Heterogeneous Responses to Oil Price Shocks: Trade and Output Effects in Oil-Import-Dependent Economies

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Abstract

This study examines the asymmetric effects of oil price fluctuations on domestic output and trade balance across 30 oil-importing countries from 1983 to 2022. Two distinct models are employed. The first estimates GDP as a function of oil prices, oil consumption, FDI, net exports, the labour force, and gross fixed capital formation. The second model treats the trade balance as a function of oil prices, the real effective exchange rate, net national income, and FDI. Using the Nonlinear Autoregressive Distributed Lag (NARDL) approach, the analysis reveals significant asymmetries in the impact of oil price changes. Specifically, oil price increases tend to suppress GDP and worsen the trade balance, while price decreases are associated with modest improvements in both indicators. The findings indicate that higher oil prices reduce economic growth by raising production costs and inflationary pressures, whereas lower oil prices encourage output by stimulating demand and investment. Capital formation and energy consumption emerge as the strongest drivers of GDP growth, while foreign direct investment plays a supportive but less immediate role. In the case of the trade balance, positive oil price shocks deteriorate external performance, whereas adverse shocks improve it in the short term. The real effective exchange rate shows an inverse relationship with trade balance, indicating that currency appreciation hurts export competitiveness. These findings highlight the vulnerability of oil-importing economies to oil price volatility and underscore the need for targeted policy measures to enhance economic resilience and stability.

Keywords: GDP, Trade Balance, Oil Prices, Asymmetric Effect, NARDL.

Introduction

The global economy is intricately connected, and oil plays a pivotal role in driving this interconnectedness. As a vital input to industrial operations, transportation, and energy production, oil remains the primary energy source worldwide (Liu et al., 2025). Due to its centrality, fluctuations in oil prices significantly influence global economic dynamics. Oil-importing countries, in particular, are highly susceptible to these variations because they rely on external energy sources (Rentschler, 2013). A surge in oil prices can lead to inflationary pressures, reduced consumer spending and decelerated economic growth, while declining prices often minimise production costs and stimulate economic activity (Kilian & Park, 2009). Beyond short-term economic concerns, oil prices are widely viewed as an indicator of global economic health. Fluctuations affect macroeconomic indicators such as inflation, unemployment and GDP growth. For instance, rapid increases in oil prices raise costs for firms

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and households, thereby exacerbating inflation and curtailing growth (Blanchard & Gali, 2007). Conversely, declining prices can lower transportation and production expenses, prompting increased spending and investment. These shifts ripple across sectors, shaping consumer behaviour, industrial output and investment strategies (Baumeister & Kilian, 2016).

Importantly, the effects of oil price movements are asymmetric. Price hikes often cause greater economic disruption than the benefits gained from price declines (Hamilton, 2009). While exporters may see increased revenues, importers endure rising costs, deteriorating trade balances and contracting output. The theory of irreversible investment under uncertainty further explains this asymmetry; heightened volatility discourages investment and delays economic decisions (Dixit & Pindyck, 1994). Hamilton (1983) also highlighted how oil market instability leads to reduced household and firm expenditures.

Moreover, changes in oil prices significantly affect trade balances. Higher prices worsen the trade positions of oil-importing nations, while exporters enjoy improved balances and increased foreign-exchange reserves (Chen & Chen, 2007). This divergence influences exchange rates, purchasing power and fiscal capacity. For oil exporters, increased revenues can finance infrastructure and social spending, while importers may face inflation, currency depreciation and budgetary deficits (Cunado & De Gracia, 2005).

Volatility in oil markets further fuels economic uncertainty, especially for oil-dependent industries such as transportation and manufacturing. Firms often postpone investment decisions when oil prices are unstable, hampering technological advancement and economic development (Bernanke et al., 1997). Government interventions, such as fuel subsidies, may offer short-term relief but can also strain budgets and distort markets (Shehabi, 2021). Understanding oil price dynamics is therefore essential for informed policy-making and economic forecasting. Globally, oil remains the dominant energy resource. As demand rises, oil prices have become a leading signal of economic performance (Bhattarai & Yousef, 2025). Oil-importing countries, highly exposed to price shocks, experience widespread economic volatility. Key sectors such as agriculture, industry and transport are heavily affected, making macroeconomic management more complex. Rising oil prices induce inflation, deteriorate trade balances and weaken current accounts in importing nations (Lescaroux & Mignon, 2008). In contrast, oil-exporting countries benefit from increased revenues and economic expansion.

The economic effects of price fluctuations are particularly severe in developing countries. For example, oil-importing nations face a dual challenge: higher oil prices worsen trade terms and reduce purchasing power, while falling prices can temporarily boost economic activity (Aldunate & Casassus, 2012). Higher energy prices raise input costs, reduce profit margins and lower employment, dampening GDP growth. Since oil is a key input in producing electricity, transportation and various commodities, oil price hikes also trigger broader commodity price increases, fueling inflation and reducing consumption (Lescaroux & Mignon, 2008). These multidimensional impacts underscore the importance of closely monitoring and managing oil price risks in both oil-importing and exporting economies.

Oil remains the dominant global energy source, accounting for approximately 31% of total energy consumption worldwide as of 2023 (Raimi et al., 2023). Many countries, especially developing and emerging economies, are net oil importers, relying heavily on foreign energy supplies because of insufficient domestic resources. For example, Pakistan imports over 85% of its energy needs, making it particularly vulnerable to global oil price movements (Khan et al., 2024). Similarly, India imports more than 80% of its crude oil, exposing its trade balance and economic stability to external shocks (Kondratov, 2024).

Fluctuations in oil prices have asymmetric effects: an increase in oil prices often leads to inflation, trade deficits and reduced GDP growth, while a decrease in oil prices does not always produce proportional economic benefits (Hamilton, 2011). In fact, a $ 10-per-barrel increase

in oil prices can reduce GDP growth in oil-importing countries by up to 0.3% annually (Hmadouch, 2025). Such volatility places external and internal balances at risk.

Domestic output (GDP) and external balances (trade and current account) are critical macroeconomic objectives that serve as key indicators of economic health. The volatility of global oil prices, driven by geopolitical tensions, supply chain disruptions, and OPEC+ production decisions, poses a serious challenge to macroeconomic stability. For instance, during the 2022 oil price spike, several oil-importing economies recorded double-digit inflation and current account deficits exceeding 5% of GDP (Kara & Sarıkaya, 2023). Recognising the asymmetric and volatile nature of oil price impacts is essential for understanding how domestic output and external balances respond to oil market dynamics. Without adequate policy responses and risk mitigation strategies, countries highly dependent on oil imports may face sustained economic vulnerability, fiscal imbalances and long-term growth constraints.

Research Questions

Research questions for this study:

1. Does the asymmetric impact of oil prices affect the trade balance of oil-importing countries?
2. Do the asymmetric implications of oil prices affect the domestic output of oil-importing countries?

Objectives of the Study

This study has specific goals:

1. To explore the asymmetric impact of oil prices on the trade balance of oil-importing countries.
2. To explore the asymmetric effect of oil prices on the domestic output of oil-importing countries.

Scope and Significance

The current study uses panel data from 30 oil-importing countries over 40 years, from 1983 to 2022. The study examines GDP and Trade balance as dependent variables, with explanatory variables including oil prices, oil consumption, foreign direct investment, real effective exchange rates, gross fixed capital formation, labour force, net exports, and net national income. The research suggests that, in the face of asymmetry, we must plan to understand how oil price changes affect domestic output and the trade balances of oil-importing countries.

Literature Review

Oil Prices and Gross Domestic Product (GDP)

The relationship between oil price fluctuations and GDP remains a critical area of macroeconomic research, particularly for both oil-exporting and oil-importing economies. Recent studies highlight asymmetric effects, emphasising the role of a country's oil dependency and economic structure.

Nizam et al. (2022) examined the impact of oil prices and inflation on Pakistan's economic growth (1976–2019), finding that while rising oil prices contributed to inflation, they did not significantly stimulate GDP growth in the short- or long-run. Similarly, Umechukwu and Olayungbo (2022) employed a VAR model on quarterly data (1980–2018) for Algeria, Egypt, Gabon and Nigeria, revealing asymmetric responses. Algeria and Egypt benefited from positive oil shocks. In contrast, Gabon and Nigeria exhibited weaker, symmetric reactions.

Akinsola and Odhiambo (2020) analysed seven low-income oil-importing Sub-Saharan African countries (1980–2022) using a panel ARDL approach. Their findings confirmed asymmetric effects: oil price increases negatively impacted GDP, while decreases had a mild positive effect, underscoring these economies' vulnerability to global price shocks. Abdelsalam

(2023) studied 17 MENA countries (1970–2018) and found that oil exporters benefited from price increases, whereas volatility posed long-term risks. Conversely, oil importers occasionally experienced positive effects from volatility, possibly due to substitution effects and policy buffers.

Van Eyden et al. (2019) conducted a historical panel analysis (1870–2013) across OECD countries, revealing that oil price volatility rather than price levels negatively affected real GDP growth, particularly in oil-importing nations. Foudeh (2017) used an ARDL model to assess Saudi Arabia (1995–2015), confirming that oil price increases boosted GDP, foreign investment and reserves before 2014, but the post-2014 price decline severely impacted macroeconomic stability.

Sarwar et al. (2017) investigated oil prices, electricity consumption and GDP (1960–2014) in OECD and non-OECD countries, finding bidirectional causality between oil prices and GDP. In energy-dependent economies, increased electricity consumption negatively correlated with growth. Nwanna and Eyedayi (2016) examined Nigeria (1980–2014) and found that while higher oil prices stimulated exports and revenue, adverse shocks reduced public income and foreign capital inflows. Negi (2015) examined the BRIC nations (1987–2014) and found heterogeneous effects: oil price increases benefited Russia and Brazil (exporters) but harmed China and India (importers). Similarly, Ibrahim (2021) analysed Nigeria (1981–2012) using GMM, finding that oil price increases supported growth but also introduced fiscal uncertainty.

Oil Prices and Trade Balance

The asymmetric effects of oil price fluctuations on trade balances have also been widely examined, particularly in distinguishing between oil-exporting and oil-importing economies.

Forson et al. (2022) studied 34 Sub-Saharan African countries (2004–2017) and demonstrated that oil price volatility influenced trade balances through exchange rates, interest rates, and inflation. Using GARCH and panel mean group estimators, they confirmed the region's susceptibility to oil shocks. Similarly, Taşseven and Poturoğlu (2022) applied a two-regime TVAR model to Turkey (1987–2019), showing that high oil prices worsened the overall trade balance but improved consumer goods exports under high-volatility conditions. Ibukun et al. (2024) analysed ASEAN-5 economies using a TVP-VAR and found that oil price shocks negatively affected trade balances in net importers such as the Philippines and Thailand. Bala and Chin (2023) employed a dynamic threshold model for OPEC nations, revealing that oil exports improved trade balances up to a certain threshold, beyond which the benefits diminished.

Faheem et al. (2020) examined Saudi Arabia, Kuwait and the UAE (1980–2017) using linear and nonlinear ARDL models, finding that oil price changes significantly influenced trade balances, while exchange rate volatility had mixed effects. Ahad and Anwer (2021) applied a nonlinear ARDL approach to the BRIC nations (1992–2015) and found that oil price asymmetries improved trade balances. However, the effects varied across countries due to differences in industry and pricing. Baek (2020) studied Korea's trade with 14 partners, finding that oil price asymmetries unevenly affected trade balances, with long-term adverse effects on exchanges with oil-importing partners. Kunle (2020) found only short-term Granger causality between oil prices and Nigeria's trade balance, suggesting that exchange rates and inflation mediate long-term effects.

Research Gap

While existing studies have explored oil price impacts on GDP and trade balances across various regions, such as OECD (Van Eyden et al., 2019), MENA (Mahrous et al., 2020), SSA (Akinsola & Odhiambo, 2020) and OPEC (Bala & Chin, 2023), a significant methodological and regional gap persists. Most studies focus on single-country or small-group analyses and

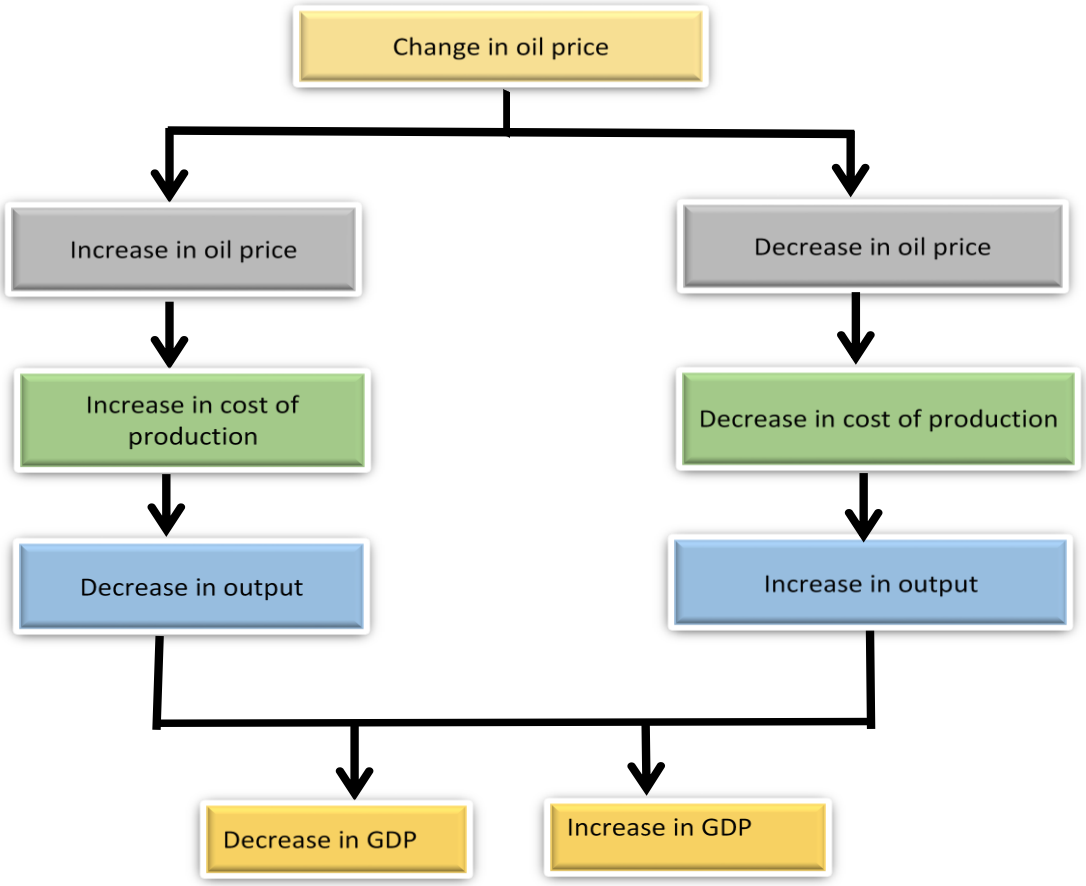
rely on linear models, failing to capture real-world nonlinearities. This study addresses this gap by employing a nonlinear ARDL framework to examine the asymmetric effects of oil price fluctuations on GDP and trade balances across 30 oil-importing countries, offering new insights for economic policy and energy vulnerability management.

Conceptual Framework

The conceptual framework of this study integrates both theoretical and empirical foundations to explain the asymmetric effects of oil price fluctuations on domestic output and trade balance in oil-importing countries. Drawing on economic growth theories and international trade models, it establishes the pathways through which oil price dynamics influence macroeconomic performance. The framework primarily builds on the Cobb-Douglas production function, which highlights the roles of labour, capital, and total factor productivity in determining economic output. Within this context, oil prices serve as a critical production input, influencing productivity and efficiency. Rising oil prices increase production costs, lower firm profitability and constrain output, whereas declining oil prices reduce input costs and encourage investment, thereby enhancing growth. This mechanism underscores how energy costs directly shape production performance and total factor productivity across economies dependent on imported oil. The theory of asymmetric effects holds that economies respond differently to positive and negative oil price shocks. An increase in oil prices has more substantial adverse effects on output than the positive effects generated by equivalent price decreases. The asymmetric response theory further suggests that structural rigidities and behavioural adjustments magnify these differences. At the same time, oil price volatility introduces uncertainty, discourages investment, and disrupts consumption, weakening overall economic stability. Beyond oil prices, the framework integrates other growth determinants, such as foreign direct investment (FDI), gross fixed capital formation (GFCF), labour force, oil consumption, and net exports, all of which influence output levels. For the trade balance, the framework applies the Marshall-Lerner condition, showing that real effective exchange rate (REER) depreciation enhances trade by improving export competitiveness, while appreciation worsens it.

Overall, the conceptual framework demonstrates that oil price movements shape domestic output and the trade balance through both cost-productivity channels and external-sector adjustments. The asymmetric nature of these relationships underscores the need for policies that promote energy diversification, efficient investment, and exchange rate stability to strengthen economic resilience.

Figure 01: Oil Prices and Economic Output: Pathways to GDP Change



Data and Methodology

Model Specification

The Nonlinear Autoregressive Distributed Lag (NARDL) model is employed to analyze the asymmetric effects of oil price shocks on domestic output (GDP) and trade balance. The study employs two econometric models to examine the impact. The first model analyzes the effect of oil prices on GDP, while the second investigates the impact of oil prices on trade balance. Both models include control variables such as oil consumption, foreign direct investment (FDI), net exports, labor force and gross fixed capital formation (GFCF).The model is designed to capture both the short-term and long-term dynamics of oil price changes, separating positive and negative price shocks.

Model 1: Impact of Oil Price on Domestic Output

Domestic Output is affected by oil price, consumption, FDI, net exports, labour force and GFCF. GDP is the dependent variable, while oil price, consumption, FDI, net exports, labour force and gross fixed capital formation are independent variables. GDP = f (OP, OC, FDI, X, LF, GFCF)

Where,

GDP = Gross Domestic Product

OP = Oil price

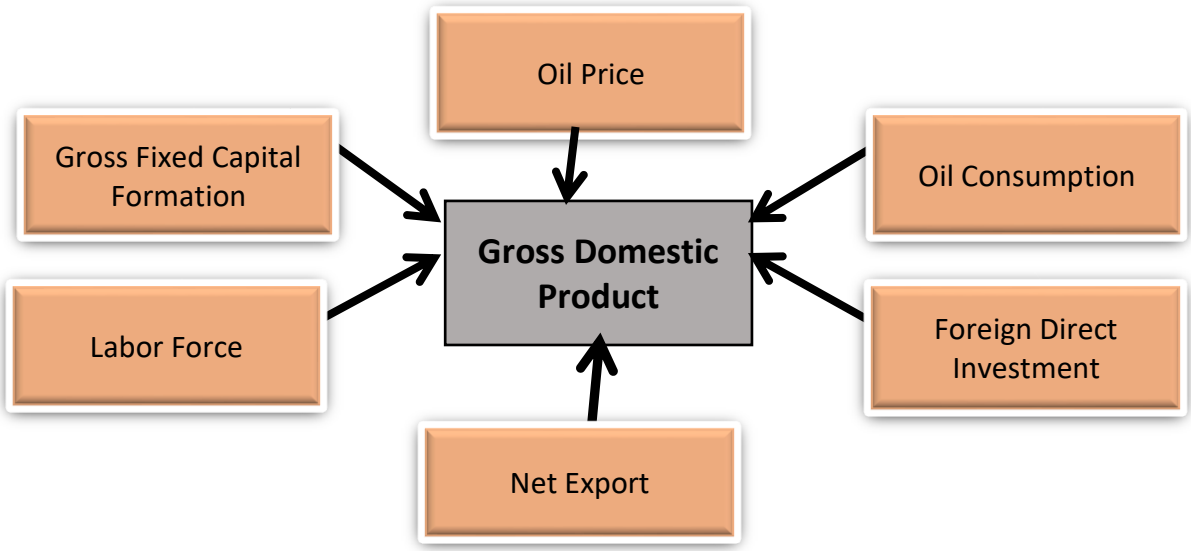
OC = Oil consumption

GFCF = Gross fixed capital formation

LF = Labor Force

X = Net Exports,
FDI = Foreign Direct Investment

Figure 2: Model Specification (GDP and Oil Prices)



Econometric Model

$$\ln(GDP_t) = \epsilon_0 + \sum_{i=1}^{q_1}(\epsilon_1 lnGDP_{t-1}) + \sum_{i=1}^{q_2}(\epsilon_2^{+} lnOP_{t-i}^{+}) + \sum_{i=1}^{q_3}(\epsilon_3^{-} lnOP_{t-i}^{-}) + \sum_{i=1}^{q_4}(\epsilon_4 lnOC_{t-1}) + \sum_{i=1}^{q_5}(\epsilon_5 lnFDI_{t-1}) + \sum_{i=1}^{q_6}(\epsilon_6 lnX_{t-1}) + \sum_{i=1}^{q_7}(\epsilon_7 lnLF_{t-1}) + \sum_{i=1}^{8}(\epsilon_8 lnGFCF_{t-1}) + u_t \quad (01)$$

Where ϵ'_s are long-run estimated parameters of the non-linear ARDL model, q's are the optimal lag length of the long-run model.

$$\ln \Delta(GDP_t) = \vartheta_0 + \sum_{i=1}^{p_1}(\vartheta_1^{+}\Delta lnOP_{t-i}^{+}) + \sum_{i=1}^{p_2}(\vartheta_2^{-}\Delta lnOP_{t-i}^{-}) + \sum_{i=1}^{p_3}(\vartheta_3\Delta lnOC_{t-1}) + \sum_{i=1}^{p_3}(\vartheta_3\Delta lnFDI_{t-1}) + \sum_{i=1}^{p_4}(\vartheta_4\Delta lnX_{t-1}) + \sum_{i=1}^{p_5}(\vartheta_5\Delta lnLF_{t-1}) + \sum_{i=1}^{p_6}(\vartheta_6\Delta lnGFCF_{t-1}) + (\delta ECM_{t-1}) + u_t \quad (02)$$

Table 01: Description, Data Source and Measurement of Variables

Code	Variable	Description	Measurement	Expected Sign	Data Source
Dependent Variable					
GDP	Gross Domestic Product	Gross Domestic Product is a country's economic output, representing the market worth of all final goods and services produced in a certain time span.	U.S. dollars.		World Development Indicators (WDI)
Principal variable					
OP	Oil Price	The average crude oil price is $ per barrel. This commodity is vital to the world economy. It shows worldwide oil production and demand.	$/Barrel	negative	BP Statistical Review of World Energy

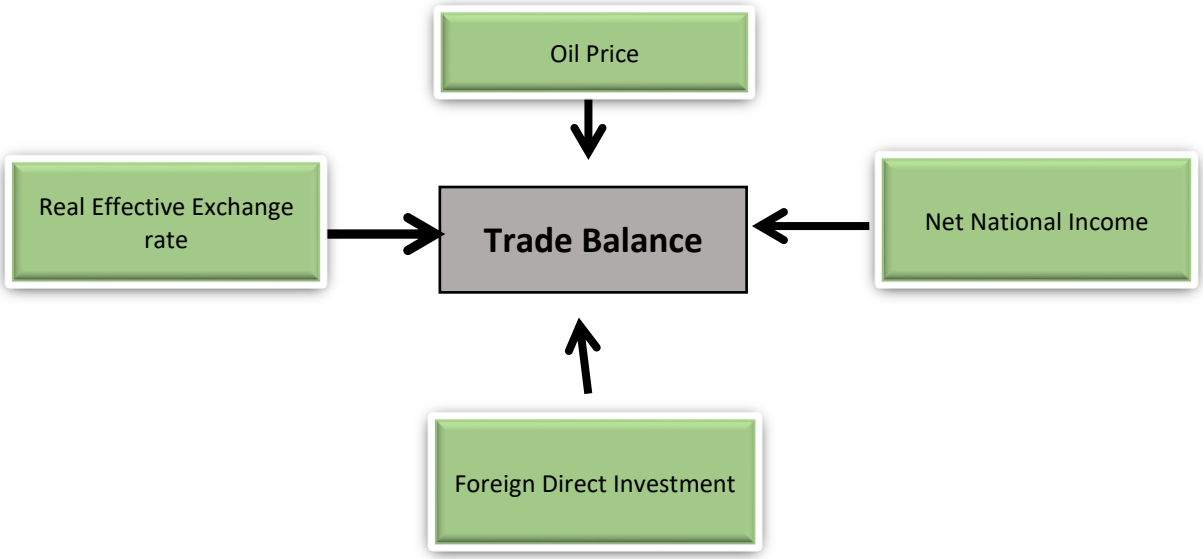
Control Variables					
OC	Oil Consumption	A country's oil consumption, measured in barrels or tons, shows its energy dependence on oil.	Barrel or Tons	positive	BP Statistical Review of World Energy
FDI	Foreign-Direct Investment	Foreign direct investment includes corporate, real estate and infrastructure developments.	(Bop, current US$)	positive	World Development Indicators (WDI)
X	Net Exports	A country's trade performance is measured by its net exports, which are the difference between exports and imports.	(current US$)	positive	World Development Indicators
LF	Labor Force	Labor force is the total number of people who are either employed or actively seeking employment, reflecting the participation of working-age population in the economy	No. of people	positive	World Development Indicators (WDI)
GFCF	Gross Fixed Capital Formation	The net increase in physical assets in an economy is measured by gross fixed capital formation. Over a year, it represents investment in production-related buildings, machinery, infrastructure and equipment.	(current US$)	Positive	World Development Indicators (WDI)

Model 2: Impact of oil price on Trade balance

Analysis of Trade Balance uses oil price, real effective exchange rate, net national income and foreign direct investment. Dependent and independent variables are Trade Balance, oil price, Real Effective exchange rate, net national income, as well as FDI. TB=f (OP, REER, NNI, FDI,)

Where, TB= Trade Balance
REER= Real Effective exchange rate
NNI= Net National Income
FDI= Foreign Direct Investment

Figure 03: Model Specification (Trade Balance and Oil Prices)



Econometric Model

$$\ln(TB_t) = \epsilon_0 + \sum_{i=1}^{q_1}(\epsilon_1 lnTB_{t-1}) + \sum_{i=1}^{q_2}(\epsilon_2 lnOP_{t-i}^{+}) + \sum_{i=1}^{q_3}(\epsilon_3 lnOP_{t-i}^{-}) + \sum_{i=1}^{q_4}(\epsilon_4 lnREER_{t-i}) + \sum_{i=1}^{q5}(\epsilon_5 lnNNI_{t-1}) + \sum_{i=1}^{q6}(\epsilon_6 lnFDI_{t-1}) + u_t \quad (03)$$

Where ϵ'_s are long-run estimated parameters of the non-linear ARDL model ,q's are the optimal lag length of the long-run model.

$$\ln(\Delta TB_t) = \vartheta_0 + \sum_{i=1}^{q_1}(\vartheta_1 ln\Delta TB_{t-1}) + \sum_{i=1}^{q_2}(\vartheta_2 ln\Delta OP_{t-i}^{+}) + \sum_{i=1}^{q_3}(\vartheta_3 ln\Delta OP_{t-i}^{-}) + \sum_{i=1}^{q_4}(\vartheta_4 ln\Delta REER_{t-i}) + \sum_{i=1}^{q5}(\vartheta_5 ln\Delta NNI_{t-1}) + \sum_{i=1}^{q6}(\vartheta_6 ln\Delta FDI_{t-1}) + (\delta ECM_{t-1}) + u_t (04)$$

Table 02: Description, Data Source and Measurement of Variables

Code	Variable Name	Description	Measurement	Expected Sign	Data Source
Dependent Variable					
TB	Trade Balance	Trade balance captures how oil price variations effect a country's international trade position and thus domestic economic production.	Current US$.		World Development Indicators (WDI)
Principal variable					
OP	Oil Price	The average crude oil price is $ per barrel. This commodity is vital to the world economy. It shows worldwide oil production and demand.	$/Barrel	Negative	BP Statistical Review of World Energy
Control Variables					
REER	Real effective Exchange rate	National products and services' worldwide competitiveness is reflected in their real effective exchange rate. It compares a country's inflation-adjusted currency to a basket of major currencies.	Real effective exchange rate index (2010 = 100)	Negative	World Development Indicators (WDI)
FDI	Foreign-Direct Investment	Foreign direct investment might be in business, real estate, or infrastructure.	(Bop, current US$)	Positive	World Development Indicators (WDI)
NNI	Net National Income	After capital depreciation, net national income is a country's people' total income, including foreign revenue. This study expands on how oil price changes effect trade balance by including NNI.	current US$.	Positive	World Development Indicators (WDI)

Data

This study employs data for 30 oil-importing countries covering the period 1983–2022. Two empirical models are specified. In the first model, gross domestic product (GDP) serves as the dependent variable, while oil price, oil consumption, foreign direct investment (FDI), net exports, labor force and gross fixed capital formation (GFCF) are included as control variables. The second model uses trade balance as the dependent variable, with oil price as the primary explanatory variable and the real effective exchange rate (REER), FDI and net national income (NNI) as controls. The dataset was compiled from two main sources: the *World Development Indicators (WDI)* and the *BP Statistical Review of World Energy*. Specifically, GDP, trade balance, FDI, net exports, labor force, GFCF, REER and NNI were obtained from the WDI. Oil price and oil consumption data were taken from the BP Statistical Review of World Energy. The trade balance was constructed by aggregating export and import values, both available in the WDI, while net exports were calculated as exports minus imports. To obtain real oil prices, the nominal oil price series from the BP Statistical Review was deflated by the consumer price index (CPI). In order to investigate the asymmetric effects of oil price fluctuations on domestic output and trade balance, the real oil price series was further decomposed into positive and negative changes.

Results and Discussion

The results and discussion chapter addresses the study's data. The chapter opens with a detailed overview of study variable descriptive statistics. Unit root tests evaluate data stationarity. This chapter analyses essential factors and early interactions as correlations. Tabulated ARDL along with NARDL results make the conclusions evident. Interpretations of the results are also included, providing clear understanding of how oil prices affect trade balance and domestic output.

Model 1: GDP and Oil Price

Descriptive Statistics

Descriptive statistics summarize and characterize data. Descriptive statistics include observation, standard deviation, mean, median, maximum and minimum values.

Variable descriptive statistics are below:

Table 03: Descriptive Statistics of the Variables (Model 01)

	GDP	OP	OC	FDI	X	LF	GFCF
Mean	11.6995	1.305231	2.725344	0.031651	-0.00945	47.55511	11.05639
Median	11.66416	1.299246	2.714024	0.016452	0.001523	47.019	11.02293
Maximum	13.40551	13.40551	3.437563	4.049764	0.864791	81.756	12.73847
Minimum	10.08416	0.900025	1.888433	-0.3614	-0.34619	13.04	9.44727
Std. Dev	0.603043	0.800025	1.888433	-0.3614	-0.34619	13.37626	0.604254
Skewness	0.14516	0.570166	0.575646	4.682624	-1.21166	0.17267	0.182277
Kurtosis	2.806694	5.483199	3.304227	43.97104	5.422291	2.251111	2.686342
Jarque Bera	5.205719	319.5098	60.67979	75584.37	502.3739	29.10239	9.896884
Probability	0.074061	0.000000	0.000000	0.000000	0.000000	0.000000	0.007094
Sum	12015.39	1340.472	2798.928	32.50528	-9.70218	48839.1	11354.91
Sum Sq. Dev	373.1164	74.74407	219.3917	4.235808	5.511228	183576.3	374.6164
Observations	1027	1027	1027	1027	1027	1027	1027

The descriptive statistics in Table 03 reveal that GDP has a relatively stable distribution with a mean of 11.69 and low skewness, whereas oil price (OP) and oil consumption (OC) exhibit higher variability, with OP showing positive skewness and leptokurtic behavior. Foreign direct investment (FDI) displays extreme kurtosis, indicating the presence of sharp outliers, while

trade balance (X) is negatively skewed, suggesting periods of large trade deficits. The Jarque–Bera test indicates that most variables, except GDP, deviate from normality.

Table 04: Correlation Analysis (Model 01)

	GDP	OP	OC	FDI	X	LF	GFCF
GDP	1	0.227127	0.862761	-0.06173	0.064964	0.120494	0.987048
OP	0.227127	1	-0.00309	0.091284	-0.06322	-0.16132	0.209662
OC	0.862761	-0.00309	1	-0.0532	0.040835	0.168994	0.876029
FDI	-0.06173	0.091284	-0.0532	1	0.173634	0.04515	-0.05739
X	0.065965	-0.06322	0.040835	0.173634	1	-0.01131	0.081034
LF	0.120494	-0.16132	0.168994	0.04515	-0.01131	1	0.143574
GFCF	0.987048	0.209662	0.876029	-0.05739	0.081034	0.143574	1

Table 04 presents the correlation matrix, showing that GDP is strongly and positively correlated with gross fixed capital formation (GFCF, 0.99) and oil consumption (0.86), underscoring the importance of capital formation and energy use in driving economic activity. Oil price demonstrates only a weak positive correlation with GDP (0.23) and no significant relationship with oil consumption, implying limited direct pass-through effects of oil price movements on energy demand. FDI shows a negative but weak association with GDP, while trade balance maintains a very low positive correlation, highlighting their relatively minor role compared to domestic factors. Overall, the results suggest that economic growth in oil-importing countries is more closely tied to domestic capital formation and energy consumption than to oil price fluctuations or foreign capital inflows.

Unit Root Test

ADF tests are used to examine the stationary of annual panel data from 1983 to 2022. Table 5.3 shows every parameter stationary at level as well as 1st difference. All variables were stationary between level and 1st difference.

Table 5 displays Augmented Dickey-Fuller (ADF) test results.

Table 05: Results of Unit Root Test

Variables	**Level**		**1st difference**		**Order of integration**
	Individual intercept	**Individual intercept and trend**	**Individual intercept**	**Individual intercept and trend**	
GDP	-5.08081 (0.0000)***	-2.90056 (0.0019)***	-15.8983 (0.0000)***	-15.2281 (0.0000)***	I(0,1)
OP	0.9248 (1.43824)	1.93538 (0.9735)	-18.4007 (0.0000)***	-17.2166 (0.0000)***	I(1)
OC	-5.24771 (0.0000)***	-1.28995 (0.0985)*	-10.8172 (0.0000)***	-10.8306 (0.0000)***	I(0,1)
FDI	-5.86348 (0.0000)***	-5.50275 (0.0000)***	-18.5233 (0.0000)***	-14.9910 (0.0000)***	I(0,1)
X	-2.45636 (0.0070)***	-2.46060 (0.0069)***	-17.4105 (0.0000)***	-15.5555 (0.0000)***	I(0,1)
LF	-1.80606 (0.0355)**	0.99319 (0.8397)	-12.3946 (0.0000)***	-9.77845 (0.0000)***	I(0,1)
GFCF	-4.84130 (0.0000)***	-3.52223 (0.0002)***	-4.84130 (0.0000)***	-15.1741 (0.0000)***	I(0,1)

***p<.01, ** p<.05, * p<1 Note: Parenthesis () show P value

The ADF test results indicate that GDP, OC, FDI, X, LF and GFCF are stationary at both level and first difference [I (0, 1)], while OP is stationary only at the first difference [I (1)]. This stationarity confirms that the variables are appropriate for the subsequent ARDL co-integration analysis.

Symmetric and Asymmetric Impact of Oil Price on GDP

Table 06: ARDL Results for Model 1 (GDP and Oil Price)

Variable	Coefficient	Std Error	t- Statistics	Prob.*
Long Run Equations				
OP	-0.113074	0.002383	-47.45025	0.0000
X	0.345135	0.056933	6.062145	0.0000
LF	0.005906	0.001323	4.465318	0.0000
GFCF	0.939876	0.014413	65.21043	0.0000
FDI	0.187893	0.064416	2.916875	0.0037
OC	0.067557	0.024702	2.734876	0.0064
Short Run Equations				
COINTEQ01	-0.141858	0.025388	-5.587577	0.0000
D(GDP(-1))	0.195817	0.054958	3.563001	0.0004
D(OP)	0.023699	0.009032	2.623859	0.0091
D(OP(-1))	-0.018986	0.010205	-1.860395	0.0637
D(X)	0.459128	0.087487	5.247959	0.0000
D(X(-1))	0.068505	0.047669	1.437091	0.1512
D(LF)	-0.000380	0.000454	-0.836679	0.4031
D(LF(-1))	0.000787	0.000431	1.827619	0.0681
D(GFCF)	0.639452	0.031504	20.29778	0.0000
D(GFCF(-1))	-0.181625	0.044488	-4.082549	0.0001
D(FDI)	-0.174296	0.073584	-2.368671	0.0182
D(FDI(-1))	-0.072290	0.061915	-1.167575	0.2434
D(OC)	0.036152	0.037661	0.959940	0.3375
D(OC(-1))	-0.103352	0.040082	-2.578542	0.0102
C	0.173914	0.030125	5.773000	0.0000
Mean dependent var	0.023794	S.D. dependent var		0.047832
S.E. of regression	0.012943	Akaike info criterion		-5.459392
Sum squared resid	0.103190	Schwarz criterion		-3.484672
Log likelihood	3214.398	Hannan-Quinn criter		-4.709832

Table 07: NARDL Results for Model 1 (GDP and Oil price)

Variable	Coefficient	Std Error	t- Statistics	Prob.*
Long Run Equations				
OP_NEG	0.092649	0.030757	3.012279	0.0027
OP_POS	-0.147679	0.032139	-4.594995	0.0000
X	0.252127	0.070095	3.596942	0.0004
LF	0.001118	0.000721	1.551724	0.1215
GFCF	1.180843	0.048524	24.33520	0.0000
FDI	0.223063	0.063850	3.493574	0.0005
OC	0.354005	0.067130	5.273431	0.0000
Short Run Equations				
COINTEQ01	-0.130333	0.034514	-3.776244	0.0002
D(GDP(-1))	0.155983	0.070984	2.197431	0.0285
D(GDP(-2))	-0.037948	0.017406	-2.180111	0.0298
D(GDP(-3))	0.000875	0.017280	0.050615	0.9597

D(GDP(-4))	0.002009	0.017455	0.115096	0.9084
D(OP_NEG)	0.054652	0.017315	3.156430	0.0017
D(OP_NEG(-1))	-0.008590	0.018285	-0.469763	0.6388
D(OP_POS)	0.000743	0.016170	0.045928	0.9634
D(OP_POS(-1))	0.002322	0.014149	0.164097	0.8697
D(X)	0.489227	0.088777	5.510730	0.0000
D(X(-1))	0.088597	0.050106	1.768193	0.0777
D(LF)	-0.001146	0.000801	-1.431097	0.1531
D(LF(-1)	0.000437	0.000548	0.797889	0.4254
D(GFCF)	0.638267	0.037384	17.07323	0.0000
D(GFCF(-1)	-0.136937	0.054834	-2.497284	0.0129
D(FDI)	-0.365911	0.133979	-2.731109	0.0066
D(FDI(-1)	-0.124539	0.076861	-1.620309	0.1059
D(OC)	0.028524	0.038621	0.738557	0.4606
D(OC(-1)	-0.129120	0.058678	-2.200507	0.0283
C	-0.025970	0.014033	-1.850665	0.0649
@TREND	0.001133	0.000349	3.246471	0.0013
Mean dependent var	0.021537		S.D. dependent var	0.046267
S.E. of regression	0.011482		Akaike info criterion	-5.360172
Sum squared resid	0.056425		Schwarz criterion	-2.547599
Log likelihood	3259.446		Hannan-Quinn criter.	-4.291301

Impact of Oil Price on GDP

The ARDL results show that oil prices exert a significant negative long-run effect on GDP (–0.113). This finding suggests that rising oil prices raise production costs, increase inflationary pressures and discourage investment, thereby reducing output. Theoretically, when oil prices increase in oil-importing countries, the cost of imports rises, leading to higher expenditure on energy inputs. Since oil is a key factor of production, firms face higher costs, which reduce profit margins and discourage output expansion. As production cost escalate, total factor productivity declines, resulting in lower aggregate output and slower economic growth. In the short run, oil prices have a small positive effect (0.024), which may reflect temporary gains from higher energy-driven activity, while the lagged effect is negative, indicating delayed adjustment costs. The NARDL results highlight clear asymmetries: positive oil price shocks contract GDP (–0.148), whereas negative shocks expand it (+0.093). This asymmetry confirms that oil-importing economies gain more from falling prices than they lose from comparable increases. These findings are consistent with Negi (2015), Ibrahim (2015) and Foudeh (2017), who also reported adverse long-run effects of rising oil prices on output. By contrast, they contradict Ghalayini (2011), who found a positive relationship. The asymmetric evidence aligns with Akinsola and Odhiambo (2020) and Nwanna and Eyedayi (2016), further reinforcing the notion that oil price declines enhance economic activity.

Impact of Net Exports on GDP

Net exports strongly and positively affect GDP in both models (0.345 in ARDL; 0.252 in NARDL). This indicates that greater trade surpluses boost economic activity by stimulating production to meet global demand. In the short run, the effect remains highly significant (0.459 in ARDL; 0.489 in NARDL), confirming the immediate role of export growth in driving output. These results are consistent with Nwanna and Eyedayi (2016), Abdelsalam (2023) and Nazir and Qayyum (2014), who emphasized the positive role of trade balances in fostering growth. However, they diverge from LADAN et al. (2023) and Ali and Akhtar (2024), who reported weaker or negative effects.

Impact of Labor Force on GDP

The labor force has a positive and significant long-run effect on GDP in both models (0.0059 in ARDL; 0.0011 in NARDL), confirming that human capital is a key driver of sustained growth. In the short run, coefficients are weaker and often insignificant, suggesting that labor market expansions influence output primarily in the long run.

These results are consistent with the growth literature, particularly Akinsola and Odhiambo (2021), Foudeh (2017) and Ouis and Souar (2021). However, they differ from Maqbool et al. (2025) and Ibrahim and Morad (2020), who reported insignificant or contrary findings.

Impact of Gross Fixed Capital Formation on GDP

Gross fixed capital formation (GFCF) emerges as the most powerful determinant of GDP growth. The ARDL results show a long-run coefficient of 0.94, while the NARDL model yields an even stronger estimate (1.18). Short-run coefficients are also highly significant (0.639 in ARDL; 0.638 in NARDL), indicating that investment in capital goods swiftly translates into higher productivity and output. These results align with Taher (2021), Bekhet et al. (2017) and Ibrahim (2018), who highlighted the role of capital accumulation in growth. However, they contradict Ghalayini (2011) and Olayungbo and Umechukwu (2022), who found weaker or mixed effects.

Impact of Foreign Direct Investment on GDP

FDI significantly promotes GDP in the long run, with coefficients of 0.188 (ARDL) and 0.223 (NARDL). This suggests that foreign capital inflows enhance growth through technology transfer, innovation and increased investment. In the short run, however, FDI exhibits negative or insignificant coefficients, which may reflect adjustment costs, repatriation of profits, or sectoral imbalances before long-run benefits materialize.

These results are in line with Foudeh (2017), Akinsola and Odhiambo (2020) and Abdelmoula and Abdelsalam (2020). By contrast, they diverge from Nazir and Qayyum (2014) and Berument et al. (2010), who reported negative or insignificant impacts of FDI on growth.

Impact of Oil Consumption on GDP

Oil consumption positively affects GDP, with long-run coefficients of 0.068 (ARDL) and 0.354 (NARDL). This reflects the critical role of energy as a production input, where higher consumption stimulates industrial activity and overall output. Short-run coefficients are weaker and sometimes insignificant, but the long-run results strongly support the role of energy use in fostering growth.

These findings are consistent with Negi (2015), Ibrahim et al. (2014) and Ogu and Ojimadu (2020), who also confirmed the positive role of energy consumption. However, they contradict Liaqat et al. (2020, 2022), who reported limited or negative effects of oil use.

Model 02: Trade Balance and Oil Price

Descriptive Statistics

Descriptive statistics summarize and characterize data. Descriptive statistics produce observation, SD, mean, median, max, min.

Below are variable descriptive statistics:

Table 08: Descriptive Statistics of Variables (Model 02)

	TB	OP	REER	NNI	FDI
Mean	11.48745	1.292245	103.3329	11.63202	0.035342
Median	11.52736	1.290666	100.2575	11.61424	0.017531
Maximum	12.84268	3.437563	229.848	13.2921	0.864791
Minimum	9.748332	0.800025	53.79077	9.171941	-0.3614
Std. Dev	0.621256	0.274831	19.72796	0.69638	0.06849
Skewness	-0.34906	0.621163	2.036885	-0.43568	4.254464
Kurtosis	2.74547	5.576923	12.37456	3.887697	37.35428
Jarque-Bera	21.28132	315.4214	4026.754	59.63488	48277.99
Probability	0.000024	0.000000	0.000000	0.000000	0.000000
Sum	10625.89	1195.327	95582.93	10759.61	32.69137
Sum Sq. Dev	356.6266	69.79158	359613.6	448.0898	4.334424
Observations	925	925	925	925	925

The descriptive statistics of Model 2 variables indicate that the trade balance (TB) has a mean of 11.49 with moderate variation (Std. Dev. 0.62), while oil prices (OP) average 1.29 and show higher dispersion relative to TB. The real effective exchange rate (REER) displays substantial variability (mean 103.33; Std. Dev. 19.73), reflecting exchange rate fluctuations across countries and years. Net national income (NNI) remains relatively stable (mean 11.63; Std. Dev. 0.69). In contrast, foreign direct investment (FDI) shows a very low mean (0.035) but high volatility, as indicated by extreme values and high skewness (4.25) and kurtosis (37.35). The Jarque-Bera test confirms non-normality for all variables, suggesting the presence of heterogeneity and potential asymmetries that justify the use of advanced econometric techniques such as ARDL and NARDL.

Table 09: Correlation Analysis (Model 02)

	TB	OP	REER	NNI	FDI
TB	1	0.344205	-0.19464	0.900536	0.086029
OP	0.344205	1	-0.13619	0.24057	0.092596
REER	-0.19464	-0.13619	1	-0.19318	-0.06232
NNI	0.900536	0.24057	-0.19318	1	-0.11697
FDI	0.086029	0.092596	-0.06232	-0.11697	1

Unit Root Tests

ADF tests determine 1983–2022 annual panel data steady. In Table 5.8, all variables are stationery and 1st difference. All variables were stationary at level and 1st difference in ADF tests.

We can proceed with co-integration using ARDL if variables stagnate. To test variable integration order, utilize Augment Dickey-Fuller. Table 5.8 displays ADF test results' tests determine 1983–2022 annual panel data steady. In Table 5.8, all variables are stationery and 1st difference. All variables remained stationary at level and 1st difference in ADF tests.We can proceed with co-integration using ARDL if variables stagnate. To test variation integration order, utilize Augment Dickey-Fuller. Table 5.8 displays ADF test results.

Table 10: Results of Unit Root Test

Variables	Level		1st difference		Order of integration
	Individual intercept	Individual intercept and trend	Individual intercept	Individual intercept and trend	
TB	-5.70989 (0.0000)***	-3.02025 (0.0013)***	-21.4296 (0.0000)***	-21.1563 (0.0000)***	I(0,1)
OP	0.9248 (1.43824)	1.93538 (0.9735)	-18.4007 (0.0000)***	-17.2166 (0.0000)***	I(1)
REER	-7.16297 (0.0000)***	-6.80207 (0.0000)***	-16.6758 (0.0000)***	-15.9130 (0.0000)***	I(0,1)
NNI	-7.33187 (0.0000)***	-1.8809 (0.0296)*	-14.2140 (0.0000)***	-15.7268 (0.0000)***	I(0,1)
FDI	-5.86348 (0.0070)***	-5.50275 (0.0000)***	-18.5233 (0.0000)***	-14.9910 (0.0000)***	I(0,1)

***p<.01, ** p<.05, * p<1

Symmetric and Asymmetric Impact of Oil Price on Trade Balance (TB)

Table 11: ARDL Results for Model 2 (Trade Balance and Oil price)

Variable	Coefficient	Std. Error	t- Statistics	Prob.*
Long Run Equations				
LOG(OP)	-0.008910	0.027981	-1.918414	0.0503
LOG(REER)	-0.188136	0.102574	-1.834154	0.0670
NNI	0.132746	0.030430	4.362361	0.0000
FDI	0.009034	0.024422	0.369911	0.7116
Short Run Equations				
COINTEQ01	-0.000792	0.005063	0.156348	0.0000
DLOG(TB(-1))	0.035544	0.023654	1.502626	0.1334
DLOG(TB(-2))	-0.171947	0.017978	-9.564225	0.0000
DLOG(OP)	0.011249	0.002108	5.335520	0.0000
DLOG(REER)	-0.023002	0.003915	-5.875892	0.0000
D(NNI)	0.077691	0.004706	16.50880	0.0000
D(FDI)	0.061384	0.022194	2.765863	0.0058
C	0.000996	0.000423	2.356059	0.0187
Log likelihood	4135.035			

Table 12: NARDL Results for Trade Balance Model

Variable	Coefficient	Std. Error	t- Statistics	Prob.*
Long Run Equations				
OP_POS	-0.058175	0.027251	-2.134759	0.0331
OP_NEG	0.032254	0.034640	0.931117	0.3521
REER	-0.002605	0.000386	-6.754213	0.0000
NNI	0.876358	0.035637	24.59108	0.0000
FDI	0.540033	0.133229	4.053427	0.0001
Short Run Equations				
COINTEQ01	-0.295202	0.033100	-8.918532	0.0000
D(OP_POS)	0.084183	0.025649	3.282112	0.0011
D(OP_NEG)	0.140267	0.018186	7.712692	0.0000
D(REER)	-0.001486	0.000445	-3.337763	0.0009

D(NNI)	0.580118	0.066383	8.738914	0.0000
D(FDI)	0.342899	0.184102	1.862546	0.0629
C	0.412853	0.051412	8.030206	0.0000
@TREND	0.001925	0.000316	6.100160	0.0000
Log likelihood	2143.784			

Impact of Oil Price on Trade Balance

In the linear ARDL results, the long-run coefficient on oil prices is negative (–0.0089) and statistically significant at the 5% level, indicating that higher oil prices tend to worsen the trade balance of oil-importing economies. This finding is consistent with studies such as Kilian et al. (2009) and Narayan & Narayan (2010), which highlight the adverse effect of oil price shocks on trade balances in net oil importers. Theoretically, an increase in oil prices raises the import bill for oil-importing countries, as they must spend more foreign exchange on energy imports. This worsens the trade balance by increasing import expenditures relative to export earnings. Higher energy costs also elevate domestic production costs, reducing export competitiveness and further weakening external accounts. Conversely, when oil prices decline, import payments fall, improving the trade balance through lower energy expenditure and stronger export performance. However, in the NARDL framework, asymmetric effects emerge: positive oil price shocks (OP_POS) significantly worsen trade balance in the long run (–0.0581, $p<0.05$), while adverse oil price shocks (OP_NEG) are statistically insignificant. This supports the evidence from Shin et al. (2014) and Aloui et al. (2016) that increases in oil prices have more substantial macroeconomic consequences than decreases.

Impact of Real Effective Exchange Rate (REER) on Trade Balance

Both ARDL and NARDL results indicate a statistically significant, adverse effect of REER on the trade balance, suggesting that currency appreciation undermines trade performance. Specifically, the long-run coefficient in the NARDL model (–0.0026, $p<0.01$) confirms that genuine appreciation deteriorates the trade balance, consistent with the Marshall–Lerner condition and findings of Bahmani-Oskooee & Hegerty (2010).

Net National Income (NNI)

NNI consistently shows a strong positive relationship with the trade balance in both ARDL (0.1327, $p<0.01$) and NARDL (0.8763, $p<0.01$) models, implying that higher national income improves countries' capacity to sustain external balances. This outcome aligns with Brissimis et al. (2013), who reported that rising domestic income may support export capacity and strengthen trade performance.

Foreign Direct Investment (FDI)

In the ARDL model, FDI is statistically insignificant in the long run, suggesting limited effects on the trade balance. However, in the NARDL model, FDI exhibits a strong and positive long-run effect (0.5400, $p<0.01$), implying that inward FDI flows enhance trade performance, possibly through technology spillovers and increased export capacity. This result resonates with Chakraborty & Nunnenkamp (2008) and Prasanna (2010), who emphasise the trade-enhancing role of FDI in developing economies.

Short-Run Dynamics and Adjustment

The error-correction term (COINTEQ01) is negative and significant in both the ARDL (–0.00079) and NARDL (–0.2952) models, confirming the existence of a long-run equilibrium. The speed of adjustment is substantially faster in the NARDL model, indicating that deviations from equilibrium trade balance correct more quickly when asymmetries are considered. Short-

run estimates further reveal that both positive and negative oil price shocks significantly influence trade balance, with adverse shocks (0.1403, $p<0.01$) having a more substantial short-term effect than positive ones. This suggests that trade balance reacts more sensitively to oil price declines in the short run, a result consistent with Mork (1989) and Hamilton (2003).

Conclusion

This study investigates the asymmetric effects of oil price fluctuations on domestic output and trade balances across 30 oil-importing countries over the period 1983–2022, employing the Nonlinear Autoregressive Distributed Lag (NARDL) model. The results reveal that positive and negative oil price shocks exert differential impacts on economic performance. Specifically, rising oil prices adversely affect GDP and trade by increasing production costs, reducing firm profitability and dampening consumer demand, thereby slowing economic growth. In contrast, declining oil prices ease production costs, stimulate consumer spending and enhance overall economic activity. These findings underscore a counter-cyclical relationship between oil prices and macroeconomic health, emphasising the importance of oil price stability for sustained growth. Furthermore, while higher oil prices raise import costs and worsen trade balances, adverse shocks can improve trade performance by reducing these costs.

The study highlights the need for proactive, flexible policy frameworks to address oil price volatility. Policymakers are urged to account for broader economic dynamics, including exchange rate movements, investment flows and labour market conditions, when formulating interventions. Coordinated strategies at both domestic and international levels are crucial for mitigating the adverse consequences of oil price shocks and fostering long-term economic resilience amid persistent global energy market uncertainties.

Policy Recommendations

The results highlight the asymmetric impact of oil price fluctuations and the role of oil consumption in shaping economic performance. Rising oil prices negatively affect GDP and trade balance by increasing production costs and worsening import bills, while declining prices provide temporary relief by lowering costs and stimulating growth. These findings suggest that policymakers should prioritise reducing dependence on imported oil by diversifying the energy mix, including investments in renewable and alternative energy sources such as solar, wind, and hydropower. At the same time, managing oil consumption efficiently is crucial; policies promoting energy efficiency, conservation and the adoption of modern technologies can help reduce vulnerability to oil price shocks. By combining reduced reliance on oil imports with more efficient consumption patterns, economies can enhance resilience against external shocks and secure sustainable long-term growth.

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Appendix

Table 13: List of Oil Importing Countries

Sr #	Name of country	Sr #	Name of country
1.	China	**16.**	Greece
2.	United States	**17.**	Poland
3.	India	**18.**	Australia
4.	Japan	**19.**	Belarus
5.	South Korea	**20.**	South Africa
6.	Germany	**21.**	Indonesia
7.	Italy	**22.**	Turkiye
8.	Spain	**23.**	Pakistan
9.	United Kingdom	**24.**	Sweden
10.	Netherland	**25.**	Brazil
11.	France	**26.**	Portugal
12.	Singapore	**27.**	Israel
13.	Thailand	**28.**	Bahrain
14.	Canada	**29.**	Finland
15.	Belgium	**30.**	Aruba