M02 2021M12							
-0.19	0.66***	-0.32***	-16.70***	0.34	0.70***	-0.11**	-6.57***
(-0.25)	(4.26)	(-4.06)	(-6.04)	(0.50)	(3.75)	(-2.24)	(-3.83)
Adj R2	0.25	Obs.	593	Adj R2	0.27	Obs.	593
Third subsample period: 2022M01 2024M10							
-1.00***	0.46***	-0.03**		-1.09***	0.45***	-0.02	
(-3.42)	(8.45)	(-2.68)		(-4.46)	(8.66)	(-0.65)	
Adj R2	0.25	Obs.	578	Adj R2	0.25	Obs.	578

*Notes: The t-statistics are in ( ) are calculated based on the White two-way cluster standard errors & covariance (degree of freedom corrected) and standard errors and t-statistics p-values adjusted for clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

A look at Table 8 reveals some striking findings regarding the stability of the regression estimates across the subsample periods, confirming the conclusion reached by He et al. (2003) and Giliberto and Shulman (2017) with respect to the time-varying sensitivity of REITs to stock market and interest rate movements. That said, the interest rate slope parameters remain negative and statistically significant, at least at the 5% level in all cases except for the long interest rate specification during the ongoing monetary tightening cycle. Focusing on the magnitude of the interest rate slope parameters, one can see a differing magnitude across both samples and model specifications, with long interest rates being more influential in the first subsample, whereas short interest rates became more influential during the COVID-19 pandemic, and the influence of both has been considerably diminished during the present contractionary monetary cycle. The falling interest rates triggered by the expansionary monetary policy employed in response to the pandemic seem to induce a more substantial influence of short interest rates, which reflect the direct cost of funds, on REITs' returns. This finding largely aligns with Mueller and Pauley (1995) results in showing that the relationship between REITs' returns and interest rates strengthens during falling interest rate regimes.

Interestingly, the first subsample results reveal seemingly anomalous results pertaining to the stock market slope parameter, which were negligible and statistically insignificant. The post-IPO behavior of these REITs can perhaps explain this outcome after their inception. The subsequent subsample witnessed an increase in stock market beta amid the COVID-19 crisis, reflecting a spillover effect similar to that documented by Giliberto and Shulman (2017) during the GFC, albeit far less in magnitude, emphasizing the diversification benefit of Saudi REITs (see, Marzuki & Newell, 2025). Moreover, the stock market betas dropped during the recent interest rate hikes.

6. Conclusion

The Saudi real estate sector is witnessing unprecedented growth catalyzed by serious economic reforms and mega projects as part of Saudi Vision 2030. The REIT sector is keeping step with these developments, emerging as the

largest in the Middle East and attracting international investors. Furthermore, the drastic changes in interest rates following a long period of monetary expansion warrant a careful analysis of the relationship between REIT returns and interest rate movements, given the unique features of REITs that render them more sensitive to the stance of monetary policy. The Saudi REITs context is especially insightful given the lack of autonomous monetary policy on the part of the Saudi central bank due to the long-standing fixed exchange rate regime with the US dollar.

Our methodology employs a refined econometric analysis that explicitly integrates the potential cross-sectional variations among Saudi REITs and the dynamic relationship between their returns and interest rates over time. To address the possible idiosyncrasies of the individual REITs, we initially start with a no-common-effects estimation of the Stone (1974) two-index model, a framework that enables us to determine whether individual REITs display distinct exposures to interest rates (short- and long-term) and market risks. This is achieved by testing the hypothesis that individual REITs have equivalent exposures to market and interest rate risks. Indeed, the results obtained confirm that this hypothesis cannot be rejected. Therefore, we proceeded with the common-effects model based on pooled OLS to exploit the advantages of our panel dataset. To examine potential shifts in the relationship between REIT returns and interest rates over the sample period, we segment the dataset into three distinct phases as dictated by the Federal Reserve's prevailing monetary policy cycle, as defined by Blinder (2023). This approach facilitates a comprehensive understanding of how the REITs' return-generating process evolves amidst changing monetary policy regimes.

The results from the pooled OLS estimation show that short- and long-term interest rates have a statistically significant negative impact on REITs' returns over the entire sample period, albeit this effect is generally economically moderate. The broad market returns exhibit a positive relationship consistent with the results reported elsewhere. Indeed, the results based on the prevailing monetary policy regime reveal the time-dependent nature of the REIT-interest rate nexus. Interest rates seem to exert a more substantial influence on REITs' returns during the falling interest rate cycle induced by the COVID-19 pandemic, in contrast, this influence is substantially diminished during the ongoing monetary tightening, rendering the long-term interest rate impact statistically insignificant. Market betas, on the other hand, seem to rise during the crisis period, reflecting a heightened spillover effect during turbulent market phases.

These findings carry important implications for fund managers, investors, and policymakers. The time-varying sensitivity highlights the importance of monetary policy decisions to REITs' valuations, although these decisions were made by the Fed rather than SAMA. The time-varying relationship calls for more research examining the return and risk spillovers among Saudi REITs and their international counterparts, on the one hand, and other asset classes to explore hedging and portfolio management implications, on the other. Based on our findings, we tentatively predict that the performance of Saudi REITs will improve as the Fed eases its current contractionary policy. While we appreciate the importance of macroprudential policy in ensuring the soundness of the financial system, we recommend that the CMA consider relaxing the leverage limits by allowing REITs to employ higher leverage, given their documented resilience to interest rate risk, subject to their credit ratings. In addition, REITs' managers may also consider hedging interest rate risk by entering into long-term financing agreements with banks. These steps may enable REITs to play a pivotal role in developing the promising Saudi real estate sector in the coming years.

A caveat of this research is that the relatively small sample of REITs precludes considering more risk factors and/or REIT characteristics in our regression model, like size, value, and momentum. Future research endeavors may address these limitations by conducting a cross-country study that primarily focuses on emerging markets' REITs and compares their results to ours.

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