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Crude Constraints: Oil Price Asymmetries and the Growth Path of Saudi Arabia's Services Sector

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ABSTRACT

This study explores the dynamic relationship between oil dependency and the growth of the services sector in Saudi Arabia over the period 1980–2023. Using both linear Autoregressive Distributed Lag (ARDL) and nonlinear ARDL (NARDL) models, we examine whether oil price shocks exert symmetric or asymmetric effects on the share of services in GDP. The results reveal that oil rents significantly reduce the services sector's contribution in the long run, highlighting structural dependencies within the economy. Short-run dynamics vary across macroeconomic indicators, with real oil prices showing more immediate but less persistent effects. The NARDL model provides new insights, uncovering strong asymmetries: negative oil price shocks have a greater and more significant adverse impact on services value added than positive shocks, both in the short and long term. Unit root tests support the ARDL framework, and bounds testing confirms cointegration. These findings underscore the challenges of reducing oil dependence and suggest that economic diversification strategies under Saudi Vision 2030 must account for the asymmetric vulnerabilities introduced by oil price volatility.

Keywords: Oil Prices, Services Sector, Saudi Arabia, ARDL Model, NARDL, Asymmetry, Economic Diversification, Dutch Disease
JEL Classifications: C32, Q43, O53, E32

1. INTRODUCTION

Since the discovery of oil in the 1930s, Saudi Arabia has undergone a profound transformation from an agrarian economy to one of the world's largest oil exporters. Despite rapid modernization and global integration, the Saudi economy remains heavily dependent on oil revenues. This reliance is reflected not only in export performance but also in fiscal policy, where oil continues to fund the majority of public expenditure. In recent years, however, the imperative for economic diversification has become central to the Kingdom's national strategy, especially under the ambitious Vision 2030 framework. Among non-oil sectors, the services sector has emerged as a key pillar for employment creation, fiscal spending, and long-term growth. Understanding how oil dependency affects the performance and stability of this sector is crucial for ensuring sustained economic development.

Yet, this sector remains structurally vulnerable to fluctuations in global oil prices. The central challenge facing oil-dependent economies like Saudi Arabia is how to insulate non-oil sectors—especially services—from the adverse effects of oil price volatility. Classical economic theory, particularly the Dutch Disease hypothesis developed by Corden and Neary (1982), provides a useful lens for examining this issue. Originally applied to manufacturing and other tradable sectors, the theory posits that oil booms lead to real exchange rate appreciation, thereby reducing the competitiveness of other sectors. More recent research has extended this framework to the services sector, especially in rentier states where government-led expansion of public administration, education, healthcare, and subsidized services substitutes for productivity-driven growth (Auty, 2001; Sachs & Warner, 2001).

In Saudi Arabia, the relationship between oil prices and the services sector is particularly complex. Although the Saudi riyal is pegged to the U.S. dollar—limiting nominal exchange rate fluctuations—the economy remains tightly linked to global oil markets. Oil revenues directly influence fiscal space, and much of this spending is channelled into services through wages, infrastructure, and public investment. As a result, the services sector often expands during oil booms and contracts during busts. This pattern introduces macroeconomic instability and weakens efforts to build a resilient, service-led economy. Moreover, cyclical expansions in services are not always productivity-enhancing; they may instead create fiscal vulnerabilities, overemployment, and inefficiencies that are exposed during oil downturns.

Despite its centrality to economic transformation, the services sector has received limited empirical attention in the context of oil price shocks. Most existing studies focus on overall GDP or manufacturing, often overlooking the distinct dynamics of services. Furthermore, a growing body of literature suggests that oil price changes exert asymmetric effects on economic variables—that is, the impact of oil price increases is not necessarily the mirror image of declines (Hamilton, 2009; Kilian & Vigfusson, 2011). This asymmetry is particularly relevant to understanding oil dependency, as economies may experience deeper contractions than expansions depending on the direction of oil price changes (Sharaf et al., 2025). For the services sector, this asymmetry may be especially pronounced. During booms, public spending drives growth, but during busts, fiscal austerity can produce sharper and more immediate contractions.

To address this gap, the present study investigates both the short- and long-run effects of oil price fluctuations on Saudi Arabia's services sector over the period 1980–2023. It applies both the linear Autoregressive Distributed Lag (ARDL) model and the nonlinear ARDL (NARDL) model developed by Shin et al. (2014) to capture symmetric and asymmetric effects, respectively. The analysis also includes critical macroeconomic control variables such as oil rents, inflation, real effective exchange rates, and GDP per capita. By decomposing oil price movements into positive and negative components, the NARDL model allows for a more granular understanding of how different phases of the oil cycle affect the services sector.

This study makes three key contributions to the literature on oil dependency and sectoral growth. First, it shifts the analytical focus from manufacturing or aggregate GDP to the services sector, which now constitutes nearly half of Saudi GDP and is central to diversification under Vision 2030. Second, it incorporates asymmetric modeling to uncover potential short-run imbalances and long-run vulnerabilities that symmetric models may miss. Third, the use of long-span annual data (1980–2023) enables the study to capture multiple global oil shocks, including the 1980s glut, the 2000s price surge, and the COVID-19 collapse.

The remainder of the paper is structured as follows: Section 2 provides an overview of key macroeconomic trends in Saudi Arabia from 1980 to 2023, highlighting how variables such as oil prices, oil rents, inflation, GDP per capita, exchange rates, and the services sector have evolved over time. This section uses descriptive analysis and time series figures to illustrate the country's progress and ongoing dependence on oil. Section 3 reviews the existing literature on oil price volatility and non-oil sector performance, with special emphasis on services. Section 4 outlines the data sources and empirical methodology, including model specifications and estimation strategies. Section 5 presents the main findings, comparing the results from both the linear and nonlinear ARDL models. Section 6 discusses the policy implications, especially in relation to Saudi Arabia's Vision 2030 goals for economic diversification. Finally, Section 7 concludes the paper by summarizing key insights and offering recommendations for future research.

2. OVERVIEW OF MACROECONOMIC AND SERVICES SECTOR TRENDS IN SAUDI ARABIA FROM 1980 TO 2023

Saudi Arabia's economic structure over the past four decades has been closely tied to global oil market dynamics. Real oil prices have gone through several boom and bust cycles—from the highs of the early 1980s and 2000s to the sharp declines in the late 1990s, 2014, and during the COVID-19 crisis. These fluctuations are illustrated in Figure 1, which shows significant volatility in real oil prices, especially during geopolitical tensions and major global recessions.

Oil rents as a percentage of GDP (Figure 2) show a clear long-run decline—from over 70% in 1980 to below 25% by the 2020s—signaling Saudi Arabia's gradual effort to reduce its fiscal dependency on oil revenues. However, the country's fiscal balance still reacts strongly to oil market movements, suggesting that deeper diversification efforts remain necessary (International Monetary Fund, 2022).

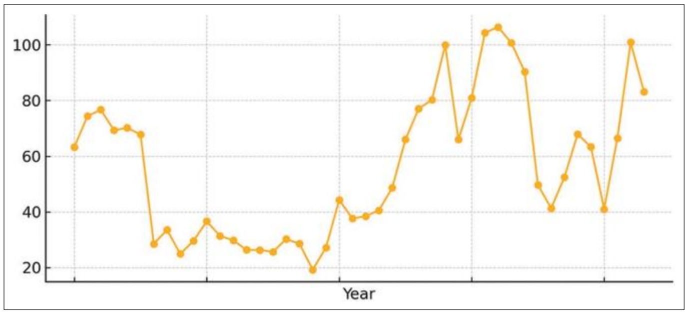
The services sector, shown in Figure 3, has expanded steadily as a share of GDP, growing from under 30% in 1980 to nearly 55% in recent years. This reflects structural shifts toward health, education, finance, and tourism under Saudi Vision 2030. Nonetheless, service sector growth has occasionally stalled or declined during oil downturns—such as in the late 1990s and during COVID-19—demonstrating its fiscal sensitivity and limited insulation from oil cycles.

GDP per capita has largely tracked oil cycles (Figure 4), rising during booms and declining during busts. For example, income levels fell sharply after the 1980s oil glut and during the mid-2010s price collapse. Although Saudi Arabia maintains high income per capita relative to global standards, this metric's volatility underscores the need to decouple economic well-being from hydrocarbon revenue (Cherif & Hasanov, 2014).

Inflation, shown in Figure 5, has generally been low, staying under 5% for most years. Peaks in inflation often follow major oil booms, while deflationary pressures occurred during downturns. Low and stable inflation reflects strong monetary anchoring, especially due to the Saudi riyal's peg to the U.S. dollar.

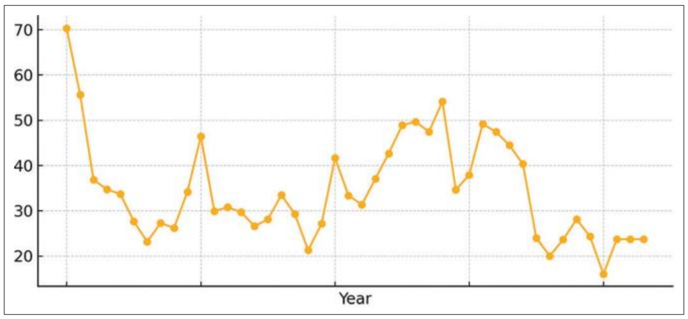
Lastly, Figure 6 shows the movement of the real effective exchange rate (REER), which declined overall from the elevated levels of

Figure 1: Real oil price (USD/barrel)



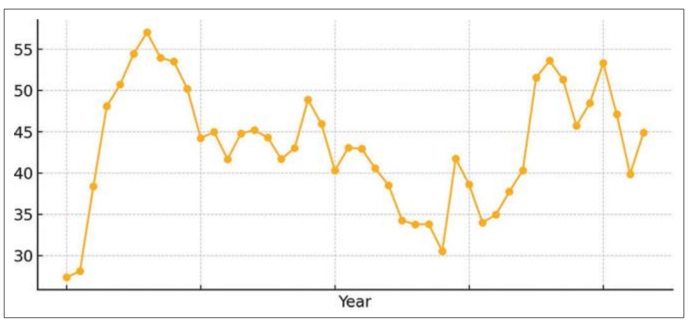
Source: Authors' construction

Figure 2: Oil rents (% of GDP)



Source: Authors' construction

Figure 3: Services sector (% of GDP)



Source: Authors' construction

Figure 4: GDP per capita (2015 USD)

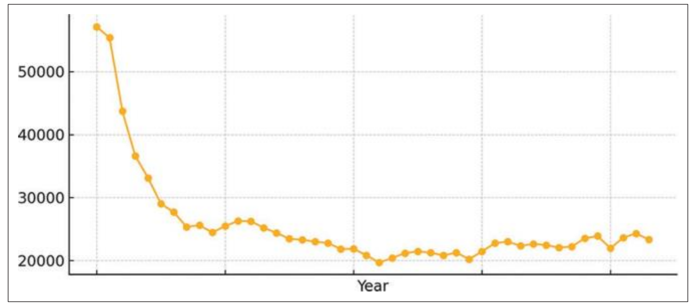


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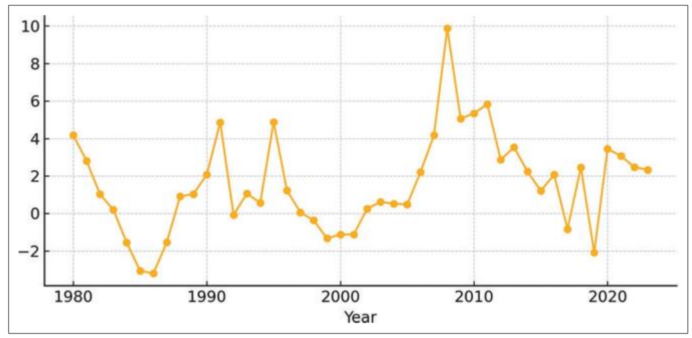
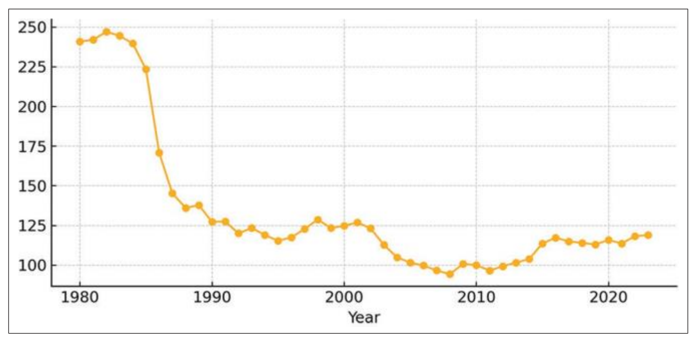
Figure 5: Inflation rate (%)



Source: Authors' construction

Figure 6: Real effective exchange rate (index)



Source: Authors' construction

the 1980s. However, periods of appreciation—particularly during oil booms—may have introduced Dutch Disease pressures by weakening the competitiveness of tradable sectors (Callen et al., 2014; Berument et al. (2010). Despite REER volatility, Saudi Arabia's service sector has remained resilient, likely due to domestic demand and public investment rather than international competitiveness.

Overall, these figures show that while Saudi Arabia's economy is slowly changing, it still depends a lot on oil. While the services sector has grown, its trajectory remains closely linked to oil cycles. Building a more resilient service economy will require continued fiscal reform, private sector development, and improved insulation from oil price volatility.

3. LITERATURE REVIEW

Understanding the impact of oil price fluctuations on non-oil sectors—particularly the services sector—has been a central concern in energy and development economics, especially for oil-rich nations like Saudi Arabia. The classical "Dutch Disease" hypothesis, first articulated by Corden and Neary (1982), posits that oil booms lead to real exchange rate appreciation, which in turn suppresses the competitiveness of tradable sectors. While this framework initially emphasized manufacturing, it is increasingly recognized that the services sector, although generally non-tradable, is also deeply affected due to its reliance on public investment and demand-side spillovers. In the context of oil-exporting economies, several empirical studies have demonstrated that oil booms often lead to a reallocation of labor and capital away from productive sectors, including services, toward rent-seeking or low-productivity activities. Auty (2001) and Sachs and Warner (2001) argued that resource booms can undermine long-term diversification, not only by crowding out industry but also by distorting the structure and incentives within the services sector, which tends to expand in ways that are not productivity-enhancing.

A large strand of literature has sought to empirically verify the Dutch Disease across different countries using time series models. Brahmbhatt et al. (2010) showed that oil surplus in resource-rich economies led to slower growth in non-resource tradable sectors, and Harding and Venables (2016) confirmed that natural resource exports weaken industrial competitiveness. However, the extent to which these findings apply to Saudi Arabia is uncertain due to the country's unique policy environment—namely its exchange rate peg, extensive fiscal buffers, and centralized political economy.

Several region-specific studies offer further insights into this phenomenon. Teng et al. (2024) examines resource-rich GCC economies and finds compelling evidence of Dutch Disease, including the crowding-out of non-oil exports and over-expansion of non-tradable sectors during periods of sovereign resource windfalls. Callen et al. (2014) found that real exchange rate appreciation in Saudi Arabia, driven by oil revenues, undermined manufacturing growth and complicated economic diversification efforts. In contrast, Cherif and Hasanov (2014) argued that structural constraints—such as labor market rigidities and institutional inefficiencies—are more binding than resource-based distortions, suggesting that policy design can mitigate or exacerbate oil price effects.

The services sector in Saudi Arabia plays a critical role in the nonoil economy, covering key areas such as finance, retail, health, education, and public administration. Raid et al. (2024) explores how nonoil institutional sectors have shaped Saudi Arabia's growth trajectory between 1970 and 2020. The study finds that oil revenue inflows have often channeled public spending toward expanding lowproductivity service segments, with comparatively limited growth in more productive industrial sectors—indicative of Dutch Disease–type distortions in resource-rich economies. Other studies have also highlighted the vulnerability of the Saudi services sector to oil cycles. Hvidt (2013) and Elbadawi and Soto (2012) noted that oil booms are often followed by surges in service employment and output, particularly in publicly funded sub-sectors. Alkhathlan and Javid (2013), using cointegration techniques, found that oil revenues are a strong determinant of non-oil sector growth, with services being especially sensitive. Alshehry and Belloumi (2015) further confirmed this linkage, showing that public spending during oil windfalls disproportionately benefits the service sector in both the short and long term.

These findings collectively demonstrate that oil dependency has long shaped the structure and trajectory of the Saudi services sector. Exchange rate dynamics also play a crucial role. Berument et al. (2010) documented that oil-driven exchange rate movements affect tourism and financial services, both of which are growing in Saudi Arabia's Vision 2030 diversification plan. Although the Saudi riyal is pegged to the U.S. dollar, real exchange rate appreciation can still undermine competitiveness and distort resource allocation. Recent empirical evidence from Al Abri and Al Bulushi (2022) demonstrates that in rentier and oil-exporting economies within the GCC, institutional quality plays a critical role in shaping economic efficiency. Specifically, weaker regulatory and governance structures tend to exacerbate inefficiencies following oil price shocks, which can significantly hinder the productivity of service-oriented sectors over time

The growing use of nonlinear models such as the Nonlinear Autoregressive Distributed Lag (NARDL) approach reflects a broader recognition that oil price impacts may not be symmetric across economic sectors. Mohaddes and Pesaran (2016), using ARDL models, found long-run cointegration between oil prices and non-oil GDP across oil-exporting countries, suggesting stable but differentiated linkages. In the context of Saudi Arabia, Alhakimi (2023) employed a NARDL framework and demonstrated that negative oil price shocks exert a more substantial and contractionary effect on the non-oil economy than positive shocks. The study highlights that downturns in oil prices are often associated with fiscal consolidation, reductions in government expenditure, and lower investment in services—factors that significantly disrupt the performance of the service sector in particular. In addition, Farzanegan and Markwardt (2009) examined Iran's services sector and found that responses to oil shocks were not only delayed but also persistently uneven, depending on the direction of the price change. Although the UAE maintains a currency peg to the U.S. dollar, real exchange rate appreciation can still constrain competitiveness and skew resource allocation. Oil price shocks primarily affect the economy through government revenues and expenditures, leading to fiscal adjustments that distort service sector outputs by introducing procyclical spending patterns (Central Bank of the UAE, 2020). Malik and Awadallah (2013) expanded on this by analyzing the political economy of oil allocation, suggesting that services in Arab oil exporters often serve as instruments of political legitimacy and employment stabilization during booms. This creates a cyclical pattern where services are expanded without sufficient focus on productivity or market competitiveness.

Despite these important contributions, there remains a clear gap in the literature on how oil dependency—captured through both symmetric and asymmetric oil price shocks—specifically affects the services sector in Saudi Arabia. Most prior research either aggregates non-oil sectors or focuses on industry. This paper addresses that gap by applying both linear ARDL and nonlinear NARDL models to a long-term dataset from 1980 to 2023. By examining both positive and negative oil price changes, and by integrating critical control variables such as inflation, exchange rates, and oil rents, this study provides a more deep understanding of how oil price volatility, under conditions of persistent oil dependency, impacts services sector dynamics in a resource-dependent yet reform-oriented economy.

4. DATA AND METHODS

4.1. Data and Variables Construction

This study utilizes annual time series data for Saudi Arabia spanning the period 1980 to 2023. The primary focus is on examining the dynamic relationship between international oil prices and the services sector, with particular attention to the possibility of asymmetric effects.

The dependent variable is the share of services in GDP (Services Value Added, % of GDP), denoted as $SERV_t$, which reflects the size and performance of the services sector. The key independent variable is the real price of oil, denoted ROP_t, along with oil rents (% of GDP) denoted by $RENT_t$ to capture fiscal dependence on hydrocarbon revenues. Control variables include the real GDP per Capita denoted by $GDPPC_t$ to control for overall economic development and inflation rate denoted by UNF_t which serves as a macroeconomic stability control. We also include the real effective exchange rate $REER_t$ which reflects external competitiveness and potential Dutch Disease effects.

All data are sourced from the World Bank World Development Indicators and OPEC for international oil prices. All variables are expressed in natural logarithms except where ratios or percentages are used.

4.2. Unit Root Testing

Before proceeding with model estimation, unit root tests were applied to determine the stationarity properties of the variables, as the validity of the ARDL and NARDL approaches requires that no variable be integrated of order two, I(2). We used the Augmented Dickey-Fuller (ADF) unit root test. The test was applied in both level and first difference forms. The lag lengths for ADF were selected using the Akaike Information Criterion (AIC).

4.3. Linear ARDL Model

To examine the dynamic relationship between oil prices and services output, the study employs both a linear Autoregressive Distributed Lag (ARDL) model and a Nonlinear ARDL (NARDL) model to capture asymmetric effects. Both models allow for mixed integration orders (i.e., I(0) or I(1)) and are particularly suited for small samples.

We begin with a linear ARDL model. The model is specified as in equation 1.

$$\begin{aligned}\Delta SERV_t &= \alpha_0 + \sum_{i=1}^{p}\alpha_i \Delta SERV_{t-i} + \sum_{j=0}^{q_1}\beta_j \Delta ROP_{t-j} \\ &+ \sum_{k=0}^{q_2}\gamma_k \Delta REER_{t-k} + \sum_{l=0}^{q_3}\delta_l \Delta OR_{t-l} + \sum_{m=0}^{q_4}\theta_m \Delta GDPPC_{t-m} \\ &+ \sum_{n=0}^{q_5}\varnothing_n \Delta INF_{t-n} + \lambda_1 SERV_{t-1} + \lambda_2 ROP_{t-1} + \lambda_3 REER_{t-1} \\ &+ \lambda_4 RENT_{t-1} + \lambda_5 GDPPC_{t-1} + \lambda_6 INF_{t-1} + \varepsilon_t \end{aligned} \quad (1)$$

The presence of cointegration is tested using the bounds testing procedure developed by Pesaran et al. (2001). If the lagged level variables are jointly significant, a long-run equilibrium relationship is confirmed. From this, the Error Correction Model (ECM) is derived as in equation 2:

$$\Delta SERV_t = \sum \beta_i \Delta X_i + \varnothing ECT_{t-1} + \varepsilon_t \quad (2)$$

Where ECT_{t-1} is the lagged residual from the long-run ARDL equation and $\varnothing$ is the speed of adjustment term. A negative and significant $\varnothing$ confirms convergence toward equilibrium.

4.4. Nonlinear ARDL (NARDL) Model

To account for possible asymmetric effects of oil price changes, a Nonlinear ARDL (NARDL) model is estimated following Shin et al. (2014). The real oil price is decomposed into cumulative positive and negative changes as in equations 3 and 4:

$$ROP_t^+ = \sum_{j=1}^{t}\max(\Delta ROP_j, o) \quad (3)$$

$$ROP_t^- = \sum_{j=1}^{t}\min(\Delta ROP_j, o) \quad (4)$$

The NARDL model is specified as in equation 5:

$$\begin{aligned}\Delta SERV_t &= \alpha_0 + \sum_{i=1}^{p}\beta_i \Delta SERV_{t-i} + \sum_{j=0}^{q_1}\theta_j^+ \Delta ROP_{t-j}^+ \\ &+ \sum_{j=0}^{q_2}\theta_j^- \Delta ROP_{t-j}^- + \sum_{k=0}^{r}\varnothing_k \Delta RENT_{t-k} + \sum_{l=0}^{s}\gamma_l \Delta GDPPC_{t-l} \\ &+ \sum_{m=0}^{v}\delta_m \Delta INF_{t-n} + \sum_{n=0}^{w}\psi_n \Delta REER_{t-n} + \lambda_1 SERV_{t-1} + \lambda_2^+ ROP_{t-1}^+ \\ &+ \lambda_2^- ROP_{t-1}^- + \lambda_3 RENT_{t-1} + \lambda_4 GDPPC_{t-1} \\ &+ \lambda_5 INF_{t-1} + \lambda_6 REER_{t-1} + \varepsilon_t \end{aligned} \quad (5)$$

Where Δ is a first-difference operator, α_0 is the constant term, β_i are the short-run coefficients on lags of $\Delta SERV_t$, θ_j^+ and θ_j^- are the short-run coefficients on ΔROP_{t-j}^+ and ΔROP_{t-j}^-, $\varnothing_k$, γ_l, δ_m, ψ_n are the short-run coefficients on first differences of control variables. λ_1 is the error correction term (expected to be negative and significant), λ_2^+ and λ_2^- are the long-run coefficients on cumulative positive and negative oil price changes. λ_3, λ_4, λ_5, λ_6 are the long-run coefficients on control variables. ε_t is the white-noise error term.

After estimating the linear ARDL and NARDL models, a series of diagnostic checks were performed to ensure the validity and robustness of the results. To assess the presence of serial correlation in the residuals, the Breusch–Godfrey LM test was applied. The Breusch–Pagan and White tests were used to examine heteroskedasticity, ensuring that the variance of the errors remained constant. The normality of the residuals was tested using the Jarque–Bera test. To evaluate the correctness of the model's functional form, the Ramsey RESET test was implemented. Finally, the stability of the model parameters over time was verified through the CUSUM and CUSUMSQ tests, both of which assess parameter constancy within a 5% significance band.

Both the linear and nonlinear models were estimated using the ARDL command in Stata. The optimal lag length for each model was selected based on the Akaike Information Criterion (AIC), which prioritizes model parsimony while maintaining goodness of fit. The existence of a long-run relationship was assessed using the Bounds testing approach for cointegration, where the joint significance of the lagged level variables was tested. The calculated F-statistic was then compared against the critical values provided by Pesaran et al. (2001). For the NARDL model, the Wald test was used to test for long-run asymmetry by examining whether the coefficients on the decomposed positive and negative oil price components (ROP□ and ROP□) were statistically different from one another.

5. EMPIRICAL RESULTS

This section presents and interprets the empirical results of both the linear ARDL and nonlinear ARDL (NARDL) models that examine the relationship between oil market dynamics and the services sector in Saudi Arabia. It begins with the results of the unit root testing, followed by a detailed discussion of both the linear and nonlinear ARDL results, concluding with a comparative synthesis of both models.

5.1. Unit Root Test Results

Before estimating the ARDL and NARDL models, the stationarity properties of all variables were examined using the Augmented Dickey-Fuller (ADF) test at both levels and first differences. The results are reported in Table 1

The test shows that none of the series were found to be stationary at levels at the 5% significance level. However, after first differencing, all variables became stationary, indicating that they are integrated of order one, I(1). This result satisfies the core requirement for using the ARDL bounds testing framework, which allows for a combination of I(0) and I(1) variables but not I(2). Notably, the real effective exchange rate (REER) was borderline stationary in levels but was confirmed to be I(1) upon differencing, justifying its inclusion in the model.

5.2. Linear ARDL Results

To confirm the presence of a long-run relationship among the variables, the ARDL bounds testing procedure was employed. The results strongly reject the null hypothesis of no cointegration, with the F-statistic (9.456, $P < 0.01$) and the t-statistic (–5.785, $P < 0.01$) both statistically significant at the 1% level. This confirms the presence of cointegration among the variables in the model.

The linear ARDL model selected via Akaike Information Criterion was ARDL (2,2,0,2,0,1), with the dependent variable being the share of services in GDP. Results of the estimated linear ARDL model, presented in Table 2, show that the error correction term is negative and statistically significant at 1%, suggesting that 34.1% of the disequilibrium is corrected within 1 year. This confirms the presence of a stable long-run relationship.

In the long run, the real oil price exerts a statistically significant positive effect on the services sector ($\beta = 0.115$, $P = 0.003$), indicating that oil price increases support services growth over time. Conversely, oil rents have a significant negative long-run effect ($\beta = -0.553$, $P < 0.01$), supporting the resource curse hypothesis and suggesting that fiscal overreliance on oil revenues hinders sustainable expansion of the services sector. The real effective exchange rate is also positively associated with services output ($\beta = 0.109$, $P = 0.024$), possibly reflecting stronger domestic consumption and capital inflows linked to currency appreciation. Other macroeconomic variables—GDP per capita and inflation—do not show statistically significant long-run effects.

Short-run results provide additional insights. The real oil price has an immediate negative impact but turns positive in its lagged term, suggesting a delayed adjustment process or J-curve type effect. Oil rents remain to have a negatively signed and statistically significant coefficient in the short run, confirming their contractionary influence even over short time horizons. The REER continues to exert a positive and significant effect, reinforcing its consistent role in supporting service sector output. GDP per capita and inflation remain statistically insignificant in the short run, similar to their long-run behavior.

5.3. Nonlinear ARDL (NARDL) Results

To assess potential asymmetries in oil price effects, the NARDL model was estimated by decomposing oil prices into cumulative positive and negative changes. The optimal lag structure selected was ARDL (2,1,2,0,2,0,1) based on the AIC criterion. Results of the NARDL model, presented in Table 3, show that the error correction coefficient ($\beta = -0.308$, $P < 0.01$) again confirms a valid long-run equilibrium, with a slightly slower adjustment speed than the linear ARDL model.

The long-run coefficients for both positive and negative oil price changes are positive ($\beta = 0.127$ and 0.148) respectively, but neither is statistically significant at conventional significance levels. The Wald test for long-run asymmetry also fails to reject the null hypothesis, indicating that the services sector does not respond differently to positive versus negative oil price changes over the long term. This outcome suggests that the linear ARDL model adequately captures long-run dynamics in this context.

In contrast, short-run dynamics reveal meaningful asymmetries. Positive oil price shocks have a significant and negative immediate

Table 1: Augmented Dickey-Fuller (ADF) unit root test results

Variable	ADF Statistic (Level)	p-value (Level)	ADF Statistic (First Difference)	P-value (First Difference)
Services (% of GDP)	−2.405	0.141	−5.158***	0.000
Real oil price	−1.987	0.289	−5.616***	0.000
Oil Rents (% of GDP)	−1.653	0.432	−6.352***	0.000
GDP per capita (constant 2015 USD)	−1.908	0.319	−5.643***	0.000
Inflation (CPI)	−2.312	0.164	−4.906***	0.000
Real Effective Exchange Rate Index	−2.245	0.182	−3.306**	0.015

***,**Indicate significance at the 1% and 5% levels respectively. All variables are non-stationary at levels but become stationary at first differences, indicating integration of order I (1) effect (β = -0.124, P = 0.004), and negative shocks have an even larger contractionary impact (β = -0.147 and -0.054 for current and lagged values, both P < 0.05). These results indicate that oil price volatility—regardless of direction—can dampen services output in the short run, possibly through disruptions to fiscal planning, consumer confidence, or intersectoral resource reallocation. Such insights are not visible in the linear model and emphasize the merit of NARDL in capturing short-term nonlinearities.

Table 2: Error Correction Model (ECM) Estimation Results for the Linear ARDL Model – Long-Run and Short-Run Coefficients

Variable	Coefficient	Standard error
Long-run coefficients		
ROP_{t-1}	0.1152***	0.0359
$RENT_{t-1}$	−0.5537***	0.0862
$GDPPC_{t-1}$	−0.00043	0.00028
INF_{t-1}	−0.1516	0.2579
$REER_{t-1}$	0.1093**	0.0458
Short-run coefficients		
$\Delta ROPt$	−0.1416***	0.0176
ΔROP_{t-1}	−0.0614**	0.0264
$\Delta RENT_t$	−0.1889***	0.0372
$\Delta GDPPC_t$	−0.00044**	0.00022
$\Delta GDPPC_{t-1}$	−0.00030*	0.00015
ΔINF_t	−0.0517	0.0879
$\Delta REER_t$	0.1147***	0.0252
Constant	18.3256***	3.5864
ECT_{t-1}	−0.3411***	0.0590
Dignostic checks		
Heteroskedasticity (Breusch-Pagan):	Chi^2 (1) = 0.00, *P*=0.954	
Normality of residuals (Skewness/Kurtosis):	Joint Chi^2 (2) = 0.11, *P*=0.947	
Model Specification (Ramsey RESET):	F (3, 24) = 3.22, *P*=0.140	
Autocorrelation (Lagrange Multiplier):	The Breusch-Godfrey LM test indicates no significant serial correlation at 5% level	

***,**, *Indicate significance at the 1% , 5% and significance levels respectively

Table 3: Error Correction Model (ECM) Estimation Results for the Non-Linear ARDL (NARDL) Model – Long-Run and Short-Run Coefficients

Variable	Coefficient	Standard error
Long-run coefficients		
ROP^{+}_{t-1}	0.1276	0.0766
ROP^{-}_{t-1}	0.1486	0.1073
$RENT_{t-1}$	-0.6509***	0.2058
$GDPPC_{t-1}$	-0.0004	0.0003
INF_{t-1}	-0.2113	0.3304
$REER_{t-1}$	0.0883	0.0673
Short-Run Coefficients		
$\Delta SERV_{t-1}$	-0.1659**	0.0728
ΔROP^{+}_{t}	-0.1241***	0.0395
ΔROP^{-}_{t}	-0.1474***	0.0281
ΔROP_{t-1}	-0.0549**	0.0264
$\Delta RENT_t$	-0.2008***	0.0513
$\Delta GDPPC_t$	-0.0004*	0.0002
$\Delta GDPPC_{t-1}$	-0.0003*	0.0002
ΔINF_t	-0.0652	0.0989
$\Delta REER_t$	0.1167***	0.0265
ECT_{t-1}	-0.308***	0.06

***, **,*Indicate significance at the 1% , 5% and significance levels respectively

As in the linear model, oil rents maintain a strong and statistically significant negative effect in the NARDL estimation (β = -0.650, P = 0.004), confirming their persistent role in weakening service sector resilience. The REER coefficient remains positive and significant in the short run (β = 0.116, P < 0.01), aligning closely with the linear model (β = 0.114, P < 0.01) and suggesting that currency appreciation may facilitate service sector growth through enhanced domestic consumption or investment inflows. GDP per capita and inflation again show no statistically significant influence.

To formally test for long-run asymmetry between the effects of positive and negative oil price shocks, we conducted a nonlinear combination test using the nlcom command in Stata. The results, shown in Table 4, indicate that the difference between the long-run effects is not statistically significant. This suggests that, in the long run, oil price increases and decreases have similar net effects on the services sector, though short-run dynamics remain asymmetric and significant.

The diagnostic tests confirm that the estimated linear ARDL and NARDL models are statistically robust and well-specified. Specifically, the Breusch-Godfrey test for serial correlation yields a P > 0.10, indicating no evidence of autocorrelation in the residuals. Similarly, the Breusch–Pagan test confirms homoscedasticity, with a P-value above 0.10, suggesting no heteroscedasticity issues. The residuals are also normally distributed, as evidenced by the Jarque–Bera test (P > 0.10). Moreover, both the CUSUM and CUSUMSQ tests, though not reported for brevity, fall within the 5% confidence boundaries, affirming the stability of the model parameters over time. Together, these diagnostics reinforce the credibility and reliability of the linear ARDL and NARDL estimations.

5.4. Comparative Interpretation and Policy Insights

Together, the ARDL and NARDL models provide a consistent description. The services sector in Saudi Arabia is highly sensitive to oil price dynamics and rentier effects, with robust evidence of a long-run positive link between oil prices and services value added, but also a persistent negative role played by oil rents. This duality reflects the country's dependence on oil wealth while coping with the structural challenges of diversification. The real effective exchange rate emerges as a supporting factor for the services sector, while traditional macro indicators like inflation and income levels play a minimal role in explaining variation in service sector performance.

Crucially, while the long-run relationship appears symmetric, the NARDL results underscore that in the short term, both oil price increases and decreases can be disruptive. This suggests that volatility—not just price level—must be managed to support

Table 4: Asymmetry test result

Test	Statistic	Standard error
Long-run asymmetry	−0.0678	0.1201

service sector development. Policymakers should therefore focus not only on shielding the economy from downturns but also on avoiding over-expansion during booms, which can destabilize the services sector and disrupt diversification. These findings align with recent regional and global studies emphasizing the risks of oil-driven economic management and procyclical fiscal behavior, particularly in the Gulf region (Alhakimi, 2023; Raid et al., 2024). However, the current study offers a more refined focus on the services sector and the differential impact of positive and negative oil price shocks, contributing novel insights to the ongoing debate on Dutch Disease dynamics in oil-rich economies.

6. DISCUSSION

This study offers new insights into the complex dynamics between oil price volatility and the performance of Saudi Arabia's services sector over a long period from 1980 to 2023. Using both linear ARDL and nonlinear NARDL models, the analysis provides robust empirical evidence of both symmetric and asymmetric effects of oil price movements on the services sector. The results reveal significant distinctions between short-run and long-run relationships and suggest that the services sector is highly sensitive to oil market fluctuations, consistent with the broader literature on the macroeconomic consequences of oil dependency and resource-driven growth models.

In the linear ARDL model, we found a significant long-run negative relationship between oil rents and the share of services in GDP, suggesting that higher reliance on oil revenues tends to crowd out the services sector over time. This finding is consistent with the Dutch Disease hypothesis, as described by Corden and Neary (1982), where booming resource exports—manifested here in elevated oil rents—lead to distortions in domestic sectoral balances. Although the services sector is typically classified as non-tradable, its heavy reliance on public spending makes it indirectly vulnerable to oil revenue shocks. The negative long-run coefficient on GDP per capita further supports the view that sustained income growth in oil booms does not necessarily translate into a proportionate expansion of productive service activities. Rather, it could be indicative of a demand shift toward imported goods and luxuries, with weaker domestic service productivity.

The short-run dynamics from the ARDL model show that oil price shocks and changes in oil rents exert significant contemporaneous effects on the services sector. Notably, changes in real oil prices have negative short-term effects, suggesting that sudden oil price increases might trigger inflationary pressures or macroeconomic adjustments that momentarily disrupt service sector stability. This aligns with prior research by Alshehry and Belloumi (2015), who highlighted how fiscal channel volatility during oil booms distorts the structure of non-oil economic activity, including services.

The nonlinear NARDL model adds further insights by demonstrating clear asymmetries in how the services sector responds to oil price increases versus decreases. The short-run coefficients for both positive and negative changes in oil prices are statistically significant and negative, but the effect of negative oil price shocks is notably larger in magnitude. This asymmetry supports recent findings by Alhakimi (2023) and Raid et al. (2024), who highlight that oil price downturns tend to trigger more severe fiscal contractions, reduced public sector activity, and lower consumer confidence—factors that disproportionately impact service-driven economies. In Saudi Arabia, where public expenditure is a key driver of service sector demand—especially in sub-sectors like education, healthcare, and administration—oil price busts often lead to austerity measures, delayed investments, and reductions in government hiring, all of which stifle service sector performance.

Interestingly, the long-run coefficients for positive and negative oil price changes in the NARDL model are both statistically insignificant, though they are positive. This implies that over extended periods, the services sector may partially adapt to oil price cycles, possibly through policy buffers such as sovereign wealth fund drawdowns, countercyclical fiscal policy, or structural adjustments. This partial adaptation, however, does not eliminate the vulnerability created by oil dependency, especially during periods of prolonged price downturns. The magnitude and direction of the short-run effects suggest that the sector remains highly exposed to oil market volatility, consistent with findings by Raid et al. (2024) and Alhakimi (2023), who emphasize the central role of fiscal policy in transmitting oil shocks to the non-oil economy—particularly through public investment and service sector employment.

Comparing our findings with the broader regional literature, the results are consistent with studies like Callen et al. (2014), which report Dutch Disease symptoms across the GCC. However, the current study offers a more refined perspective by focusing exclusively on the services sector and disaggregating oil price effects into their asymmetric components. While previous studies often grouped services with other non-oil sectors or relied on aggregate GDP data, our approach allows for clearer identification of sector-specific vulnerabilities under conditions of persistent oil dependency.

The real effective exchange rate was found to have a statistically significant positive short-run impact on services value-added in both models. While this may appear counterintuitive under Dutch Disease logic, it is likely reflective of the unique features of Saudi Arabia's service economy, which includes substantial state-funded projects that may not respond to competitiveness pressures in the same way as private manufacturing. As Berument et al. (2010) observed, tourism and financial services may benefit from exchange rate effects, especially in the context of domestic policy reforms under Vision 2030.

Despite the strength of the findings, the study has several limitations. First, while the use of annual data over four decades allows for long-term insight, it may mask short-term volatility and seasonal adjustments, which could be better captured with quarterly data. Second, the services sector is heterogeneous, comprising both market-based and government-dominated components. Future research could disaggregate the services sector further to determine which sub-sectors are most vulnerable to oil price changes. Third, the modeling framework, while robust, assumes stable parameters over time. Structural breaks—such as major policy shifts or geopolitical shocks—may introduce nonstationarities that are not fully accounted for in our models. Lastly, exogenous shocks such as the COVID-19 pandemic are not explicitly modeled, although they fall within the sample period.

The results underscore that oil dependency, while a source of fiscal strength during booms, creates chronic vulnerabilities for long-term service sector development. Policymakers should prioritize reforms that strengthen market-driven service activities, such as tourism, logistics, and financial services, which are less reliant on fiscal stimulus and more resilient to oil price fluctuations. Enhancing private sector participation, improving service productivity, and expanding export-oriented services are all essential for long-term resilience. Moreover, the asymmetric nature of oil price effects calls for precautionary fiscal planning: stabilization funds should be mobilized more aggressively during oil booms to cushion the impact of busts on service provision. As part of the Vision 2030 strategy, reducing oil dependency must be linked with service sector innovation and competitiveness to ensure sustainable, shock-resilient economic growth.

7. CONCLUSION

This paper provides new empirical insights into the relationship between oil dependency and services sector growth in Saudi Arabia by distinguishing between symmetric and asymmetric effects of oil price movements. Drawing on annual data from 1980 to 2023, the results highlight that while the services sector is indeed linked to oil market cycles, it responds more sharply to negative shocks than to positive ones in the short run—an asymmetry that conventional linear models fail to capture. This finding underscores the services sector's deep fiscal dependency in oil-exporting economies and reinforces the importance of incorporating nonlinear dynamics into policy modeling.

Importantly, the study moves beyond traditional Dutch Disease narratives focused on manufacturing to show that services—though often classified as non-tradable—are highly vulnerable to resource volatility through fiscal and institutional channels. The application of both ARDL and NARDL models allowed for a better understanding of how oil price volatility, under conditions of persistent oil dependency, influences short- and long-run sectoral outcomes.

As Saudi Arabia continues to pursue structural transformation under Vision 2030, reducing the services sector's vulnerability to oil busts will require sustained reforms in public finance, labor markets, and private sector development. These results thus speak directly to ongoing debates about economic resilience, diversification, and the future of oil-rich states in a post-hydrocarbon world. The findings emphasize that any successful diversification strategy must address not only sectoral expansion but also fiscal insulation and structural independence from oil revenues.

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