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The Influence of Global Crude Oil Prices on Banking Sector Profitability: Panel Evidence from Selected Economies

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Abstract

This study investigates the impact of global crude oil prices on banking sector profitability in 16 selected economies from 2000 to 2021. Using panel Autoregressive Distributed Lag (ARDL) analysis, the study explores both long-run and short-run relationships, incorporating GDP growth, inflation, and real interest rates as control variables. The results reveal a weak but positive long-term association between oil prices and bank profitability, while GDP growth significantly enhances profitability, and inflation exerts a negative effect. Real interest rates also show a positive influence. In the short run, none of the macroeconomic variables exhibit statistically significant effects. The findings suggest that macroeconomic stability—particularly sustained growth and inflation control—is essential for long-term banking sector performance. Policymakers and financial institutions should consider structural drivers and adopt strategies that enhance resilience to commodity price volatility.

Keywords: crude oil prices; banking profitability; panel ARDL; macroeconomic variables
JEL Classification Codes: E44; G21; Q43; C33

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1. Introduction

The banking sector plays a pivotal role in economic development and financial stability (El-Ansary & Rashwan, 2020; Khairullah & Rosita, 2022). Its profitability is vital, not only for the financial soundness of individual banks but also for the overall health of the economy (Albertazzi & Gambacorta, 2009; Athanasoglou et al., 2008). Understanding the determinants of banking profitability is, therefore, of great interest to policymakers, regulators, and researchers. As the backbone of financial intermediation, the banking sector mobilizes savings into investment, provides credit to businesses, and facilitates economic growth (Dima & Opris, 2013). However, bank performance is susceptible to macroeconomic conditions, including changes in interest rates, inflation, and GDP growth (Demirgüç-Kunt & Huizinga, 1999).

Among these macroeconomic factors, global crude oil price fluctuations have emerged as a critical yet understudied influence on banking sector profitability (Alqahtani et al., 2020; Esmaeil et al., 2020; Katırcıoglu et al., 2018; Killins & Mollick, 2020; Lee & Lee, 2019; Saif-Alyousfi et al., 2021). Often referred to as the lifeblood of modern economies, oil prices shape inflation, exchange rates, and aggregate economic activity (Hamilton, 2009b; Musa et al., 2019; Nitami & Hayati, 2021; Sarmah & Bal, 2021). As such, oil price volatility may exert far-reaching effects on economic sectors, including banking (Alqahtani et al., 2020; Filis et al., 2011; Lee & Lee, 2019). Economies with high dependence on oil production or consumption are particularly vulnerable to such volatility, which may ultimately affect banking performance (Sadorsky, 2014).

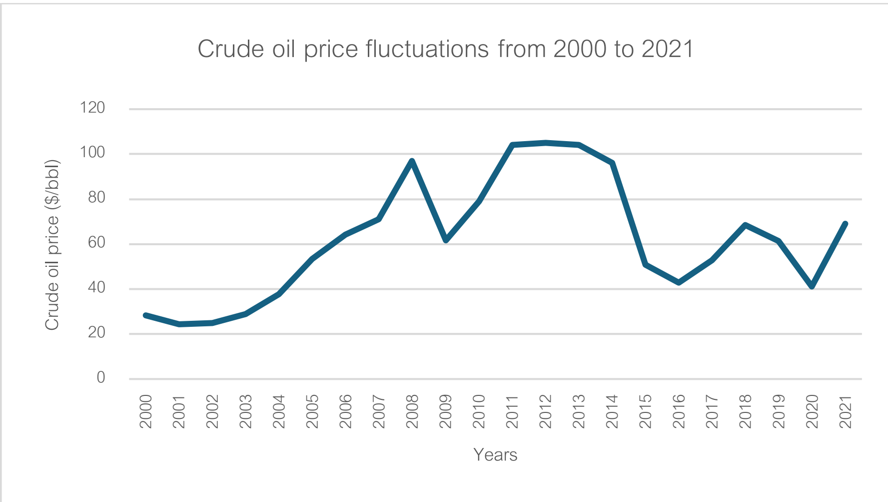

Figure 1: Average Annual Brent Crude Oil Prices, 2000–2021

Source: Authors' calculations based on data from the World Bank Commodity Price Index (WBCPI).

The relationship between global oil prices and banking sector profitability is complex and likely to vary by country depending on economic structure, financial development, and energy dependency. In large and diverse economies such as those in North America, Europe, and Asia-Pacific, unique dynamics may emerge (Sadorsky, 2012). Banks in these economies may be exposed to substantial risks and opportunities as crude oil prices fluctuate, indirectly affecting households and firms to which they provide financial services (Bouri et al., 2018). However, empirical research examining this relationship—especially in larger economies with varied structures—remains limited.

This study focuses on a group of the world's largest or major economies, selected based on GDP size, banking sector maturity, integration with global oil markets, and regional diversity. These countries not only contribute significantly to the global economy but also display substantial exposure to oil price volatility. Their diversity allows for meaningful cross-country comparison, and the availability of quality macroeconomic and financial data supports the robustness of a panel ARDL framework. By analyzing this group, the study fills a notable gap in the literature and offers insights into how oil price shocks may affect bank profitability in globally influential economies.

Bank profitability, often measured by return on assets (ROA), is influenced by several macroeconomic indicators. Previous studies highlight the importance of GDP growth and inflation (BaŞarır & Sarıhan, 2017; Yuan et al., 2022) as well as interest rates (Almaqtari et al., 2019; Caliskan & Lecuna, 2020). The interplay between these variables and oil prices adds further complexity, making it essential to assess their combined effect on bank performance. While prior research has emphasized the macroeconomic effects of oil shocks, relatively few studies directly examine their impact on banking sector profitability, particularly across a wide panel of large economies (Kang et al., 2015).

To address this gap, the present study applies a panel Autoregressive Distributed Lag (ARDL) approach to examine both short-run and long-run relationships between global crude oil prices and banking sector profitability. The analysis incorporates key macroeconomic controls—GDP growth, inflation, and interest rates—to investigate potential mediating effects.

The study is guided by the following research questions:

1. How do fluctuations in global crude oil prices influence banking sector profitability in large economies?
2. What is the nature of the relationship between GDP growth and profitability in the context of oil price changes?
3. How do inflation and interest rates mediate the oil price–profitability nexus?

The remainder of the paper is structured as follows: Section 2 reviews the relevant literature and develops the study's hypotheses. Section 3 describes the data and methodology. Section 4 presents and discusses the empirical findings. Section 5 concludes with key implications and recommendations for policymakers, financial institutions, and future research.

2. Literature Review

2.1 Theoretical Literature Review

The complex relationship between global crude oil prices and macroeconomic performance has long attracted scholarly attention, particularly regarding how oil price fluctuations permeate broader economic systems. Seminal works by Dery and Serletis (2024), Garzon and Hierro (2021), Wen et al. (2021), and Hamilton (1983) consistently highlight oil price shocks as precursors to economic recessions. These studies emphasize that such shocks influence inflation, interest rates, and output, thereby disrupting financial system stability. Their theoretical frameworks present oil shocks as critical channels through which macroeconomic volatility affects banking sector performance.

On the supply side, theories explain how rising oil prices increase input and production costs, contributing to cost-push inflation and reduced economic output (Koppány et al., 2023; Köse & Ünal, 2021; Kudabayeva et al., 2024; Montoro, 2012; Sek et al., 2015). Blanchard and Galí (2007) argue that these supply shocks foster adverse economic conditions marked by higher prices and lower output. In such environments, borrowers' repayment capacity weakens, non-performing loans (NPLs) rise, and banking sector stability is compromised.

From a demand-side perspective, Kilian (2008) posits that oil price hikes reduce disposable income for consumers and raise operational costs for firms, thereby curtailing household consumption and business investment. This deceleration in economic activity weakens credit demand and erodes banks' loan portfolios. Supporting this view, studies by Komlichenko and Rotan (2021), Marchenko et al. (2022), and Mirovic et al. (2023) demonstrate how these developments deteriorate bank profitability, particularly in economies where banking is tightly interlinked with real sector performance.

To better understand banking sector vulnerability in such contexts, Diamond and Dybvig (1983) Financial Intermediation Theory proves particularly relevant. This theory underscores the mismatch between short-term liabilities and long-term assets in banks, making them highly sensitive to macroeconomic shocks such as inflation and interest rate volatility. Oil price shocks, by affecting these variables, compress net interest margins and elevate credit risk—key determinants of banking profitability. This connection is further reinforced by Sadorsky (1999) and Bernanke (1983), who show how macroeconomic instability undermines financial system performance.

The Dutch Disease Hypothesis, proposed by Corden and Neary (1982), offers another critical theoretical lens. It explains how oil booms can lead to real exchange rate appreciation and reduced competitiveness of non-oil sectors. In oil-dependent economies, such distortions heighten banking sector exposure to oil market fluctuations. Moreover, the Monetary Transmission Mechanism described by Christiano et al. (2005) suggests that oil-induced inflation often prompts central banks to raise interest rates. While intended to stabilize prices, this response can raise borrowing costs, suppress credit activity, and negatively impact bank earnings.

More recently, researchers have noted that oil prices are increasingly influenced not only by physical supply and demand but also by financial speculation and market sentiment. Kilian and Murphy (2012) argue that precautionary demand and expectations significantly shape oil price movements. This view is supported by Fattouh et al. (2013) and Alquist and Kilian (2010), who highlight the role of futures markets, investor sentiment, and geopolitical risk in exacerbating oil price volatility. BüyükŞahin and Robe (2014) further show how hedge fund activity amplifies price swings, complicating credit risk assessment and increasing systemic financial vulnerabilities—especially in oil-dependent economies.

2.2 Empirical Literature Review

Empirical studies broadly support the theoretical insights linking oil price volatility with macroeconomic and financial outcomes. Hamilton (2009a) confirms that oil price surges frequently precede economic downturns, particularly in oil-importing nations. These downturns reduce demand for financial services, increase credit risk, and erode banking sector profitability. Likewise, Jones et al. (2004), Baumeister and Kilian (2016), and Lorusso and Pieroni (2018) find that GDP growth declines during oil price shocks, thereby weakening the economic environment for banks.

Several studies identify the transmission channels through which oil price volatility affects financial markets. Barsky and Kilian (2002) and LeBlanc and Chinn (2004) show that higher oil prices generate inflationary pressures that lead central banks to tighten monetary policy. Resulting interest rate hikes compress banks' net interest margins and elevate default risk. Similarly, Bernanke et al. (1997) and Hooker (2002) find that inflation and monetary tightening lower household and corporate borrowing, reducing bank revenues and profitability.

While initial empirical studies focused on macroeconomic indicators, more recent research examines oil price impacts on firm-level banking performance. For example, Papapetrou (2001) shows that oil shocks depress Greek bank stock prices, reflecting lower profitability expectations. In the Gulf Cooperation Council (GCC), Mohanty et al. (2011) find that oil price surges lead to higher NPLs and tighter credit conditions, ultimately reducing ROA.

Expanding this line of inquiry, Al-Harthy et al. (2021) observe that during oil price declines, banks in Oman experience deposit outflows, deteriorating credit conditions, and weakened capital adequacy—all of which suppress profitability. In Nigeria, Kutu and Ohonba (2024) report that oil price volatility significantly undermines bank ROA, highlighting the banking sector's dependence on oil revenue-driven activity. Similar findings are reported in Saudi Arabia by Bouzidi et al. (2024), Samargandi and Sohag (2022), and Amin (2022), who link oil price movements to fluctuations in ROA, ROE, and NPL ratios.

Notably, empirical evidence points to asymmetries between oil-exporting and oil-importing economies. Cunado and de Gracia (2005) find that oil-importing Asian countries suffer reduced bank performance following oil price hikes due to inflationary pressure and slower growth. In contrast, Basher and Sadorsky (2006) find positive correlations between oil prices and bank profitability in oil-exporting countries, where higher oil revenues boost liquidity and credit expansion.

However, these benefits are not universally guaranteed. Studies by El-Chaarani (2019), Elsayed et al. (2023), Mohammed et al. (2020), Saif-Alyousfi et al. (2021), and Umar et al. (2021) caution that the gains from oil booms depend on effective fiscal policies, robust regulation, and sound credit risk management.

Mismanagement of oil revenues or regulatory weakness can increase financial fragility—even in periods of high oil prices.

To analyze such nuanced dynamics, researchers have increasingly adopted the Panel ARDL model developed by Pesaran et al. (1999). This technique allows for the estimation of both long- and short-run relationships in heterogeneous panel data. Studies by Dietrich and Wanzenried (2011) and Trujillo-Ponce (2013), focusing on bank profitability in Switzerland and Spain, respectively, demonstrate the suitability of this model for examining complex macro-financial linkages—such as the effect of oil price fluctuations on banking sector profitability.

2.3 Hypotheses Formulated

Based on the theoretical foundations and empirical evidence discussed above, the following hypotheses are proposed:

H_1: There is a significant long-run relationship between global crude oil prices and banking sector profitability (ROA) in the largest economies.

H_2: Increases in global crude oil prices are associated with reduced bank profitability through inflation and interest rate channels in the largest economies.

H_3: The short-run impact of oil price fluctuations on banking sector profitability varies significantly across countries due to differences in energy dependency and monetary policy frameworks.

Despite the rich literature examining the macroeconomic implications of oil price volatility, a notable gap remains in understanding its direct influence on banking sector profitability—particularly across countries with varying degrees of oil dependency. Most prior research emphasizes the indirect effects of oil shocks via inflation, interest rates, or GDP growth, with limited studies explicitly linking these dynamics to bank-level performance indicators such as ROA.

Moreover, cross-country empirical studies often neglect the structural differences between oil-importing and oil-exporting economies in terms of financial sector exposure to oil-related industries. There is a lack of panel-based evidence that simultaneously considers macroeconomic volatility, energy dependency, and banking sector heterogeneity over an extended time horizon.

This study addresses these gaps by employing a panel ARDL framework to examine both the short-run and long-run effects of global crude oil price fluctuations on banking sector profitability across the world's largest economies. In doing so, it offers a deeper understanding of the underlying transmission mechanisms and the potentially asymmetric impacts of oil price volatility on financial performance.

3. Data and Methods

3.1 Data and Variables

This study investigates the influence of global crude oil prices on banking sector profitability across a panel of major economies from 2000 to 2021. The analysis includes 16 countries whose GDP exceeded USD 300 billion as of 2023. While not all are among the world's largest economies by traditional definitions, their substantial economic size and financial system development justify their inclusion in the sample. Using GDP as a selection criterion ensures that the analyzed economies have significant integration with global financial markets and are likely to be exposed to crude oil price fluctuations.

The selected countries are: Brazil, Canada, China, India, Indonesia, Italy, Japan, Malaysia, Nigeria, Pakistan, the Philippines, the Russian Federation, South Africa, Thailand, the United Kingdom, and the United States. These countries were chosen based on (i) their status as middle- or high-income economies and (ii) the availability of reliable and consistent macroeconomic and financial sector data over the study period. Collectively, they account for over 70% of the combined GDP of all countries with a GDP greater than USD 300 billion (World Bank, 2024).

The study period of 2000–2021 was selected based on data availability and completeness. In particular, data on return on assets (ROA)—a key indicator of banking sector profitability—are not fully available for more recent years. As noted by Pierson et al. (2015), financial data publication typically involves delays due to the time required for validation, auditing, and dissemination by financial institutions and regulatory agencies.

All data used in this study are secondary and sourced from authoritative World Bank databases, including the Global Financial Development (GFD) database, World Development Indicators (WDI), and the World Bank Commodity Price Indices (WBCPI). Table 1 provides detailed descriptions of the variables and their respective sources.

Table 1: Variable Description

Variable	Description	Source
Return on Assets (ROA)	Commercial banks' after-tax net income to average total assets (proxy for bank profitability)	GFD
Global Crude Oil Prices	Average annual price of Brent crude oil in USD per barrel	WBCPI
GDP Growth Rate (GDPGR)	Annual percentage growth rate of GDP at market prices based on constant local currency	WDI
Inflation Rate (INF)	Annual percentage change in the consumer price index (CPI)	WDI
Real Interest Rate (IR)	Average lending interest rate adjusted for inflation	WDI

Source: Authors' compilation from GFD, WDI, and WBCPI databases.

The selected period, 2000 to 2021, spans over two decades, capturing long-term trends and major global economic events that have influenced both crude oil prices and banking sector profitability. This includes the early 2000s recession, the 2008 global financial crisis, the oil price collapse of 2014–2016, and the post-crisis recovery phase. Incorporating these episodes ensures a more robust analysis of the dynamic relationship between global crude oil markets and financial sector performance (Hamilton, 2009a; Reinhart & Rogoff, 2009).

To address missing data, the mean imputation technique is employed in this study. This approach is particularly useful when the proportion of missing data is small—as is the case here—and helps preserve the full sample size, which is critical for maintaining statistical power (Little & Rubin, 2019). Mean imputation is computationally efficient and straightforward to apply, making it suitable for preliminary analyses and empirical models where more complex imputation techniques may be impractical. By replacing missing values with the mean of the respective variable, the dataset remains complete and amenable to standard statistical methods that require fully observed data (Schafer & Graham, 2002). Although this method may reduce data variability and underestimate standard errors, its simplicity and effectiveness are well-suited for exploratory analyses and time-series panel models when the missingness is minimal.

3.2 Research Method

This study employs the panel Autoregressive Distributed Lag (ARDL) model to investigate both short-run and long-run relationships between global crude oil prices and banking sector profitability. Specifically, the Pooled Mean Group (PMG) estimator, developed by Pesaran et al. (1999), is applied. The PMG estimator assumes homogeneity in the long-run coefficients across countries, while allowing for heterogeneity in short-run dynamics and error correction mechanisms. This implies that although the long-run relationship between the dependent and independent variables is constrained to be the same across countries, the short-run adjustments can differ. PMG is thus particularly suitable for macroeconomic panel data where countries share common structural characteristics over time but respond differently in the short term (Blackburne & Frank, 2007).

3.2.1 Panel Unit Root and Cointegration Tests

The analysis begins with panel unit root tests to determine the order of integration of the variables. The Im-Pesaran-Shin (IPS) test (Im et al., 2003) is employed to assess whether the variables are stationary in levels or require differencing. The test is conducted on both levels and first differences to verify stationarity. If the variables are integrated of mixed orders [I(0) and I(1)], the panel ARDL model remains suitable.

Following the unit root tests, Pedroni's panel cointegration tests (Pedroni, 1999; 2004) are conducted to explore whether a long-run equilibrium relationship exists among the variables. If cointegration is confirmed, the long-run coefficients can be reliably estimated. If not, alternative strategies are adopted as outlined in the methodological framework.

3.2.2 Panel ARDL Model Specification

In the absence of cointegration, the panel ARDL framework remains appropriate due to its flexibility in handling variables integrated of different orders. The ARDL model, coupled with the PMG estimator, allows for robust estimation of dynamic relationships between global crude oil prices and banking sector profitability, while controlling for key macroeconomic factors (Pesaran & Shin, 1999; Pesaran et al., 1999; Pesaran & Smith, 1995).

The baseline panel ARDL model is specified as:

$$ROA_{it} = \alpha_i + \sum_{k=1}^{p} \beta_{1k} ROA_{it-k} + \sum_{k=0}^{q} \beta_{2k} ln(OIL_{it-k}) + \sum_{k=0}^{q} \beta_{3k} GDPGR_{it-k} + \sum_{k=0}^{q} \beta_{4k} INF_{it-k} + \sum_{k=0}^{q} \beta_{5k} IR_{it-k} + \epsilon_{it} \quad (1)$$

Where ROA_{it} is the return on assets for country i at time t, $ln(OIL_{it})$ is the natural logarithm of global crude oil prices for country i at time t, $GDPGR_{it}$ is the GDP growth rate for country i at time t, INF_{it} is the inflation rate for country i at time t, IR_{it} is the interest rate for country i at time t, α_i represents country-specific fixed effects, $\beta_{1k}, \beta_{2k}, \beta_{3k}, \beta_{4k}$ and β_{5k} are the coefficients of the lagged terms, and ϵ_{it} is the error term.

The dependent variable, ROA, reflects banking sector profitability and is defined as after-tax net income divided by average total assets. It is a widely used indicator in cross-country banking studies (Athanasoglou et al., 2008; Demirgüç-Kunt & Huizinga, 1999).

The independent variable is Brent crude oil price (in USD per barrel), a global benchmark commonly used to represent oil price trends (Kilian & Park, 2009; Ratti & Vespignani, 2016). The model includes three key macroeconomic controls:

GDP Growth Rate (GDPGR): A proxy for economic activity, influencing credit demand, financial stability, and default risk (Brei et al., 2020; Fraumeni, 2022; Sain & Kashiramka, 2023).

Inflation Rate (INF): Reflects purchasing power and borrowing costs. High inflation can erode margins and introduce instability in loan performance (Rondinelli & Zizza, 2020; Salisu et al., 2017).

Interest Rate (IR): Affects banks' lending profitability and cost of funding, often adjusted in response to inflationary pressures from oil price changes (Aizenman et al., 2019; Borio et al., 2017).

These controls help isolate the specific impact of oil prices on banking profitability and enhance the reliability of the results. The short-run dynamics and the speed of adjustment towards the long-run equilibrium are captured using an Error Correction Model (ECM) derived from the ARDL model.

Error Correction Model (ECM)

Short-run dynamics and the adjustment toward long-run equilibrium are captured using an ECM derived from the panel ARDL framework:

$$\Delta ROA_{it} = \phi(ROA_{it-1} - \beta_0 - \beta_1 ln(OIL_{it-1}) - \beta_2 GDPGR_{it-1} - \beta_3 INF_{it-1} - \beta_4 IR_{it-1}) + \sum_{k=1}^{p-1} \gamma_{1k} \Delta ROA_{it-k} + \sum_{k=0}^{q-1} \gamma_{2k} \Delta ln(OIL_{it-k}) + \sum_{k=0}^{q-1} \gamma_{3k} \Delta GDPGR_{it-k} + \sum_{k=0}^{q-1} \gamma_{4k} \Delta INF_{it-k} + \sum_{k=0}^{q-1} \gamma_{5k} \Delta IR_{it-k} + \epsilon_{it} \quad (2)$$

Where Δ denotes the first difference operator, ϕ is the error correction term, representing the speed of adjustment towards the long-run equilibrium, $\gamma_{1k}, \gamma_{2k}, \gamma_{3k}, \gamma_{4k}$ and γ_{5k} are the short-run coefficients.

Model Diagnostics and Estimation Strategy

This study assumes long-run homogeneity across countries with regard to the oil price–profitability relationship, making PMG the preferred estimator. The PMG estimator pools long-run coefficients while allowing country-specific short-run dynamics and error correction terms (Pesaran et al., 1999; Pesaran & Smith, 1995).

To test the validity of this assumption, the Hausman test is used to compare the PMG estimator with the Mean Group (MG) and Dynamic Fixed Effects (DFE) estimators. If the null hypothesis of no systematic difference is not rejected, PMG is more efficient and preferred.

To ensure model reliability, multicollinearity among regressors is assessed using the Variance Inflation Factor (VIF). Acceptable VIF values indicate that the independent variables do not exhibit harmful collinearity, supporting the robustness of coefficient estimates.

4. Results and Discussion

4.1 Descriptive Statistics

Table 2 presents descriptive statistics for the study variables. The return on assets (ROA), a proxy for banking sector profitability, has a standard deviation of 1.55%, suggesting moderate variability across the sample. Its wide range—from a minimum of -23.26% to a maximum of 9.81%—indicates the presence of both substantial losses and notable profitability within the banking sectors of the sampled countries, reflecting significant heterogeneity in financial performance.

The interest rate (IR) exhibits the greatest dispersion, ranging from 0.5% to 67.08%, which reflects diverse monetary environments across the sampled economies. The natural logarithm of oil prices (ln(OIL)) ranges from 3.20 to 4.72, indicating relatively stable global crude oil prices over the study period. The GDP growth rate (GDPGR) averages 3.54% with a standard deviation of 3.56%, while the inflation rate (INF) averages 4.48% and also shows notable variation.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
ROA	352	0.9565	1.5523	-23.257	9.8053	-10.260	172.384
ln(OIL)	352	4.0538	0.4723	3.1954	4.7182	-0.357	2.099
GDPGR	352	3.5402	3.5572	-10.360	15.329	-0.569	4.734
INF	352	4.4806	4.1695	-1.353	21.477	1.469	5.194
IR	352	10.553	10.468	0.500	67.083	2.919	12.572

Source: Authors' computations.

Regarding distributional properties, ROA is highly negatively skewed (-10.26) and extremely leptokurtic (kurtosis = 172.38), indicating a non-normal distribution with several extreme outliers. ln(OIL) and GDPGR are slightly negatively skewed with near-normal kurtosis, suggesting approximate symmetry. In contrast, INF and

IR are positively skewed, with IR exhibiting particularly high kurtosis (12.57), reflecting a long right tail and potential outliers. These distributional characteristics underscore the need for robust estimation techniques, such as the panel ARDL model, which can handle such non-normality.

4.2 Correlation Analysis

Table 3 shows the correlation matrix for the study variables. The correlation between ROA and ln(OIL) is negative and very weak (-0.0174), with a high p-value (0.7444), suggesting that global crude oil price fluctuations are not linearly related to banking sector profitability in the sample of large economies. This finding implies that oil price shocks may not exert a direct or immediate influence on ROA in these countries.
ROA exhibits weak but statistically significant positive correlations with GDPGR (0.1240, $p < 0.05$), INF (0.1413, $p < 0.01$), and IR (0.1309, $p < 0.05$). These results suggest that economic growth, inflation, and interest rates may each contribute modestly to variations in banking profitability.

Table 3: Correlation Analysis

	ROA	ln(OIL)	GDPGR	INF	IR
ROA	1.0000				
ln(OIL)	-0.0174	1.0000			
	(0.7444)				
GDPGR	0.1240**	0.0221	1.0000		
	(0.0200)	(0.6800)			
INF	0.1413***	0.0251	0.2026***	1.0000	
	(0.0079)	(0.6389)	(0.0001)		
IR	0.1309**	-0.1203**	0.0275	0.4474***	1.0000
	(0.0140)	(0.0240)	(0.6074)	(0.0000)	

Source: Author's computations.

*Notes: (1) ***, *, and * denote significance at the 1%, 5%, and 10% levels, respectively.

(2) Figures in parentheses are p-values.

The correlations between ln(OIL) and the macroeconomic variables (GDPGR, INF, and IR) are also weak and mostly statistically insignificant, suggesting that oil price changes do not strongly co-move with these indicators in the sample. Notably, the negative and weak correlation between oil prices and IR (-0.1203) could reflect the complex interplay between energy markets and monetary policy, where central banks may respond to oil-induced inflationary pressures by adjusting interest rates.

These findings reinforce the importance of employing multivariate models such as panel ARDL to explore dynamic relationships, as simple correlations may overlook lagged or indirect effects, particularly in the presence of structural heterogeneity and temporal variation across countries.

4.3 Panel Unit Root Test

The first step in applying the panel ARDL methodology involves testing for the stationarity of variables using the Im–Pesaran–Shin (IPS) unit root test, as proposed by Im et al. (2003). This test evaluates whether panel data series are stationary by testing the null hypothesis that all series contain a unit root. Table 4 summarizes the IPS test results at both levels and first differences. At the level, the null hypothesis of a unit root can be rejected for ROA, ln(OIL), GDPGR, and INF at the 1% significance level, as indicated by significantly negative test statistics and p-values below 0.01. These variables are therefore stationary in level form. However, the interest rate (IR) variable yields a test statistic of –0.4620 with a p-value of 0.3220, suggesting it is non-stationary at level.

Table 4: Panel Unit Root Test Results

Variables	Level		1st Difference	
	Statistic	p-value	Statistic	p-value
ROA	-4.2493	0.0000***	-9.6411	0.0000***
$ln(OIL)$	-3.1725	0.0008***	-7.9464	0.0000***
$GDPGR$	-3.6369	0.0001***	-12.6342	0.0000***
INF	-4.9060	0.0000***	-13.5019	0.0000***
IR	-0.4620	0.3220	-10.4306	0.0000***

Source: Authors' computations.

Note: *** indicates statistical significance at the 1% level.

At first differences, all variables become stationary at the 1% significance level, confirming they are integrated of order one, I(1). These findings validate the use of the panel ARDL methodology, which accommodates variables that are either I(0), I(1), or a mix of both.

4.4 Optimal Lag Selection and Cointegration Test

The selection of optimal lag lengths for each country and variable was conducted using the Bayesian Information Criterion (BIC). For consistency across the panel, the most frequently occurring lag structure (i.e., the mode) was adopted. Table 5 shows that the optimal lag for the dependent variable ROA is 1, while ln(OIL), GDPGR, INF, and IR are optimally specified with zero lags for most countries. This lag structure captures temporal dependencies in ROA while maintaining model parsimony for the explanatory variables.

Table 5: Optimal Lag (1, 0, 0, 0, 0)

Countries	ROA	$ln(OIL)$	$GDPGR$	INF	IR
Brazil	1	0	0	0	0
Canada	1	0	0	1	0
China	1	1	0	0	0
India	1	1	0	0	0
Indonesia	1	0	0	0	0
Italy	1	0	0	0	0
Japan	1	0	0	0	0
Malaysia	1	1	1	0	1

Countries	ROA	$ln(OIL)$	$GDPGR$	INF	IR
Nigeria	1	0	1	1	1
Pakistan	1	0	0	0	0
Philippines	1	0	0	0	0
Russian Federation	1	0	1	0	0
South Africa	1	0	0	0	1
Thailand	1	0	1	0	0
United Kingdom	1	1	0	0	0
United States	1	0	0	0	1
Mode	1	0	0	0	0

Source: Authors' computations.

Cointegration Test

To determine whether a long-run equilibrium relationship exists among the variables, the Pedroni (1999, 2004) panel cointegration test was applied. This approach is well-suited for heterogeneous panels as it produces both within-dimension (panel statistics) and between-dimension (group statistics) results.

Table 6: Pedroni Cointegration Test Results

Test Stats.	Panel	Group
v	-1.04	.
rho	-0.6432	0.3671
t	-6.194***	-8.059***
adf	-0.8525	-1.292

Source: Authors' computations.

Note: *** indicates statistical significance at the 1% level.

Among the test statistics, both the Panel t-statistic and Group t-statistic are significant at the 1% level, providing strong evidence of cointegration. While the v-, rho-, and ADF-statistics are not statistically significant, the significance of the t-statistics—generally considered more robust in Pedroni's framework—supports the existence of a long-term relationship between global crude oil prices, macroeconomic variables (GDPGR, INF, IR), and banking sector profitability (ROA).

In sum, the unit root, lag selection, and cointegration results confirm that the panel ARDL approach with PMG estimation is appropriate for modeling the dynamic relationships in this study.

4.5 Hausman Test and Variance Inflation Factor (VIF) Analysis

Hausman Test Result

To determine the most appropriate estimator between the Pooled Mean Group (PMG) and Mean Group (MG), the Hausman specification test is conducted. The results yield a chi-squared value of 3.40 with an associated p-value of 0.4926. Since this p-value exceeds the conventional 5% significance threshold, the null hypothesis—that the PMG estimator is consistent and efficient—is not rejected. Thus, the PMG estimator is preferred for this study.

The detailed output is as follows:

$$\chi^2(4) = (b-B)'[(V_b - V_B)^{(-1)}](b-B) = 3.40$$
$$Prob > \chi^2 = 0.4926$$

Where b represents the coefficients estimated using the consistent but less efficient MG estimator, B represents coefficients from the efficient under the null, but potentially inconsistent PMG estimator, V_b and V_B are the covariance matrices of b and B, respectively.

This result supports the underlying PMG assumption of long-run homogeneity across countries, which is appropriate given the panel of large economies analyzed. It implies that while short-run dynamics can differ, the long-run relationship between global crude oil prices and banking sector profitability is consistent across these countries.

Variance Inflation Factor (VIF) Analysis

To assess potential multicollinearity among the independent variables, the Variance Inflation Factor (VIF) is calculated. Table 7 presents the VIF values and their corresponding tolerance levels. All VIF values fall well below the commonly accepted threshold of 10, indicating that multicollinearity is not a concern in this study.

Table 7 presents the results of the Variance Inflation Factor (VIF) analysis, which is conducted to assess the degree of multicollinearity among the explanatory variables used in the regression model. Multicollinearity can inflate standard errors and undermine the statistical significance of individual predictors, thereby affecting the reliability of regression outcomes. Detecting and addressing it is thus essential for model robustness.

Table 7: Variance Inflation Factor (VIF) Analysis

Variable	$ln(OIL)$	$GDPGR$	INF	IR	Mean VIF
VIF	1.02	1.05	1.32	1.02	1.17
Tolerance $(1/VIF)$	0.977690	0.953914	0.758009	0.778644	

Source: Authors' computations.

The average VIF value of 1.17, along with high tolerance values (all above 0.75), further confirms that no harmful multicollinearity exists. Each independent variable contributes unique explanatory power, supporting the validity of the regression estimates and enhancing confidence in the model's interpretability.

Although multicollinearity is not present, the relatively weak pairwise correlations observed earlier may stem from several structural and econometric factors:

- Cross-country heterogeneity: The selected economies differ in oil dependency, monetary policy, financial market structure, and economic resilience, which could dilute simple linear relationships.
- Time-varying effects and structural breaks: Events such as the 2008 financial crisis, COVID-19 pandemic, or geopolitical disruptions may have altered the strength and direction of macro-financial linkages over time.
- Lagged and dynamic effects: Variables like interest rates and inflation typically influence banking profitability with a lag, underscoring the need for dynamic models like ARDL that can account for temporal dependencies.
- Nonlinear and interaction effects: Real-world macroeconomic relationships are often nonlinear (e.g., inflation may benefit banks up to a threshold) and may involve complex interactions between variables that simple correlation analysis fails to capture.

Given these factors, the application of the panel ARDL approach is justified, as it offers a more nuanced and flexible framework to examine dynamic and heterogeneous relationships across countries.

4.6 Interpretation and Discussion of Results

Table 8 presents the estimation results from the Pooled Mean Group (PMG) estimator using the ARDL (1, 0, 0, 0, 0) model, selected based on the most frequently occurring optimal lag structure across the sampled countries, as determined by the Bayesian Information Criterion (BIC).

Long-Run Estimates

The long-run coefficient for the natural logarithm of crude oil prices (ln(OIL)) is positive (0.113) and marginally significant at the 10% level. This suggests a weak but positive association between global crude oil prices and banking sector profitability, offering partial support for Hypothesis 1, which posits a significant long-run relationship. This result may reflect a macroeconomic pass-through effect—where oil price increases improve broader economic conditions that indirectly benefit the banking sector.

GDP growth (GDPGR) demonstrates a robust and statistically significant positive impact (0.059, $p < 0.01$), confirming that economic expansion enhances banking sector profitability. In contrast, inflation (INF) exhibits a significant negative effect (-0.046, $p < 0.01$), indicating that rising inflation dampens profitability, likely through increased uncertainty, higher operational costs, and shrinking real interest margins. Interestingly, the interest rate (IR) shows a positive and statistically significant impact (0.026, $p < 0.05$), implying that in these economies, rising interest rates may benefit banks, potentially due to wider lending margins.

These results provide partial support for Hypothesis 2, which suggests that oil prices affect profitability through inflation and interest rate channels. While the negative effect of inflation supports the hypothesis, the positive effect of interest rates suggests that these mediating mechanisms may vary across countries or be influenced by specific structural features, such as monetary regimes or banking sector balance sheets.

Short-Run Estimates and Adjustment Mechanism

The short-run dynamics, captured by the first-differenced variables, reveal no statistically significant immediate effects of oil prices, GDP growth, inflation, or interest rates on banking sector profitability. For instance, the coefficient for Δln(OIL) is 0.135 but statistically insignificant ($p = 0.270$), indicating that short-term oil price movements do not substantially impact ROA. Similarly, ΔGDPGR, ΔINF, and ΔIR are all insignificant at conventional levels, reinforcing the dominance of long-run over short-run influences.

However, the error correction term (ECT) is highly significant ($p < 0.01$) and negative (-0.623), confirming the existence of a strong adjustment mechanism toward long-run equilibrium. Approximately 62% of any short-term deviation from the long-run path is corrected within one period, suggesting a relatively rapid adjustment process.

These findings partially support Hypothesis 3, which suggests variation in short-run effects due to differences in energy dependency and monetary policy frameworks across countries. While the current model does not disaggregate these country-level dynamics, the lack of average short-run effects may mask heterogeneity at the national level—further justifying the use of a PMG framework that allows for cross-sectional variation in short-run dynamics.

Table 8: Pooled Mean Group Estimation Results

Selected Model: ARDL (1, 0, 0, 0, 0)

$D.ROA$	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
Long-Run						
$ln(OIL)$	0.1129512	0.0672101	1.68	0.093*	-0.0187782	0.2446806
$GDPGR$	0.0592563	0.0133063	4.45	0.000***	0.0331765	0.0853361
INF	-0.0455925	0.0171827	-2.65	0.008***	-0.0792701	-0.0119149
IR	0.0258162	0.0104533	2.47	0.014**	0.0053282	0.0463042
Short-Run						
ECT	-0.6225372	0.0694857	-8.96	0.000***	-0.7587268	-0.4863477
$ln(OIL)$						
$D1.$	0.1354403	0.1227221	1.10	0.270	-0.1050906	0.3759712
$GDPGR$						
$D1.$	0.0200299	0.0225846	0.89	0.375	-0.0242351	0.0642948
INF						
$D1.$	0.0101062	0.0195693	0.52	0.606	-0.0282488	0.0484613
IR						
$D1.$	-0.1579076	0.1320052	-1.20	0.232	-0.416633	0.1008177
$\_cons$	0.1024444	0.0923505	1.11	0.267	-0.0785591	0.283448

Source: Authors' computations.

*Note: ***, *, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Comparative Discussion with Prior Studies

The weak long-run effect of crude oil prices on bank profitability aligns with the findings of Alqahtani et al. (2020) in oil-exporting economies, and Killins and Mollick (2020) in Canada, both of whom suggest an indirect or muted relationship. Katırcıoglu et al. (2018) also report a conditional link depending on the degree of energy sector dependence.

The strong positive effect of GDP growth supports prior studies such as Yüksel et al. (2018), Başarır and Sarıhan (2017), and Yuan et al. (2022), which emphasize the central role of economic expansion in supporting banking sector performance through increased credit activity and reduced default risk.

Conversely, the adverse effect of inflation is consistent with studies by Boyd et al. (2001), Hooshyari and Moghanloo (2015), and Katircioğlu et al. (2020), all of which highlight the erosion of profit margins and lending efficiency in high-inflation environments. The positive influence of interest rates is in line with findings by Almaqtari et al. (2019), who show that higher rates can improve banks' interest margins, especially when liabilities are less sensitive than assets.

The lack of significant short-run effects contrasts with the findings of Saif-Alyousfi et al. (2021), Al-Khazali and Mirzaei (2017), and Alqahtani et al. (2020), which report more immediate responses in oil-dependent economies. This difference may be explained by the more diversified and resilient banking systems of the world's largest economies, which are better equipped to absorb short-term macroeconomic shocks.

5. Conclusion and Policy Implications

This study examined the influence of global crude oil prices on banking sector profitability in major economies using panel ARDL analysis over the period 2000–2021. The findings reveal a positive but marginally significant long-run relationship between crude oil prices and bank profitability, offering partial support for Hypothesis 1. However, the relatively weak magnitude of this relationship suggests that while oil prices may affect profitability indirectly, their direct influence is limited—likely due to structural diversification and financial hedging mechanisms common in large economies.

In contrast, GDP growth exhibits a strong and significant positive effect on banking profitability, whereas inflation has a significant negative impact. Interest rates also positively affect profitability, indicating that banks tend to benefit from a rising rate environment. These results support Hypothesis 2, which proposes that oil price changes influence bank profitability through inflation and interest rate channels. While inflation appears to erode real returns and heighten uncertainty, the positive effect of interest rates reflects potential gains from wider lending margins.

In the short run, none of the macroeconomic variables, including oil prices, exhibit a statistically significant effect on bank profitability. This outcome supports Hypothesis 3, which posits that short-run impacts vary across countries depending on their energy dependence and monetary policy frameworks. The aggregated results suggest that structural factors dominate over short-term fluctuations in determining banking sector performance.

Policy and Strategic Implications

The findings carry several important implications for policymakers, regulators, and banking sector stakeholders:

- Limited Oil Price Exposure: The weak long-run association between oil prices and bank profitability suggests that banking systems in large economies are relatively insulated from direct oil market shocks. Nonetheless, banks should continue to monitor oil price trends due to their broader macroeconomic effects.
- Macroeconomic Stability is Crucial: The strong link between GDP growth and banking profitability underscores the importance of fostering stable and sustained economic growth. Sound fiscal and structural policies that support productive investment and consumption can indirectly strengthen the banking sector.
- Inflation Management: The negative effect of inflation on profitability highlights the need for effective inflation-targeting frameworks. Persistent inflation not only erodes purchasing power but also increases the riskiness of lending operations, reducing bank margins and credit quality.
- Interest Rate Strategy: The positive relationship between interest rates and profitability suggests that banks should optimize their asset-liability structures to benefit from rising rates while managing potential risks to borrowers' repayment capacity.
- Banking Sector Resilience: Policymakers should ensure that banks remain robust to macroeconomic shocks—including oil price volatility—by promoting prudent regulation, stress testing, and diversification strategies.

Recommendations for Future Research

Given the lack of significant short-term effects, future studies could explore alternative frameworks or additional variables to capture immediate macro-financial interactions more precisely. These may include exchange rates, fiscal deficits, political instability, or sector-specific indicators. Employing alternative methodologies, such as Structural VAR (SVAR) models or nonlinear panel techniques, may also uncover deeper causal mechanisms and asymmetries in the relationship between macroeconomic variables and banking sector outcomes.

Overall, this study contributes to the growing literature on macro-financial linkages by highlighting the nuanced and largely long-run nature of the oil price–bank profitability relationship in the world's largest economies.

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