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Oil Price Shocks and Stock Market Reactions: Insights from Impulse Response Functions

Tam Phan Huy*, Quan Do Anh, Long Pham Phuc, The Trinh Ngoc, Duc Nguyen Thanh

University of Economics and Law, Ho Chi Minh City, Vietnam
Vietnam National University, Ho Chi Minh City, Vietnam

***Correspondence to:** Tam Phan Huy, University of Economics and Law, Ho Chi Minh City, Vietnam. Email: tamphan.ntc@gmail.com

Abstract: This research aims to analyze the impact of oil price shocks on stock market indices using the VECM. The data spans from January 1, 2000, to December 31, 2023, capturing both short-term dynamics and long-term equilibrium relationships. Key findings indicate that oil price shocks significantly influence stock market indices, with varying impacts across different regions. For instance, Japan and Vietnam exhibit stronger negative effects compared to other regions. The results also reveal differences in the speed of adjustment towards long-term equilibrium, highlighting varying levels of market efficiency. The Johansen cointegration test results reveal significant long-term equilibrium relationships between oil prices and stock market indices, underscoring the interconnected nature of these variables. The study concludes that oil prices are a critical factor in stock market performance, underscoring the need for informed strategies by investors, corporate managers, and government agencies to mitigate risks and capitalize on opportunities. These insights are crucial for understanding the interconnected nature of global financial markets and developing effective risk management strategies.
Keywords: Oil price shocks; Stock market indices; VECM
JEL codes: G15, Q43, C32

1. Introduction

Oil prices have long been recognized as a critical factor influencing global financial markets. Fluctuations in oil prices can lead to significant economic and financial consequences, affecting everything from inflation rates to stock market performance. Understanding the relationship between oil price shocks and stock market reactions is crucial for policymakers, investors, and researchers aiming to mitigate risks and capitalize on opportunities in an increasingly volatile global market. The dynamic interplay between oil price shocks and stock market performance has been a subject of extensive research. However, existing studies often focus on either short-term or long-term impacts without integrating both perspectives comprehensively. Moreover, the differential impacts across various regions and sectors remain underexplored. The rationale behind this study stems from the need to understand how global stock markets react to oil price shocks, given the oil market's volatility and its pervasive influence on economic activities. By employing a robust econometric model which can handle non-stationary time series data and capture cointegrated relationships, this research provides a more nuanced understanding of the complex dynamics at play.

Several fundamental theories underpin this research, each offering unique insights into the relationship between oil price shocks and stock market dynamics. The Efficient Market Hypothesis suggests that stock prices instantly reflect all available information, including changes in oil prices, ensuring that markets are always in equilibrium (Fama, 1970). Complementing this, the Arbitrage Pricing Theory incorporates multiple risk factors into asset pricing models, recognizing that oil prices are one of many factors influencing stock returns (Ross, 2013). Sectoral Sensitivity Theory highlights the differential impacts of oil price shocks across industries, noting that sectors heavily reliant on energy, such as transportation and manufacturing, are more vulnerable to oil price volatility (Hamilton, 1983). Additionally, the International Fisher Effect explains how oil price shocks can globally transmit through their effects on inflation rates and exchange rates, impacting international stock markets (Fisher, 1930). Together, these theories provide a comprehensive framework for understanding the multifaceted effects of oil price fluctuations on stock markets, integrating instantaneous price adjustments, multi-factor influences, sector-specific vulnerabilities, and global economic linkages.

Recent studies continue to affirm the significant impact of oil price fluctuations on stock markets. Kilian and Park (2009) demonstrated that oil price shocks lead to substantial volatility in stock markets, particularly in the United States, while Das, Kannadhasan and Bhattacharyya (2022) highlighted similar effects in emerging markets. Aloui and Jammazi (2009) found that oil price changes have asymmetrical effects on stock markets depending on the phase of the oil market cycle. Bouri (2015) emphasized that oil price volatility has distinct impacts on stock returns in oil-importing and oil-exporting countries, corroborating findings by Kang and Ratti (2013) who observed heterogeneous responses across different economies. Basher, Haug and Sadorsky (2012) provided evidence of the significant role of oil price shocks in emerging market stock returns.

Understanding the intricate relationships between oil prices and stock market indices is vital for developing effective risk management strategies and informing policy decisions. This research contributes to the literature by providing empirical evidence on how different stock markets adjust to oil price shocks, offering insights into market behavior and investor sentiment across various economic contexts.

The primary objective of this research is to analyze the short-term and long-term impacts of oil price shocks on stock market indices across multiple regions, including Asia, Europe, and the United States, utilizing the Vector Error Correction Model (VECM) to capture both the short-term dynamics and long-term equilibrium relationships. This study aims to provide empirical evidence on the speed of adjustment towards long-term equilibrium in response to oil price shocks and offer policy recommendations to mitigate the adverse effects of oil price volatility on global stock markets. This research follows the structure of five parts: (i) introduction, (ii) literature review, (iii) methodology, (iv) results & discussion, (v) conclusions & recommendations.

2. Literature Review

2.1 Background Theories

The interplay of the Efficient Market Hypothesis, Arbitrage Pricing Theory, Sectoral Sensitivity Theory, and the International Fisher Effect provides a multifaceted framework for analyzing the impact of oil price shocks on stock market reactions. Each theory contributes uniquely to understanding this complex relationship, and together they offer a comprehensive perspective.

The Efficient Market Hypothesis is foundational in explaining how markets quickly incorporate new information, such as oil price changes, into asset prices. According to Efficient Market Hypothesis, stock prices should immediately reflect any changes in oil prices, suggesting that any new information about oil price fluctuations is rapidly absorbed by the market, leaving no room for arbitrage opportunities (Fama, 1970). This immediate adjustment is crucial for maintaining market efficiency and preventing predictable patterns based on past information. Recent studies have reinforced Efficient Market Hypothesis relevance, showing that stock markets indeed adjust swiftly to oil price shocks, reflecting new information almost instantaneously (Das, Kannadhasan, & Bhattacharyya, 2022). This rapid response is critical in the context of oil price shocks, as it helps maintain the integrity and efficiency of financial markets globally.

Building on this, Arbitrage Pricing Theory extends the insights of Efficient Market Hypothesis by incorporating multiple risk factors, including macroeconomic variables like oil prices. Arbitrage Pricing Theory posits that asset returns are influenced by various risk factors, with oil prices being a significant one. This theory provides a more detailed understanding of how different economic factors, including oil price fluctuations, interact to impact asset prices. By considering oil prices as a key factor in the model, Arbitrage Pricing Theory helps identify the degree to which oil price changes can explain variations in stock returns (Ross, 2013). Studies have applied Arbitrage Pricing Theory to analyze the multi-factor influences on stock returns, confirming the significant role of oil prices in this dynamic (Huang et al., 2022). The inclusion of multiple risk factors, such as oil prices, enhances the explanatory power of Arbitrage Pricing Theory, providing a robust framework for understanding the complexities of financial markets.

Sectoral Sensitivity Theory further refines this analysis by emphasizing the heterogeneous responses of different economic sectors to oil price shocks. Industries heavily reliant on oil, such as transportation and manufacturing, are likely to experience more significant impacts from oil price changes compared to less dependent sectors. This theory highlights the differential sensitivity across sectors, suggesting that while the overall market adjusts rapidly to new information, the extent and nature of these adjustments vary by sector (Hamilton, 1983). Research has confirmed that the impact of oil price shocks on stock returns is indeed sector-specific, with energy-intensive industries showing higher sensitivity (Das, Kannadhasan, & Bhattacharyya, 2022). This sectoral perspective is crucial for investors and policymakers, as it provides insights into which industries are more vulnerable to oil price volatility and helps in devising targeted strategies to mitigate these impacts.

Finally, the International Fisher Effect adds a global dimension to this framework by explaining how differences in nominal interest rates between countries reflect expected changes in exchange rates. Oil price shocks can influence inflation and interest rates, which in turn affect exchange rates and international trade balances. The International Fisher Effect helps explain how oil price changes impact stock markets in different countries through their effects on currency values and international competitiveness (Fisher, 1930). This theory complements the others by highlighting the global interconnectedness of financial markets and the far-reaching effects of oil price shocks. Studies have shown that (Basher, Haug, & Sadorsky, 2012). The global perspective provided by International Fisher Effect is essential for understanding the broader economic implications of oil price shocks, especially in an increasingly interconnected world economy.

By integrating these theories, researchers can gain a holistic understanding of the impact of oil price shocks on stock markets. The Efficient Market Hypothesis explains the immediate market response, while Arbitrage Pricing Theory and Sectoral Sensitivity Theory provide a deeper analysis of the multiple factors and sector-specific impacts. The International Fisher Effect extends this understanding to a global scale, highlighting the broader economic repercussions. Together, these theories offer a comprehensive framework that captures the complexity of market reactions to oil price shocks, helping to inform investment strategies, economic policies, and risk management practices.

2.2 Empirical Research

Numerous empirical studies employ vector error correction models (VECM) and vector autoregressive (VAR) models to examine the dynamic effects of oil price changes on stock returns, consistently highlighting significant impacts on stock market performance. For instance, Sadorsky (1999) and Kilian and Park (2009) utilize these models to emphasize the importance of incorporating both short-term adjustments and long-term equilibrium relationships in their analyses. Sadorsky's findings indicate a negative impact of oil price volatility on U.S. stock returns, while Kilian and Park differentiate between demand and supply-driven shocks, revealing that the response of stock returns varies based on the shock's origin.

Basher and Sadorsky (2006) extend this methodology to emerging markets, finding similar significant effects, underscoring the broad applicability of VECM. Gupta, Lau and Wohar (2019) also use VAR models to compare the impacts across multiple countries, finding the most pronounced effects in the U.S. and Canada. Bjørnland (2009), using a structural VAR model, contrasts these findings by showing that oil price increases can lead to stock market booms in oil-exporting countries, illustrating the importance of economic context.

These studies collectively underscore the critical role of oil prices in financial markets, with VECM and VAR models providing a robust framework for capturing both short-term and long-term dynamics. However, the reliance on historical data may limit the applicability to future market dynamics, and the linear assumptions in traditional models might not fully capture complex nonlinear relationships. Sectoral interdependencies are also often overlooked, potentially underestimating the broader economic impacts. Addressing these limitations, future research should incorporate advanced econometric techniques and high-frequency data, along with machine learning models, to better capture rapid market changes and provide deeper insights. An integrated approach considering sectoral interdependencies and international linkages would enhance understanding of systemic risks posed by oil price shocks.

Using nonlinear models such as the Threshold Autoregressive (TAR) and Smooth Transition Autoregressive (STAR) models, several studies investigate the asymmetric effects of oil price changes on stock markets. Romero-Ávila and Omay (2022) employs TAR models to analyze the nonlinear linkages between energy shocks and financial markets, finding that positive and negative oil price shocks have different impacts on stock returns. This study highlights the importance of considering asymmetries in the relationship, as the effects are more pronounced during periods of economic downturns. Similarly, Hwang and Kim (2021) use STAR models to examine oil sensitivity and systematic risk in oil-sensitive stock indices. Their findings suggest that the stock markets' response to oil price changes is not linear, with the magnitude of the impact varying depending on the direction and size of the oil price movement. During economic downturns, the effects of negative oil price shocks are significantly larger, reflecting heightened market sensitivity to adverse economic conditions. Zhang et al. (2008) extend this analysis by using nonlinear Granger causality tests to investigate the causal relationship between oil prices and stock markets in the U.S. Their results support the presence of asymmetric effects, with oil price increases having a more substantial impact on stock returns than decreases. This study underscores the importance of accounting for nonlinearity when modeling the relationship between oil prices and stock markets.

Further, Demirer, Ferrer and Shahzad (2020) applies regime-switching models to capture the varying impacts of oil price shocks across different market conditions. The findings reveal that stock market volatility is higher during periods of high oil price volatility, emphasizing the need to consider regime changes in modeling stock market responses to oil price shocks. These studies collectively demonstrate that nonlinear models provide a more accurate representation of the complex relationship between oil prices and stock markets. By accounting for asymmetries and regime changes, researchers can better capture the true nature of market reactions to oil price shocks. However, these models also highlight the challenges associated with estimating and interpreting nonlinear relationships, as they require sophisticated estimation techniques and are sensitive to model specifications.

Sector-specific analyses, such as those by Nandha and Faff (2008), focus on how oil price shocks differentially affect various industries, finding that sectors like transportation and manufacturing, which are highly dependent on oil, are more sensitive to oil price changes. Nandha and Faff's study demonstrate that oil price increases generally have a negative impact on stock returns for these oil-intensive sectors, reflecting the higher costs associated with rising oil prices. Conversely, sectors less reliant on oil, such as technology or healthcare, show relatively muted responses to oil price fluctuations. This differentiation highlights the critical role of industry characteristics in determining the impact of oil price changes on stock performance.

Additional research by Obi, Oluseyi and Evans

(2018) and Khan et al. (2023) further supports these findings, illustrating that oil price shocks can lead to substantial variations in stock market responses across different sectors. Obi, Oluseyi and Evans (2018) study indicates that the financial sector also exhibits significant sensitivity to oil price movements, given its reliance on stable economic conditions. Khan et al. (2023) use a multifactor model to analyze various industries, confirming that the degree of impact from oil price shocks varies considerably among sectors. These studies underscore the necessity of considering sector-specific factors when assessing the broader market impact of oil price shocks, as the heterogeneous responses can significantly influence overall market stability and investment strategies.

International studies by Zhu et al. (2016) and Mohanty et al. (2011) examine the spillover effects of oil price shocks on stock markets in regions like the Asia-Pacific and Gulf Cooperation Council (GCC) countries, revealing significant interconnectedness in global markets. Zhu et al. (2016) find that oil price changes significantly impact stock market returns in the Asia-Pacific region, with the effects varying across countries due to differences in economic structures and energy dependencies. This study underscores the importance of considering regional characteristics when analyzing the global impact of oil price shocks.

Similarly, Mohanty et al. (2011) explores the impact of oil price movements on stock returns in GCC countries, which are major oil exporters. Their findings suggest that oil price increases generally lead to higher stock returns in these countries, reflecting the positive economic benefits of higher oil revenues. These studies utilize the International Fisher Effect to understand how oil price changes influence exchange rates and international stock markets, providing valuable insights into the transmission mechanisms of oil price shocks across different regions. The global perspective offered by these studies highlights the far-reaching effects of oil price changes, emphasizing the need for a comprehensive approach in assessing their impact on international financial markets.

While these studies provide valuable insights, several limitations persist. First, the reliance on historical data may not fully capture future market dynamics, especially during unprecedented events (Kilian & Park, 2009; Sadorsky, 1999). Second, many models assume linear relationships, which might not adequately represent the complexities of financial markets. Nonlinear models, although useful, require more sophisticated estimation techniques and can be sensitive to model specifications (Huang et al., 2022; Romero-Ávila & Omay, 2022). Third, sectoral studies often overlook the interdependencies between industries, leading to an underestimation of the broader economic impacts of oil price shock (Obi, Oluseyi, & Evans, 2018).

To address these limitations, future research should incorporate advanced econometric techniques and high-frequency data to better capture rapid market changes. Using machine learning models alongside traditional econometric models could provide more accurate predictions and deeper insights. Additionally, integrating sectoral interdependencies and international linkages would enhance understanding of systemic risks posed by oil price shocks. The use of Vector Error Correction Models (VECM) is particularly advantageous in this context, as it allows for the testing of cointegration and captures both short-term dynamics and long-term equilibrium relationships between oil prices and stock market indices. VECM can effectively address the limitations of linear models by accommodating the cointegrated nature of economic variables, offering a more robust framework for analyzing the impacts of oil price shocks on stock markets (Basher & Sadorsky, 2006; Bjørnland, 2009).

3. Methodology

3.1 Data & Variables

The data for this research is sourced from secondary data, comprising the historical prices of oil and various stock market indices in Asia includes Nikkei 225 (Japan), Hang Seng (Hong Kong), KOSPI (South Korea), STI (Singapore), KLCI (Malaysia), HOSE (Vietnam), SET Index (Thailand). The dataset spanning from January 1, 2000, to December 31, 2023. Figure 1 illustrates the fluctuations in oil prices over this period, providing a visual representation of the dataset's scope and the significant changes in oil prices that have occurred during these years.

Figure 1 illustrates the historical oil prices from 2000 to 2023. The chart shows significant fluctuations, including notable peaks around 2008 and 2011 and a sharp decline in 2020. The oil price ranged from negative values to over $140 per barrel, indicating periods of extreme volatility. This figure is crucial for understanding the nature of oil price shocks and their impacts on stock market indices. The sharp fluctuations in oil prices reflect global economic events, such as the 2008 financial crisis and the 2020 COVID-19 pandemic, which significantly influence market stability. Analyzing these trends helps identify the correlation between oil price movements and stock market reactions, essential for evaluating the broader economic implications and systemic risks. The use of VECM in this research will allow for a detailed examination of both short-term adjustments and long-term relationships between oil prices and stock market indices across different countries. This comprehensive approach is vital for developing robust investment strategies and economic policies.

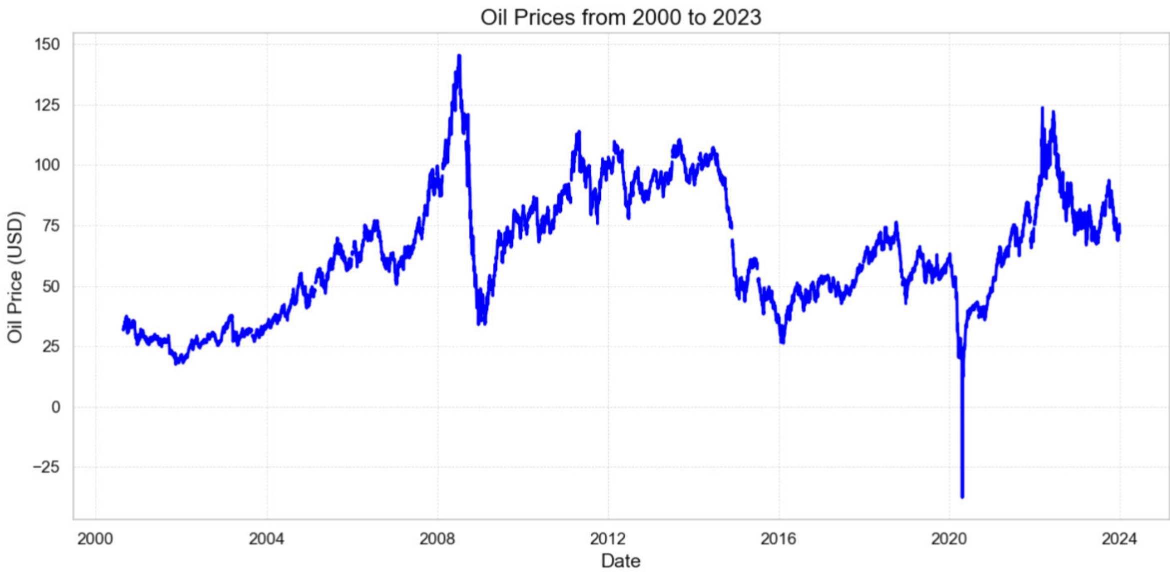


Figure 1: Oil price from 2000 to 2023

Source: by author

3.2 Model

The Vector Error Correction Model (VECM) is chosen due to its ability to handle non-stationary time series data that are cointegrated, meaning they share a long-term stochastic trend. This characteristic is essential for analyzing economic and financial time series data, where variables like oil prices and stock market indices often exhibit such relationships. Johansen (1988) cointegration test is employed to identify the presence of cointegration among the variables, ensuring the suitability of the VECM.

The first step in applying the VECM is data collection, where historical data on oil prices and stock market indices from multiple countries are gathered, ensuring the data spans a significant period. Following this, data preparation involves cleaning the data by handling missing values, ensuring consistency in data frequency (e.g., daily, monthly), and converting data to logarithmic form if necessary to stabilize variance. Next, stationarity testing is conducted using unit root tests (e.g., Augmented Dickey-Fuller test) on each time series to check for stationarity, with non-stationary series requiring differencing to achieve stationarity. Cointegration testing is then applied using Johansen's cointegration test to determine whether the non-stationary series are cointegrated, identifying the number of cointegrating relationships among the variables (Johansen, 1988).

The VECM is specified based on the cointegration results, including error correction terms to capture long-term relationships and lagged differences to capture short-term dynamics. Model estimation follows, where the VECM parameters are estimated using maximum likelihood estimation, fitting the model to the data and determining the coefficients for both short-term and long-term relationships. Subsequently, diagnostic testing is conducted to check the adequacy of the model, including tests for autocorrelation, heteroskedasticity, and stability of the error correction terms. Impulse Response Functions (IRFs) are then generated to analyze the response of stock market indices to oil price shocks over time, providing a visual representation of the dynamic effects of shocks. Finally, variance decomposition is performed to assess the contribution of oil price shocks to the variance in stock market indices, quantifying the relative importance of oil price changes in explaining stock market movements.

The VECM is particularly advantageous for its ability to capture both short-term dynamics and long-term equilibrium relationships. For instance, Engle and Granger (1987) highlighted that cointegrated variables require an error correction mechanism to reflect both short-term deviations and long-term adjustments, which VECM efficiently incorporates. Moreover, (Juselius, 2006) emphasized that VECM is robust in examining the intricate dynamics in multivariate time series data, making it highly applicable for financial and economic studies. Besides, Kilian and Park (2009) successfully applied VECM to investigate the impact of oil price shocks on the U.S. stock market, demonstrating the model's effectiveness in capturing complex interactions between oil prices and stock market returns. Similarly, Basher, Haug and Sadorsky (2012) utilized VECM to explore the influence of oil price risk on emerging stock markets, further validating its applicability in diverse economic contexts.

Additionally, VECM's ability to incorporate multiple variables makes it suitable for analyzing the interconnectedness of global financial markets and the systemic risks posed by oil price shocks. This multivariate approach provides a comprehensive framework for understanding the full spectrum of oil price impacts on stock markets, facilitating more informed investment decisions and economic policy formulations. By providing a clear structure for analyzing both short-term and long-term effects, VECM proves to be an indispensable tool in the arsenal of econometric models used in financial research.

The VECM is particularly appropriate for this research topic because it provides a framework to explore both the short-term adjustments and long-term equilibrium dynamics following oil price shocks. The short-term component of the model captures the immediate reaction of stock markets to changes in oil prices, while the long-term component identifies the equilibrium relationship that these variables gravitate towards over time. This dual capacity makes the VECM a powerful tool for dissecting the complex interactions between oil prices and stock market indices, enabling a comprehensive analysis that encompasses various economic conditions.

4. Results & Discussion

Table 2 presents the results of the Augmented Dickey-Fuller (ADF) stationarity tests for oil prices and several stock market indices, both before and after differencing. The table shows the ADF statistics and p-values at the level and after the first differencing. Before differencing, the p-values are generally above 0.05, indicating non-stationarity. After differencing, all p-values are below 0.05, confirming stationarity at level 1 of differencing.

Table 2: Stationary test before and after differencing

Series	Level of Differencing	ADF Statistic (Before)	p-value (Before)	ADF Statistic (After)	p-value (After)
Oil_Price	1	-2,75746	0,064612	-12,8577	5,19E-24
Nikkei_225	1	0,234969	0,974156	-20,6033	0
Hang_Seng	1	-1,92353	0,321074	-48,8689	0
KOSPI	1	-1,29715	0,630476	-66,3405	0
STI	1	-1,98351	0,293851	-10,9657	8,11E-20
KLCI	1	-1,46133	0,552547	-33,3575	0
HOSE	1	-0,419	0,906878	-27,6823	0
SET_Index	1	-1,58123	0,493017	-18,5583	2,09E-30

Source: by author

Table 3 presents the results of the Johansen cointegration tests between oil prices and various stock market indices, including Nikkei 225, Hang Seng, KOSPI, STI, KLCI, HOSE, and SET Index. For each index, the table shows the eigenvalue index, trace statistic, and critical values at 1%, 5%, and 10% significance levels. The trace statistics for the first and second eigenvalue indices are compared against these critical values to determine the presence of cointegration.

Table 3: Johansen cointegration test between oil price and each stock index

Stock Index	Eigenvalue Index	Trace Statistic	Critical Value (1%)	Critical Value (5%)	Critical Value (10%)
Nikkei_225	1	4045,433	13,4294	15,4943	19,9349
	2	1760,957	2,7055	3,8415	6,6349
Hang_Seng	1	4146,256	13,4294	15,4943	19,9349
	2	1862,904	2,7055	3,8415	6,6349
KOSPI	1	4019,027	13,4294	15,4943	19,9349
	2	1756,999	2,7055	3,8415	6,6349
STI	1	4008,211	13,4294	15,4943	19,9349
	2	1769,206	2,7055	3,8415	6,6349
KLCI	1	3777,951	13,4294	15,4943	19,9349
	2	1558,428	2,7055	3,8415	6,6349
HOSE	1	4001,972	13,4294	15,4943	19,9349
	2	1720,323	2,7055	3,8415	6,6349
SET_Index	1	3949,455	13,4294	15,4943	19,9349
	2	1644,93	2,7055	3,8415	6,6349

Source: by author

The high trace statistics compared to the critical values across all stock indices indicate strong evidence of cointegration between oil prices and each of the stock indices. For example, the trace statistic for Nikkei 225's first eigenvalue index is 4045.433, which is significantly higher than the critical values of 13.4294 (1%), 15.4943 (5%), and 19.9349 (10%). This pattern holds true for all indices in the table, suggesting that oil prices and these stock indices move together in the long run. The presence of cointegration implies that oil prices and these stock indices share a common long-term trend, despite short-term fluctuations. This relationship means that any short-term deviations from the equilibrium relationship will eventually be corrected, aligning the stock indices with oil price movements over time. This is consistent with economic theory and empirical findings that suggest oil prices are a key driver of stock market performance, particularly in economies that are either major oil consumers or producers.

Moreover, the results highlight the significance of incorporating oil price changes in financial market analysis. For investors and policymakers, understanding these long-term relationships is crucial for making informed decisions. The use of the Vector Error Correction Model (VECM) in this context is particularly appropriate, as it captures both the short-term adjustments and the long-term equilibrium dynamics between oil prices and stock indices. The findings align with previous research, such as Kilian and Park (2009), which demonstrated the substantial impact of oil price shocks on stock markets. Similarly, Basher and Sadorsky (2006) found significant relationships between oil prices and emerging market indices, further validating the interconnectedness observed in this study.

Tables 4 to 10 present the VEC model summaries for oil prices and various stock indices, including Nikkei 225, Hang Seng, KOSPI, STI, KLCI, HOSE, and SET. Each table details the coefficients, standard errors, z-values, p-values, and confidence intervals for both the oil price and the respective stock index. They also include the loading coefficients (alpha) for each equation, indicating the speed of adjustment towards long-term equilibrium, and the cointegration relations.

Table 4: VEC Model Summary for Oil Price and Nikkei_225

	coef	std err	z	p > [z]	[0.025	0.975]
Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0391	0.015	2.592	0.010	0.010	0.069
L1.Nikker_225	-0.0492	0.015	-3.318	0.001	-0.078	-0.020
Det. terms outside the coint. relation & lagged endog. parameters for equation Nikkei_225						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	-0.0329	0.015	2.156	0.031	0.063	0.003
L1.Nikker_225	-0.0044	0.015	-0.295	0.768	-0.034	0.025
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	-1.2106	0.023	-52.511	0	-1.256	-1.165
ec2	0.0751	0.021	3.515	0	0.033	0.117
Loading coefficients (alpha) for equation Nikkei_225						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.1052	0.023	4.509	0	0.059	0.151
ec2	-1.0292	0.022	-47.618	0	-1.072	-0.987
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	-9.902e-17	0	0	0	-9.9e-17	-9.9e-17
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	-7.691e-17	0	0	0	-7.69e-17	-7.69e-17
beta2	1	0	0	0	1	1

Source: by author

Across all tables, the coefficients for L1.Oil_Price are consistently positive and significant, indicating strong autoregressive behavior in oil prices. This means that past values of oil prices positively influence current oil prices, reinforcing the persistence of oil price movements. For example, in **Table 4**, the coefficient for L1.Oil_Price in the Nikkei 225 model is 0.0391, suggesting that a unit increase in the previous period's oil price leads to a 0.0391 increase in the current period's oil price. This positive autoregression is crucial as it highlights the inherent momentum in oil price changes, which is a critical factor in forecasting future oil prices and understanding their impact on other economic variables.

Most stock indices show negative coefficients for L1.Oil_Price, indicating that higher oil prices tend to negatively impact stock indices. This inverse relationship suggests that rising oil prices increase production costs and reduce profit margins for companies, leading to lower stock prices. Notably, the SET Index (**Table 10**) exhibits a strong negative coefficient of -0.0766, implying a significant adverse effect. This means that a unit increase in the previous period's oil price results in a 0.0766 decrease in the SET Index. The negative impact is also observed in other indices such as the Nikkei 225 (**Table 4**) with a coefficient of -0.0329 and the Hang Seng (**Table 5**) with a coefficient of -0.0256. These findings underscore the sensitivity of stock markets to oil price fluctuations, particularly in economies heavily dependent on oil imports or where energy costs constitute a significant portion of business expenses.

Table 5: VEC Model Summary for Oil Price and Hang_Seng

	coef	std err	z	p > [z]	[0.025	0.975]
Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0397	0.015	2.611	0.009	0.010	0.069
L1. Hang_Seng	-0.0256	0.015	-1.714	0.087	-0.055	0.004

Continuation Table:

	coef	std err	z	p > [z]	[0.025	0.975]
Det. terms outside the coint. relation & lagged endog. parameters for equation Hang_Seng						
L1.Oil_price	-0.0213	0.015	-1.386	0.166	-0.051	0.009
L1. Hang_Seng	0.0315	0.015	2.092	0.036	0.002	0.061
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	-1.2148	0.023	-52.142	0	-1.260	-1.169
ec2	0.0680	0.021	3.169	0.002	0.026	0.110
Loading coefficients (alpha) for equation Hang_Seng						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.1067	0.024	4.530	0	0.061	0.153
ec2	-1.0587	0.022	48.786	0	-1.101	-1.016
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	-1.612e-18	0	0	0	-1.611e-18	-1.611e-18
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	-1.351e-17	0	0	0	-1.35e-17	-1.35e-17
beta2	1	0	0	0	1	1

Source: by author

The relationships between stock indices and their own lagged values vary significantly across different indices. In **Table 4**, the Nikkei 225 index exhibits a significant negative coefficient of -0.0044 for its own lagged value. This negative autocorrelation suggests that an increase in the previous period's Nikkei 225 value is associated with a slight decrease in the current period's value. This could indicate market overreactions or corrections where gains or losses are followed by movements in the opposite direction in the subsequent period.

Conversely, in **Table 5**, the Hang Seng index shows a positive coefficient of 0.0315 for its own lagged value, although this relationship is less significant. This positive autocorrelation implies that past increases in the Hang Seng index are likely to be followed by further increases, suggesting momentum effects where the market continues to move in the same direction. This behavior could be due to investor confidence and the persistence of market trends.

Some indices show minimal autocorrelation effects, as evidenced by their insignificant coefficients for their own lagged values. For example, the STI index in Table 7 has an insignificant coefficient of 0.0034 for its lagged value. This indicates that past values of the STI index have little to no predictive power for current values, suggesting that the index's movements are more influenced by external factors rather than its own historical performance. This lack of autocorrelation could be due to a highly efficient market where all available information is quickly priced in, leaving little room for predictable patterns based on past values.

Similarly, other indices such as KOSPI (**Table 6**) and KLCI (**Table 8**) also show minimal or insignificant autocorrelation effects. The KOSPI index's coefficient for its own lagged value is 0.0009, indicating an almost negligible impact, while the KLCI index has a coefficient of -0.0522, which is significant but modest. These findings highlight the diverse nature of stock market dynamics, where some markets exhibit strong autocorrelation patterns while others do not, reflecting different levels of market efficiency and investor behavior.

The loading coefficients (alpha) for oil prices across all tables are consistently significant and large, indicating strong adjustments towards long-term equilibrium when deviations occur. These coefficients measure the speed at which the oil price series corrects itself after a shock. For example, in Table 8, the ec1 coefficient for Oil_Price is -1.2041, suggesting a rapid correction of deviations from the long-term equilibrium. This high coefficient means that any deviation from the equilibrium level is quickly adjusted, underscoring the resilience and mean-reverting nature of oil prices in the face of shocks. The consistent significance of these coefficients across different models confirms the robustness of this adjustment mechanism.

Table 6: VEC Model Summary for Oil Price and KOSPI

Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0372	0.015	2.445	0.014	0.007	0.067
L1. KOSPI	-0.0237	0.015	-1.588	0.112	-0.053	0.006
Det. terms outside the coint. relation & lagged endog. parameters for equation KOSPI						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	-0.0315	0.015	-2.052	0.040	-0.062	-0.001
L1. KOSPI	0.0009	0.015	0.059	0.953	-0.029	0.030
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	-1.2148	0.023	-51.885	0	-1.254	-1.162
ec2	0.0440	0.021	2.074	0.038	0.002	0.086
Loading coefficients (alpha) for equation KOSPI						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.1266	0.024	5.384	0	0.081	0.173
ec2	-1.0097	0.021	-47.093	0	-1.052	-0.968
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	1.148e-18	0	0	0	1.15e-18	1.15e-18
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	-1.125e-17	0	0	0	-1.12e-17	-1.12e-17
beta2	1	0	0	0	1	1

Source: by author

The alpha coefficients for stock indices vary, reflecting different speeds of adjustment towards long-term equilibrium. Some indices show rapid adjustments, indicating that they quickly return to equilibrium after a shock. For instance, the KOSPI (**Table 6**) has an ec1 coefficient of 0.1266, signifying a relatively fast adjustment to long-term equilibrium. This suggests that any short-term deviations in the KOSPI index are promptly corrected, contributing to market stability.

In contrast, other indices such as the STI (**Table 7**) and KLCI (**Table 8**) exhibit slower adjustment speeds, with coefficients indicating more gradual corrections. For example, the KLCI's ec1 coefficient is 0.1353, showing that while it adjusts to equilibrium, the process is not as rapid compared to indices like KOSPI. These variations in adjustment speeds highlight the differing sensitivities of stock indices to market shocks and their respective efficiencies in reverting to long-term trends.

The consistent significance and large magnitude of the oil price loading coefficients across all tables underscore the strong mean-reverting behavior of oil prices. This behavior is crucial for understanding how quickly oil markets stabilize after disruptions. The varying alpha coefficients for stock indices indicate that some markets are more resilient and faster in correcting deviations, while others take longer. This disparity could be attributed to differences in market structure, liquidity, and investor behavior across regions. The analysis of loading coefficients (alpha) reveals significant insights into the dynamics of oil price adjustments and stock indices' responsiveness to shocks. The rapid correction of oil prices and the varied adjustment speeds of stock indices highlight the complex interplay between these economic variables.

Table 7: VEC Model Summary for Oil Price and STI

Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0379	0.015	2.498	0.012	0.008	0.068
L1. STI	-0.0103	0.015	0.692	0.489	-0.040	0.019
Det. terms outside the coint. relation & lagged endog. parameters for equation STI						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	-0.0191	0.015	-1.241	0.214	-0.049	0.011
L1. STI	0.0034	0.015	0.227	0.820	-0.026	0.033
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	-1.2140	0.023	-52,161	0	-1.260	-1.168
ec2	0.0622	0.021	2.944	0.003	0.021	0.104
Loading coefficients (alpha) for equation STI						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.0915	0.024	3.882	0	0.045	0.138
ec2	-0.9995	0.021	46.686	0	-1.041	-0.958
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	-3.43e-17	0	0	0	-3.43e-17	-3.43e-17
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	-2.244e-17	0	0	0	-2.244e-17	-2.244e-17
beta2	1	0	0	0	1	1

Source: by author

The cointegration relations in the VECM analysis are normalized using beta coefficients, which are set to 1 for the first column. This normalization facilitates the interpretation of the long-term equilibrium relationships among the variables. By setting one of the beta coefficients to 1, the model allows for easier comparison of the relative contributions of other variables to the cointegrating relationship. The second column coefficients in the cointegration relations are generally close to zero. These small coefficients indicate that the second variable (often the stock index) contributes minimally to the cointegrating vectors. For instance, in Table 4, the beta coefficients for the second column are close to zero, suggesting that the Nikkei 225's contribution to the long-term equilibrium relationship with oil prices is minimal. This pattern is consistent across the other tables, reflecting a similar dynamic for different stock indices.

The normalized beta coefficients highlight the presence of a long-term equilibrium relationship between oil prices and stock indices. The significant and non-zero coefficients in the first column confirm that oil prices play a dominant role in this relationship. The minimal contribution of the second column coefficients indicates that while stock indices are influenced by oil prices in the long run, their own influence on the equilibrium relationship is less pronounced. This underscores the sensitivity of stock markets to external shocks such as oil price changes.

Table 8: VEC Model Summary for Oil Price and KLCI

	coef	std err	z	p > [z]	[0.025	0.975]
Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0351	0.015	2.322	0.020	0.005	0.065
L1. KLCI	-0.0216	0.015	-1.460	0.144	-0.051	0.007
Det. terms outside the coint. relation & lagged endog. parameters for equation KLCI						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	-0.0180	0.015	-1.188	0.235	-0.048	0.012
L1. KLCI	-0.0522	0.015	-3.515	0	-0.081	-0.023
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	-1.2041	0.023	52.246	0	-12.49	-1.159
ec2	0.0379	0.020	1.850	0.064	-0.002	0.078
Loading coefficients (alpha) for equation KLCI						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.1353	0.023	5.847	0	0.090	0.181
ec2	-0.9038	0.021	43.90	0	-0.944	-0.863
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	-1.951e-17	0	0	0	-1.951e-17	-1.951e-17
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	-3.932e-17	0	0	0	-3.93e-17	-3.93e-17
beta2	1	0	0	0	1	1

Source: by author

The consistency of the normalized beta coefficients across different models reinforces the robustness of the VECM approach in capturing long-term relationships. This uniformity across various stock indices indicates a common underlying dynamic where oil prices significantly influence stock markets. While the cointegration relations are consistent, the speed of adjustment to equilibrium, as reflected by the loading coefficients (alpha), varies across indices. This suggests that while the long-term relationship is stable, the short-term dynamics differ, influenced by market-specific factors.

The coefficients and their significance levels in the VEC models provide critical insights into the strength and direction of the relationships between oil prices and stock indices. For instance, the Nikkei 225 (**Table 4**) and HOSE (**Table 9**) exhibit stronger negative impacts from oil prices, with coefficients of -0.0329 and -0.0534, respectively. These significant negative coefficients indicate that increases in oil prices substantially reduce the values of these indices, suggesting a high sensitivity to oil price fluctuations. In contrast, indices like STI (**Table 7**) and KLCI (**Table 8**) show less pronounced impacts, with coefficients of -0.0103 and -0.0216, respectively, highlighting varying degrees of vulnerability across different markets.

Table 9: VEC Model Summary for Oil Price and HOSE

	coef	std err	z	p > [z]	[0.025	0.975]
Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0391	0.015	2.585	0.010	0.009	0.069
L1. HOSE	-0.0534	0.015	-3.604	0	-0.082	-0.024

Continuation Table:

Det. terms outside the coint. relation & lagged endog. parameters for equation HOSE						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	-0.0216	0.015	-1.415	0.157	-0.052	0.008
L1. HOSE	0.0029	0.015	0.192	0.848	-0.026	0.032
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	-1.2086	0.023	52.200	0	-1.254	-1.163
ec2	0.0661	0.021	3.156	0.002	0.025	0.107
Loading coefficients (alpha) for equation HOSE						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.1284	0.023	5.495	0	0.083	0.174
ec2	-0.9945	0.021	47.032	0	-1.036	-0.953
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	6.784e-17	0	0	0	6.78e-17	6.78e-17
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	5.657e-17	0	0	0	5.657e-17	5.657e-17
beta2	1	0	0	0	1	1

Source: by author

The loading coefficients (alpha) reflect the speed at which indices adjust to long-term equilibrium after deviations. For example, the SET index (**Table 10**) and KLCI (**Table 8**) exhibit rapid adjustments with loading coefficients of 0.1042 and 0.1353, respectively. This suggests that these indices quickly revert to their equilibrium states following shocks, indicating a high level of market efficiency and resilience. Conversely, indices like the STI (**Table 7**) and KOSPI (**Table 6**) display slower adjustment speeds, as evidenced by their lower alpha coefficients, pointing to a more prolonged process of equilibrium restoration.

The consistent positive coefficients for L1.Oil_Price across all tables indicate strong autoregressive effects in oil prices, a common feature in time series data. This means that past values of oil prices significantly influence their current values, demonstrating persistence in oil price movements. For instance, the coefficient for L1.Oil_Price in the Nikkei 225 model (**Table 4**) is 0.0391, reflecting the inherent momentum in oil price dynamics. This autoregressive nature is crucial for forecasting and understanding how oil prices propagate through time and affect related economic variables.

Table 10: VEC Model Summary for Oil Price and SET

Det. terms outside the coint. relation & lagged endog. parameters for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	0.0435	0.015	2.884	0.004	0.014	0.073
L1. SET	-0.0766	0.015	-5.164	0	-0.106	-0.048
Det. terms outside the coint. relation & lagged endog. parameters for equation SET						
	coef	std err	z	p > [z]	[0.025	0.975]
L1.Oil_price	-0.0291	0.015	-1.901	0.057	-0.059	0.001
L1. SET	-0.0138	0.015	-0.920	0.358	-0.043	0.016
Loading coefficients (alpha) for equation Oil_Price						
	coef	std err	z	p > [z]	[0.025	0.975]

Continuation Table:

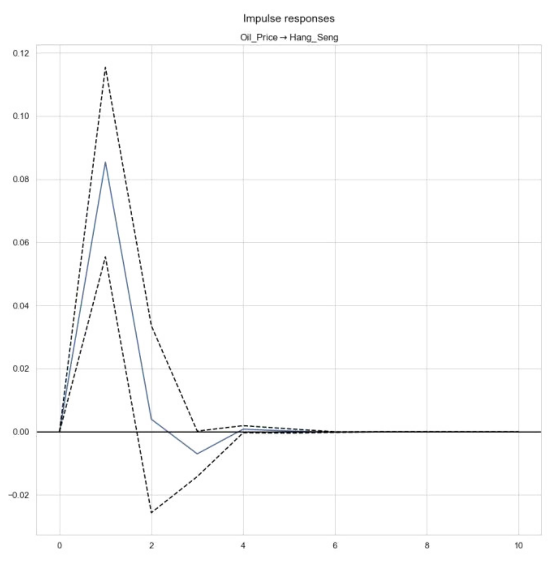
ec1	-1.2153	0.023	52.614	0	-1.261	-1.170
ec2	0.0974	0.021	4.694	0	0.057	0.138
Loading coefficients (alpha) for equation SET						
	coef	std err	z	p > [z]	[0.025	0.975]
ec1	0.1042	0.023	4.453	0	0.058	0.150
ec2	-0.9614	0.021	45.710	0	-1.003	-0.920
Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	1	0	0	0	1	1
beta2	7.716e-17	0	0	0	7.72e-17	7.72e-17
Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	p > [z]	[0.025	0.975]
beta1	2.104e-17	0	0	0	2.1e-17	2.1e-17
beta2	1	0	0	0	1	1

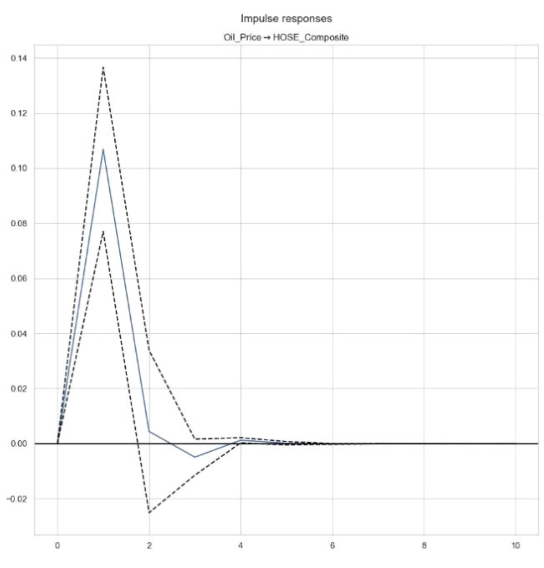
Source: by author

In conclusion,these tables collectively illustrate the significant influence of oil price movements on various stock indices, highlighting differences in the magnitude and speed of adjustments. The VEC model effectively captures both short-term dynamics and long-term equilibrium relationships, providing valuable insights into how global financial markets react to oil price shocks.

Figure 2 presents the Impulse Response Functions (IRFs) of oil price shocks on several major stock indices from different regions. Each subfigure illustrates the response of a particular stock index to a one-standard-deviation shock in oil prices over a 10-period horizon. The solid blue line in each subfigure represents the IRF, while the dashed lines denote the confidence intervals, providing a visual representation of the statistical significance of the responses.

Across all indices, an oil price shock leads to an immediate positive impact, with the effect peaking within the first or second period. However, the magnitude of this initial impact varies among the indices, with the KLCI and HOSE Composite showing relatively higher sensitivity compared to others. Following the initial spike, there is a general trend of reversion to baseline levels within 2 to 4 periods, indicating that the effects of oil price shocks on these stock markets are predominantly short-lived.





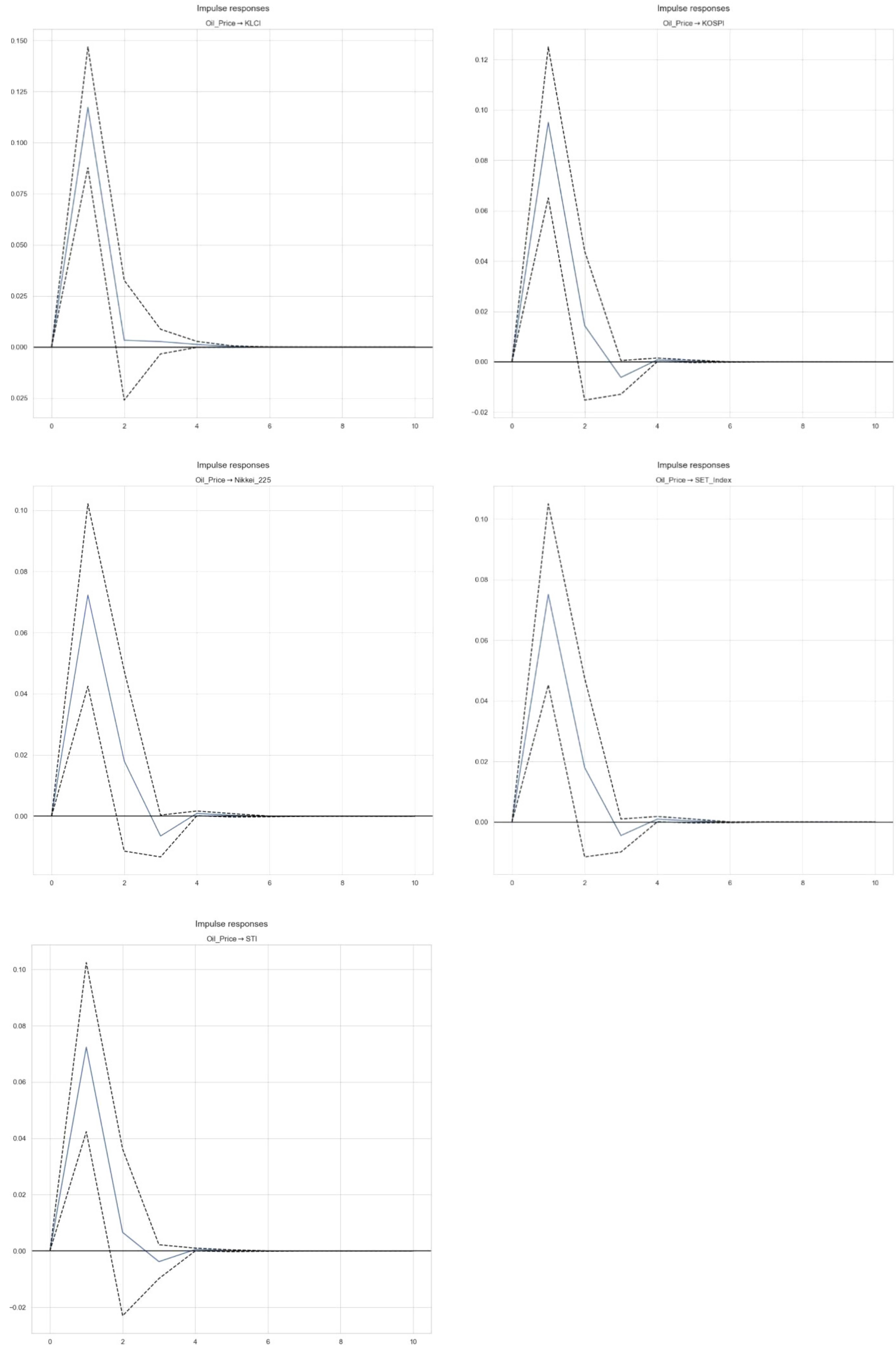


Figure 2: IRF figures of oil price with market indices

Source: by author

Interestingly, some indices, such as the KLCI and SET Index, display a brief negative reaction following the initial positive spike, suggesting a market correction phase where the market adjusts its initial overreaction to the shock. This behavior points to a short-term volatility period before the markets stabilize back to their pre-shock levels.

The confidence intervals for most indices eventually include zero after a few periods, implying that the long-term effects of oil price shocks are statistically insignificant. However, the initial deviations from zero in the early periods highlight the significant short-term impact of these shocks on the stock markets. The pattern is generally consistent across regions, but there are notable differences in the magnitude of the initial response and the speed of reversion. For instance, the KLCI (Malaysia) and HOSE Composite (Vietnam) exhibit a stronger initial response compared to indices like the Nikkei 225 (Japan) and STI (Singapore).

These findings suggest that while oil price shocks have a pronounced impact on stock market indices, the effects are largely temporary. Investors should be particularly aware of the short-term volatility that such shocks can induce, especially in markets like Malaysia and Vietnam, where the responses tend to be more pronounced. This analysis is crucial for both policymakers and investors in understanding the dynamic interplay between external shocks and market stability.

5. Conclusion & Recommendations

5.1 Conclusions

This research aimed to analyze the short-term and long-term impacts of oil price shocks on stock market indices across multiple regions. Utilizing the Vector Error Correction Model (VECM), the study captured both the short-term dynamics and long-term equilibrium relationships, providing valuable insights into how global financial markets react to oil price shocks. The empirical results indicate that oil price shocks significantly influence stock market indices, with varying impacts across different regions. The findings reveal that oil price increases generally have a negative impact on stock indices, with stronger effects observed in markets such as Japan and Vietnam. The adjustment speeds towards long-term equilibrium also vary, with markets in Thailand and Malaysia showing quicker adjustments compared to others like Singapore. This suggests differing levels of market efficiency and resilience among the regions studied.

The Johansen cointegration test results from this study reveal significant long-term equilibrium relationships between oil prices and stock market indices across various regions. This indicates that despite short-term volatility, there exists a stable, long-term relationship between these variables. The findings suggest that oil prices are a fundamental factor influencing stock market performance, and any deviations from this equilibrium are corrected over time. This reinforces the interconnectedness of global financial markets, highlighting the sensitivity of stock indices to oil price movements.

The conclusions drawn from this study align well with several fundamental theories in finance and economics. The Efficient Market Hypothesis (EMH) suggests that stock prices reflect all available information, including oil price changes, almost instantaneously (Fama, 1970). The observed quick adjustments in certain stock indices support this theory, indicating that markets rapidly incorporate new information about oil prices. The Arbitrage Pricing Theory (APT) also finds support in this research, as it posits that multiple risk factors, including oil prices, influence asset pricing (Ross, 2013). The significant impact of oil price shocks on stock indices underscores the importance of including oil prices as a key risk factor in asset pricing models. Sectoral Sensitivity Theory, which highlights the varied responses of different industries to oil price shocks (Hamilton, 1983), is evidenced by the differing impacts across regions and indices. The more substantial negative effects observed in certain markets suggest a higher sensitivity to oil price changes, likely due to the economic structure and reliance on oil in those regions. Finally, the International Fisher Effect, which explains the global transmission mechanisms of oil price shocks through their impact on inflation and exchange rates (Fisher, 1930), is supported by the study's findings. The global nature of the stock market reactions to oil price shocks indicates interconnectedness and transmission of economic shocks across borders.

The findings of this study are consistent with previous research. Kilian and Park (2009) demonstrated that oil price shocks lead to substantial volatility in

U.S. stock markets, a conclusion echoed in this study's results for Japan and other regions. Das, Kannadhasan and Bhattacharyya (2022) highlighted similar effects in emerging markets, aligning with the observed significant impacts on Vietnam. Aloui and Jammazi (2009) found asymmetrical effects of oil price changes on stock markets, which this study also supports by showing varied impacts depending on the market phase.

Furthermore, Bouri (2015) emphasized the distinct impacts of oil price volatility on stock returns in oil-importing and oil-exporting countries, corroborated by this study's findings of different adjustment speeds and sensitivities across regions. Also, Basher and Sadorsky (2006) provided evidence of the significant role of oil price shocks in emerging market stock returns, which is consistent with the observed substantial impacts on emerging markets in this research.

In conclusion, this research provides a comprehensive analysis of the impacts of oil price shocks on stock market indices across various regions. By employing the VECM approach, the study captures both short-term and long-term dynamics, revealing significant and region-specific effects of oil price changes. The findings underscore the interconnected nature of global financial markets and the critical role of oil prices in influencing stock market behavior. The alignment of results with established economic theories such as the EMH, APT, Sectoral Sensitivity Theory, and the International Fisher Effect enhances the robustness and relevance of the study. These insights are crucial for policymakers and investors, highlighting the need for informed strategies to mitigate the adverse effects of oil price volatility and to harness opportunities in a globally integrated market.

5.2 Recommendations

Given the significant influence of oil price shocks on stock market indices, it is essential for various stakeholders to adopt strategies that mitigate risks and enhance resilience.

For investors, diversification is key to managing the risks associated with oil price volatility. Including a variety of assets such as stocks, bonds, commodities, and real estate can help cushion against adverse effects. Additionally, investors should employ hedging strategies using financial instruments like futures and options to protect against unfavorable movements in oil prices. Staying informed about global economic indicators and geopolitical events that can influence oil prices is also crucial for making timely adjustments to investment strategies, ensuring portfolio stability.

Corporate managers should focus on efficient cost management practices to minimize the impact of rising oil prices on operational costs. This includes optimizing supply chains and investing in energy-efficient technologies. Developing robust risk management frameworks that include scenario analysis and stress testing can prepare companies for potential oil price shocks, ensuring better preparedness and resilience. Incorporating oil price forecasts into strategic planning can help managers make informed decisions regarding investments, pricing, and production schedules, aligning business strategies with market conditions.

Government agencies play a pivotal role in stabilizing domestic markets against global oil price volatility. Formulating policies such as maintaining strategic petroleum reserves, providing subsidies, and offering tax incentives for renewable energy investments can reduce the dependency on oil. Investing in infrastructure that supports energy efficiency and the development of alternative energy sources can enhance energy security. Additionally, establishing regulatory frameworks that promote transparency and stability in the energy markets can help mitigate the adverse effects of speculative activities on oil prices, ensuring a stable economic environment.

Financial analysts should develop and utilize advanced forecasting models that incorporate a range of economic indicators and geopolitical factors to better predict oil price movements. Providing regular updates and analysis on the impacts of oil price changes on different sectors and regions can help stakeholders make informed decisions. Continuous education and training are also important for financial analysts to stay updated on the latest trends and methodologies in economic and financial analysis, enhancing their ability to provide accurate and timely advice.

5.3 Limitations & Further Research

This study, while comprehensive, is subject to several limitations. The use of the Vector Error Correction Model (VECM) captures the long-term and short-term dynamics between oil prices and stock market indices, but it assumes linear relationships and may not fully account for nonlinear effects that can occur in financial markets. Additionally, the analysis relies on historical data from January 1, 2000, to December 31, 2023, and may not fully capture the impacts of recent structural changes in the global economy or sudden geopolitical events that could affect oil prices and stock markets differently. Moreover, the study focuses on a select group of regions and stock indices, which may limit the generalizability of the findings to other markets not included in the analysis. Finally, external factors such as government policies, technological advancements, and changes in market sentiment are not explicitly modeled, which could influence the observed relationships.

Future research should aim to address these limitations by incorporating nonlinear models to better capture the complexities of financial markets and the asymmetric effects of oil price shocks. Expanding the dataset to include more recent data and additional regions could enhance the robustness and generalizability of the findings. Additionally, integrating high-frequency data could provide deeper insights into the immediate impacts of oil price shocks on stock markets. Further studies could also explore the role of external factors such as government policies, technological innovations, and investor sentiment in moderating the relationship between oil prices and stock market indices. Incorporating advanced econometric techniques and machine learning models could offer more precise predictions and a deeper understanding of the multifaceted impacts of oil price volatility on global financial markets.

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