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THE IMPACT OF OIL PRICE ON THE EMERGING STOCK MARKETS

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ABBREVIATIONS

WTI	West Texas Intermediate
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
ARCH	Autoregressive Conditional Heteroskedasticity
OPEC	Organization of the Petroleum Exporting Countries
OAPEC	Organization of Arab Petroleum Exporting Countries
OECD	Organization for Economic Co-operation and Development
GDP	Gross Domestic Product
PPP	Purchasing power parity
IMF	International Monetary Fund
ETF	Exchange Traded Fund
CBOE	Chicago Board Options Exchange
OVX	The CBOE Crude Oil ETF Volatility Index
VIX	CBOE Volatility Index
ARJI	Autoregressive Conditional Jump Intensity
NBER	National Bureau of Economic Research
NAFTA	North American Free Trade Agreement
WTO	World Trade Organization
EFTA	European Free Trade Association
MERCOSUR	The Mercado Común del Sur (Southern Common Market)
ASEAN	Association of South East Asian Nations
SAARC	The South Asian Association for Regional Cooperation
GCC	Gulf Co-operation Council
MENA	Middle Eastern and North African countries
EVZ	CBOE EuroCurrency ETF Volatility Index
GVZ	CBOE Gold ETF Volatility Index

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ABSTRACT

This study investigates the relationship between international crude oil indices and emerging stock markets. Utilizing a widen adaptation of the GARCH model, namely GARCH-jump, the study confirms that West Texas Intermediate has a significant positive effect on the emerging economies whereas the impact of Brent oil is insignificant. The outcome is implying that a rise in the West Texas Intermediate index will cause an increase in stock return in emerging markets as well. Moreover, the effect is relatively stable during the global financial crisis and stronger in the post-crisis period confirmed by sub-period analysis. Furthermore, the jump effect is significant in the emerging markets for both oil indices, as evidenced by the statistically significant coefficient in GARCH-jump models. Moreover, the study also confirms the presence of time-varying jumps parameter in the stock returns of emerging markets. Besides, the research suggests that there is no asymmetric impact for West Texas Intermediate oil index to the emerging market returns, whereas asymmetric impact is present in the outcome of Brent oil. Thus, this study is providing new knowledge about the linkage of oil price indices and emerging markets with the extended version of the GARCH model, and it could be used for taking a better investment decision and achieving the advantages of portfolio diversification.

KEY WORDS: Brent, WTI, Emerging market, GARCH-jump

1. INTRODUCTION

Crude oil is one of the most critical factors that drive the modern world by playing a notable role in economic development. The price of crude oil has a significant impact on the returns of the stock market; therefore, shocks in the oil price bring uncertainty on the overall development of a country. It is essential to understand the reaction of the returns of the stock market to the changes in crude oil price for investors and policymakers to take a financial decision because the higher oil price can trigger inflation rates, therefore, decrease real consumption and which lead to increase production cost and ultimately affects the stock price.

Although the adaptions of renewable energy are increasing recently, oil consumption has been rising for years and still holds for the most popular energy resource. On a report from the International Energy Agency (IEA), the crude oil demand is anticipated to rise significantly for both developed and emerging markets in the next few decades (IEA, 2017). Therefore, the price of crude oil will continuously affect the world economy in general.

Numerous academic studies in financial economies have argued how the changes in crude oil price affect the overall economic development. Diaz et al. (2016), for instance, argue that the price of crude oil volatility considerably affects the return of the stock market. However, Kilian & Park (2009) argue that different type of crude oil shock has a different effect on the stock return and crude oil price. Tule et al. (2017), found that the fluctuation of the crude oil price also has a substantial effect on the sovereign bond. Moreover, Lambertides et al. (2017), suggest that the crude oil shocks have a substantial adverse effect on stock order flow imbalances.

While a considerable number of the researches in financial studies have focused on the relationship between crude oil price and return of stock market in developed countries (Morana 2017; Bastianin et al. 2016; Chen et al. 2016; Angelidis et al. 2015; Tsai 2015; Papapetrou 2001; Ågren 2006; Ciner 2013; Killian and Park 2009; Malik and Ewing 2009; Lambertides et al. 2017;), very limited number of studies have paid attention on the effect of crude oil price on the stock price in emerging markets (Fowowe 2013). However, it is quite surprising considering that emerging economies is seen as one of the biggest customers of crude oil products. They are increasing their consumption of the world's oil at a significant rate and becoming a tremendous player of the global fi-

nancial markets. For example, If the BRIC countries (Brazil, Russia, India, and China) continue their development at the same pace with the United States, they will consume immense amounts of oil in the near future.

In addition, emerging markets are more influenced by the changes in oil price than the developed markets because the developed economies are already energy efficient due to their technological innovation and other means. However, the emerging markets are experiencing rapid economic growth and expansion. In the future, they will consume most of the world's oil. Therefore, emerging economies tend to be more dependable on energy especially on the crude oil than developed economies, and also, they are more unprotected to the changes in oil price.

In recent years, the oil price in the emerging markets has also received extensive attention in the popular press. For example, the Financial Times on October 4, 2018, reported that ‘Oil price rise puts Asian economies under pressure.’ The same newspaper reported on November 14, 2018 ‘Oil price rout buoys emerging market currencies.’ Likewise, the Wall Street Journal on June 12, 2018, reported on ‘Emerging markets have an oil problem.’ Similarly, the New York Times reported on April 15, 2017, ‘Emerging market stocks have come roaring back. Can they go any higher?’ It is therefore essential to examine the linkage between how global oil indices affect the stock price returns on the emerging economies.

One of the pioneers in analyzing emerging markets behavior to the changes in oil price is Basher and Sadorsky (2006). They investigate the effect with a global multifactor model with the connection of the changes in crude oil price to the emerging economic markets. The global multi-factor model uses conditional and also the unconditional risk elements of twenty-one emerging markets for testing the impact of crude oil price on stock markets. They found a significant non-linear conditional impact of crude oil price to the return of emerging markets. However, they could not consider one of the crucial emerging market, China, because China has not been trading long enough at a time when the research has been conducted. However, the economy of China is one of the most important emerging economies to consider nowadays. Moreover, the previous study by Basher and Sadorsky (2006) also was not able to consider the global financial crisis 2007-2008 and global recession after the crisis period as well. It will be interesting to see whether the financial crisis has any specific impact on the previous research results and how the emerging markets perform while considering the Chinese stock market.

1.1 Purpose of the study

The primary purpose of this study is to extend the analysis among the crude oil indices, and the return of the emerging stock markets. More specifically, this study aims to broaden the knowledge of how variations in global crude oil price affect the return of the emerging stock markets. In addition, this study will also consider the impact of the global financial crisis and how it affects the said relationship. Basher & Sadorsky (2006) find that changes in the crude oil price are more sensitive in the less developed countries and the oil price has a much more significant impact in the case of emerging economies. Therefore, fluctuations in crude oil price could have a significant impact on emerging economies, and the relationship merits further assessment.

Besides, the data from January 1, 1988, to June 30, 2017, will be analyzed in this study. The period is interesting for conducting the research as the stock market had seen many ups and downs during this period. For example, during 1990, the oil price has spikes up suddenly which was caused by Iraq's invasion of Kuwait. Moreover, in 1999, the economy of many countries was suffering from the Dot-com bubble and price fluctuations due to several political events. Also, during 2007-2008 the world has seen the global financial crisis. However, the last few years of the testing period there was a strong economic performance and growth.

Moreover, the emerging market has a string effect of surprise news or abnormal information. These factors have a direct impact in stock price determination such as a sudden collapse of the oil market, import ban, political crisis and so on. Therefore, this paper will also consider the effect of surprise news and abnormal information in the emerging market with the GARCH-jump model employed by Chan & Maheu (2002) and investigate the impact of abnormal activities and how it affects the stock price in the emerging markets.

1.2 Research hypothesis

The Brent oil and West Texas intermediate indices are used along with the stock market data from emerging markets for testing the hypothesis. Besides, The GARCH-jump model is used to measure the effect of crude oil price on the returns of emerging economies. Moreover, the asymmetric impacts among the crude oil indices and the emerging stock markets are also analyzed in the study. Also, the relationship is tested in separate

time periods to examine how the oil price shock in different periods affects the emerging stock markets.

The following hypothesis will be analyzed in the paper to examine the connection of the crude oil indices and the stock return in emerging markets.

H1: There is a significant connection of crude oil price to the return in emerging stock markets

H2: The global financial crisis has a positive and significant effect on the relationship between the emerging stock market and oil indices

1.3 Structure of the study

The paper is separated into two categories, theoretical and empirical part. The theoretical part introduces the motivation of the topic and discusses the previous research done in this field. Moreover, this part also explains the importance of conducting research in the selected market.

In the empirical part, the GARCH-jump model is fitted to find the connection among the crude oil indices and emerging economies. The GARCH-jump model is more beneficial compared to the traditional GARCH model as it also accounts for surprising changes in the stock market and exceptional information originating from earning surprises, crisis and other similar events (Fowowe, 2013). Besides, this model also accounts for discrete jumps in asset returns.

To start with, Chapter one contains a brief introduction including the purpose, research hypothesis and structure of the paper. Then, Chapter two present how the crude oil market developed over the years. After that, Chapter three describes the emerging economic markets. Later, Chapter four presents the previous studies relevant to this paper. Chapter five and six are the empirical part of the paper. Chapter five presents the Data and descriptive statistics from the Brent oil, West Texas Intermediate, and emerging markets. This chapter also presents the methodology of the paper. After that, Chapter six presents the empirical results. Moreover, Chapter six also examines the robustness tests of the data. Then, seven concludes the paper.

2. CRUDE OIL MARKET

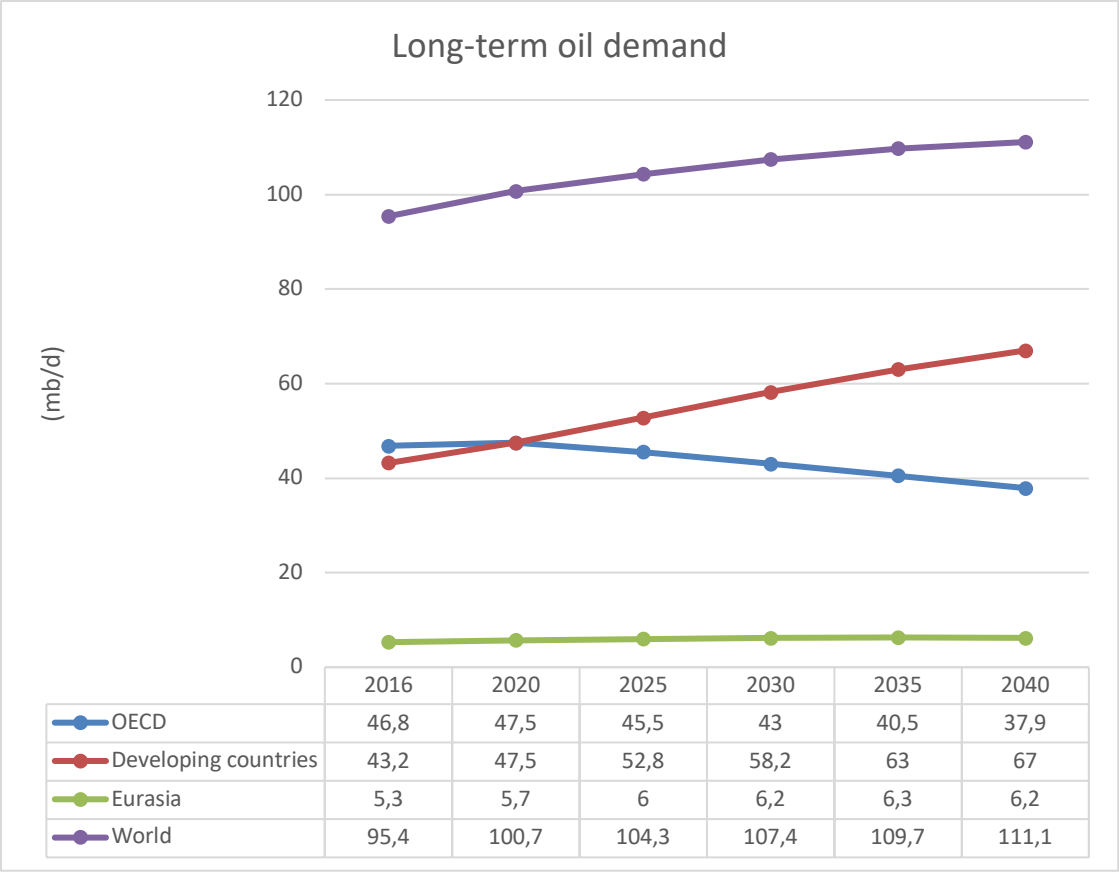
The crude oil market has seen significant development in recent decades. The main reason for this development was because of the growing demand of the oil, oil reserves, oil supply and speculation of the oil price. The globalization for the demand for oil, together with the need to diversify energy supply has triggered these changes.

The analysis of supply and demand will present a bigger picture of a clear pattern in oil price movement. However, there are many other factors which also needs to take into account for a better understanding of what drives the crude oil market. The supply and demand are the fundamental macroeconomic factors which play the crucial role for determining oil price, but there are geopolitical and economic events also needs to consider because these events, directly and indirectly, contribute to the change of oil price.

2.1 Long-term oil demand

According to the report published by Organization of the Petroleum Exporting Countries (2017) and International Energy Agency (2017), the demand for crude oil is expected to rise significantly in developing and Eurasia countries in the coming decades. The figure 1 shows the predicted demand of oil will rise mainly because of the consumption of the developing countries where demand for the oil is estimated to increase to 67.0 mb/d in 2040, from 46.8 mb/d in 2016.

The main reason behind the rising demand for oil in developing countries is the transportation sector development. While there is a significant increase in the demand growth in the developing countries, the OECD countries experience a decline in the demand for crude oil. The reasons behind this decline are technological advancement, implementation of energy policies, and renewable energy resource development. Between the developing economies, India and China predicted to have the highest demand for oil growth by 2040. The overall Eurasian countries also have an increase in oil demand by 2040 (OPEC, 2017).



	2016	2020	2025	2030	2035	2040
OECD	46,8	47,5	45,5	43	40,5	37,9
Developing countries	43,2	47,5	52,8	58,2	63	67
Eurasia	5,3	5,7	6	6,2	6,3	6,2
World	95,4	100,7	104,3	107,4	109,7	111,1

Figure 1. Long-term oil demand (World oil outlook 2040 - OPEC, 2017).

2.2 Long-term oil supply

It is projected that Organization of the Petroleum Exporting Countries (OPEC) will be a leading oil production supplier for the next several years in the world which will account for almost 40% of the oil production till 2040 (OPEC, 2017). The non-OPEC oil supply is also increasing due to the massive demand for oil — for instance, countries like the US, Brazil, and Canada increasing their oil production to meet the rising demand. On the other hand, Indonesia, Mexico, Vietnam, Thailand, Malaysia, and China anticipated to experience a decline in oil supply in the medium term (IEA, 2012). Besides, it is estimated that the non-OPEC oil supply is predicted to pick the highest point in 2027 while experiencing a minor decline in 2040 (OPEC, 2017).

2.3 Oil market development

The crude oil market has experienced fluctuations since the first energy crisis. The shocks in oil price have enormous effects on the stock markets. For example, there are many significant crude oil shocks in the history dated by the year 1973, 1979, 1990, 1999 and recently in 2007-2008 during the global financial crisis.

To overcome the fluctuation countries were concentrating on the demand side of the oil market and trying to reduce the dependency of the oil, especially after the 1970s. However, a recent emerging market strategy is to influence the supply side of the oil market to overcome the shocks, where one country increases the rate of exploitation of unconventional oil resources (Hosseini 2016). This is beneficial to countries like the United States, Russia, and China where they have the most unconventional oil resources (Kuuskraa et al. 2013).

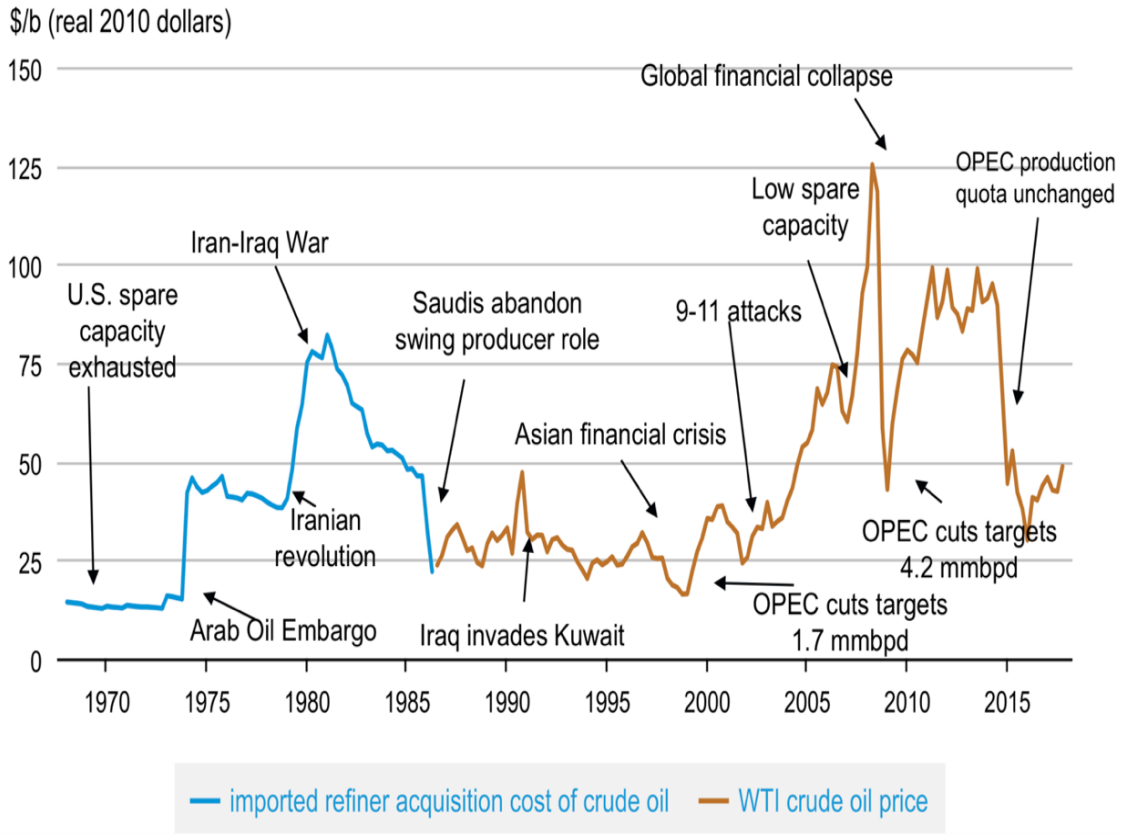


Figure 2. Reaction of crude oil to a different geopolitical and economic event (U.S. Energy Information Administration, Thomson Reuters).

Figure 2 shows different geopolitical and economic events from 1970 to 2015 which affected the crude oil market and continued the development to its current state of the oil price. As seen from the figure the oil market has experienced severe fluctuations in recent decades, and it all started in 1973.

The crude oil fluctuation in 1973 was an outcome of crude oil boycott by the Organization of Arab Petroleum Exporting Countries (OAPEC) during Yom Kippur war. The embargo came into force because the United States was providing inventories to the Israeli military during the war period. As a result of the ban, the price of the oil had raised from USD 3.4 to USD 13.4. Moreover, the crude oil fluctuation in 1979 was because of the Iran revolution. The price raised from USD 20 to USD 30 at that time. During 1990 the oil price has fluctuated again suddenly which was caused by Iraq's invasion of Kuwait. The price hiked from USD 16 to USD 26. In 1999, the price of crude oil again raised from USD 12 to USD 24 and most recently during the global financial crisis the oil market has seen another price fluctuation in history.

The reason for an increased oil price does not only depend on the oil producer or importer countries, but it also depends on the type of markets, such as developed markets, or emerging markets. This is because the developed economies can rely on other alternatives and do not depend primarily on crude oil and they tend to consume less and fewer oil products. On the other hand, the demand for oil is increasing rapidly in emerging economies. Therefore, the changes in oil price have a more significant impact on the emerging economies than the developed economies. As a result, the stock market of emerging economies faces a more severe outcome than the developed economies due to the development of the oil market.

3. EMERGING MARKET ECONOMY

The emerging markets are growing rapidly, and it is estimated that if the growth continues at this pace, the GDP of the emerging economies will permanently outpace the developed markets by 2035. (Wilson & Purushothaman 2003). According to the PPP index provided by International Monetary Fund in 2008, the market power of China and the United States are already similar. The advancement of the emerging economies is unavoidable, and it will have a significant effect on the development of the oil price in the coming decades.

According to the World Economic Outlook (October 2018), a handbook published by IMF, the annual percentage changes of Real gross domestic product for advanced economies are 2.4% whereas the percentage changes for emerging markets are 4.7% which is almost double. Besides, the world growth accounts for 3.7% overall. The Real gross domestic product growth for these countries is presented in Chart 2.

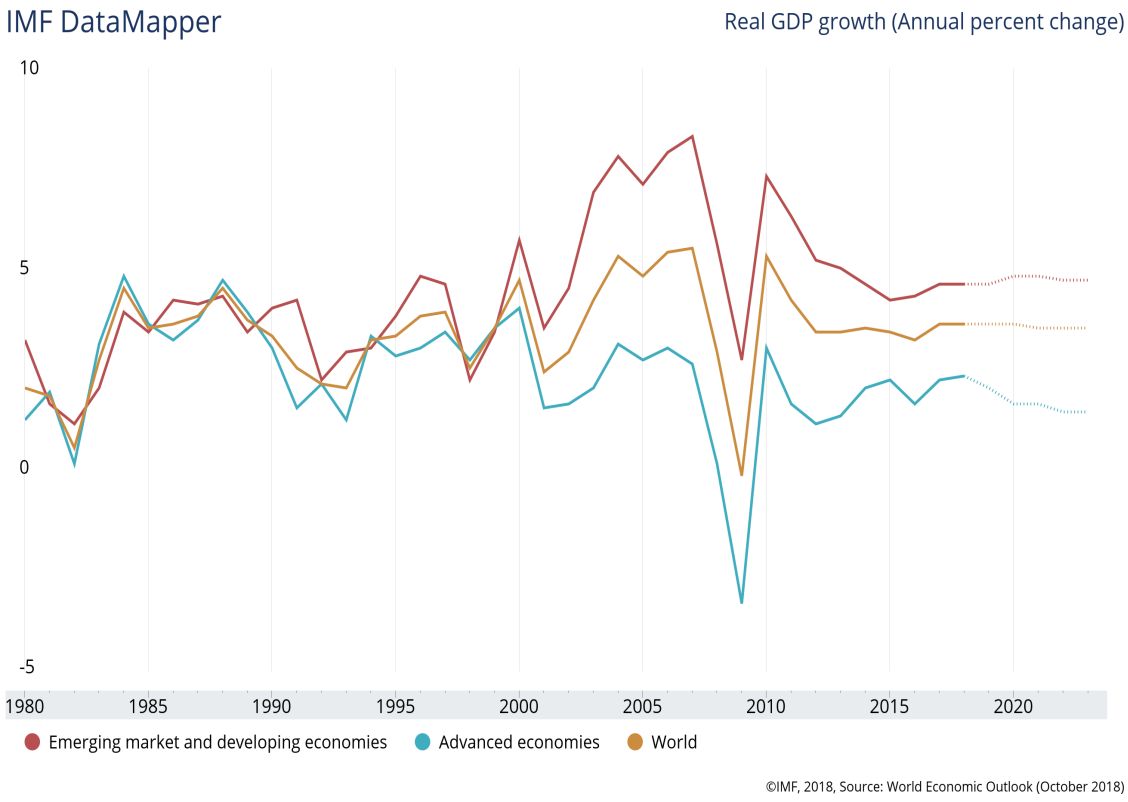


Figure 3. Real gross domestic product growth (World Economic Outlook (2018).

There are many factors which are responsible for the advancement of the emerging economies. Firstly, the reforms of the top emerging economies as BRIC (Brazil, Russia, India, and China) have enhanced their capabilities. As a result, they combined in established a new market for their branded new products. Secondly, the developed markets are suffering from the rapid aging problem. As a result, their domestic markets in the developed economies are growing very slowly. Thirdly, the international trade agreements and market integrations such as the European Union, NAFTA, WTO, EFTA MERCOSUR, ASEAN, SAARC have created a global competition of products and services, notably in emerging economies. Finally, the top emerging markets have a large population like India and China which is generating vast scale markets for different products and services.

The emerging markets have many competitive advantages compared to the developed markets, such as most of the products in the emerging economies are state-owned companies especially in China and Russia. Companies like Gazprom, Petrobras, Huawei Technologies and China Mobil first became the domestic market leaders then they became the global leaders in their sector. Besides, the emerging markets have different characteristics than the developed markets. For instance, the emerging markets are local and fragmented. Besides, they are low scale, and most of the businesses in the emerging markets are small enterprises. Therefore, they reflect market heterogeneity. Moreover, the emerging markets have more influence from different business groups, government, and nongovernmental organizations. The competition in the emerging markets is relatively low, but they are more regulated by the government and different business groups. However, one of the significant disadvantages of the emerging markets is the inadequate infrastructure such as essential banking functions, credit cards, point of sale (POS) terminals and so on. (Sheth 2011.)

In addition, Sheth (2011) findings also suggest that government policy is one of the significant comparative advantages in emerging markets. In most of the cases, the government is the largest customer, and they also provide economic incentives for exporting products to protect domestic industries from foreign competition. Moreover, other support from the government like creating special economic zones also help the domestic products to compete in the international market. Countries like China, Singapore, Japan, and Korea succeeded in the international market because of the export-oriented industrial policy. Also, the emerging market has raw materials which are a significant advantage for their economy. For example, China and India have a massive advantage of human resource. Moreover, Central American countries have industrial raw materials.

Besides, Russia and Nigeria have energy. Also, Nowadays the emerging market has access to capital and technologies. Therefore, they can add values to the raw materials before exporting rather than exporting the direct raw materials. Besides, global wealth is also diametrically shifting from the developed economies to the emerging markets and wealth is increasing rapidly and producing more high net worth individuals, especially in Asian emerging countries. (Marques 2017.)

4. LITERATURE REVIEW

Crude oil is one of the primary commodities which is influencing the economic development for decades. Both the academic communities and practitioners have acknowledged the effect of oil price on economic development. Investigating the relationship of how the oil price affects the return of the stock markets have received immense attention especially in the last few years. This is because oil is one of the dominant production units of the economic development and changes in crude oil price will bring uncertainty in overall economic development.

The demand for oil increased dramatically in emerging markets in recent decades. In 1990, the consumption of oil in China and India was 5% of global petroleum consumption whereas in 2003 the consumption increases by more than 10% globally. It increased more than double in just 13 years in these two countries. In addition, During the mid-2000's the world has seen a massive fluctuation of oil price mainly because of increased demand from emerging markets especially from China and India. The price fluctuation of oil has a significant impact on oil importing countries, where there is limited access to the global capital market and have a low foreign exchange reserve (Masih et al. 2011).

Basher & Sadorsky (2006) is one of the pioneers for analyzing the impact of crude oil price on the stock market in the emerging economies. They use a global multi-factor model for testing both conditional as well as the unconditional risk factors and examine how the oil price impact the returns of the emerging markets. They found the analytical capability of the conditional model rises compares to the unconditional model and the outcome is consistent for both versions of the model. Their main result implies that the risk of oil price has a major effect on the returns on the emerging economies. Besides, Asteriou & Bashmakova (2013) continue the earlier work of Basher & Sadorsky (2006) by including the Central and Eastern European Countries (CEECs) using the international multi-factor model. They used panel data from 1999 to 2007 and found significant negative relationship in the oil price beta which implies that the oil price is a crucial factor which determines the stock returns. Moreover, they did not find any significant non-linear connection among market risk and stock returns of emerging market or crude oil price risk and returns.

India and China are one of the critical markets in emerging economies. Ghosh & Kanjilal (2016) test the nonlinear cointegration between the international oil price and the Indian stock market with structural breaks. Their findings reject the long-run equilibrium dependencies between the variables and reveal a cointegration of the markets after the financial crisis. Moreover, they also reveal that the markets are Granger causal during the international financial crisis and post-crisis period with no feedback effect. In the Chinese economies, Zhang & Chen (2011) adjusted the GARCH-jump model to analyze the effects of how crude oil price impacts the stock returns in China. They found a presence of time-varying jumps in the market returns. Besides, they suggested that the expected volatilities of the crude oil prices are the key driver in the Chinese stock returns which are also correlated, and they found a minor positive impact of the crude oil price on the Chinese stock returns.

Besides, Cong et al. (2008) examine the said relationship with the vector autoregression model on the stock market of China. Their findings reveal that shock in crude oil does not have any direct effect on the Chinese stock market. However, it has a major effect on the manufacturing index and some oil companies. The results were statistically significant. Another recent paper by Li et al. (2012) examines how crude oil affects the Chinese stock market but at a sector level. The study period was from July 2001 to December 2010, and they use the Granger causality framework and panel cointegration for their outcome. They found a structural break in the interaction among crude oil prices and sectoral stocks of China. In addition, they found a positive effect on sectoral stocks with the long-run estimates.

Moreover, the cross-correlation function (CCF) on the Chinese sectional stock price variances with the relationship of crude oil volatility examine by Bouri et al. (2017). They tested the behavior changes of oil policy in China by separating into sub-samples. Before 2013, the oil price was controlled by the Chinese government centrally, and China had a lower oil price than the rest of the world. After 2013, the oil price in China become closer to the world market. They suggest that the time-varying dimension in the dynamics of the variance and mean linkages from the world crude oil market to the Chinese economy due to oil pricing reform of 2013. Moreover, they found evidence that causality-in-mean increased after the pricing reforms. However, it disappeared after the

date. The local indices in China present a delayed response of the oil volatility on Basic Materials, Health Care, and Telecommunications sectors.

In addition, the quantile regression approach adapts by Zhu et al. (2016) to examine how the Chinese real industry stock market affected by changes in crude oil price. They found a complex relationship among the market return and the crude oil. Moreover, they suggest this relation is only valid only when the market is expecting low returns, and bearish and dependence across industries were present at low quantiles. Also, their findings suggest that the structural breaks can change the said dependence. Finally, they conclude that there is no significant contagion of industry stock returns of China to the world crude oil markets.

Besides, one of the critical examinations about the volatility linkage of crude oil in the dominant equity markets in South Asia conducts by Noor & Dutta (2017). They applied a recently innovated vector autoregressive-generalized autoregressive conditional heteroskedastic model and found that the crude oil market transfer volatility to all the investigated market, however, the stock markets do not transfer volatility to the world oil market. In addition, they suggest that the portfolio which consists of oil should decrease the risk of the resultant portfolio.

Multivariate GARCH model is famous among the researcher to test volatility dynamics and risk measures. Basher & Sadorsky (2016) use one particular multivariate GARCH model called GO-GARCH along with DCC and ADCC model to test the conditional correlations and volatilities among oil prices, gold prices, stock prices, VIX, and bond prices of emerging economies. Their findings reveal that the oil price is a perfect element which can hedge emerging market stock price. They also suggest that the ADCC model is the best alternative for hedging the stock price of emerging economies with VIX, oil, and bonds whereas the GO-GARCH model is the best alternative for hedging the stock price of emerging economies with gold. Moreover, Choi & Hammoudeh (2010) found the dynamic conditional correlations (DCCs) increased for Brent oil, and West Texas Intermediate index, copper, gold, and silver after the 2003 Iraq war but decreased for the returns of S&P 500 index. In another research, Sadorsky (2012) use a multivariate GARCH model to understand how the volatility spillovers from the oil market to the stock returns of technology and clean energy companies. His analysis has four different types of multivariate GARCH models, namely, diagonal, BEKK, dynamic

conditional correlation, and constant conditional correlation. The outcomes suggested that stock returns of clean energy companies are highly correlated with the returns of technology companies stock prices than with the returns of oil price.

Moreover, Basher et al. (2018) examine the nonlinear relationship in dominant oil-producing countries using a multi-factor Markov-switching model. They found that the flow demand of oil shocks has a significant impact on the market returns of Norway, Canada, Kuwait, Russia, Saudi Arabia, and the United Arab Emirates whereas the oil inventory shocks affect the market returns in Kuwait, Russia, Canada, and the United Arab Emirates. Moreover, the flow of oil supply shocks affects the stock return for Kuwait, the United Kingdom, and the United Arab Emirates. However, they have not found any significant evidence in the returns of the Mexican stock market.

The ARCH and GARCH models are treated as the most frequent model to analyze financial volatility. One of the crucial studies conducts by Dutta et al. (2017), to test the crude oil price relationship with the stock markets using GARCH-jump model. They added a new variable in the GARCH (1,1) model, named OVX, which is the volatility index of oil price. They test the impact of OVX on the volatility of the stock returns of the Middle East and African countries. The findings suggest that the uncertainty of the oil price has a powerful adverse effect on the realized volatility in most of the markets in the African and Middle East countries. Even after considering VIX, which is the volatility index for the S&P 500, the impact is still significant for half of the markets. The GARCH-jump model presents that the fluctuation on the implied oil volatility index has a significant effect on most of the tested markets, and the time-varying jumps were present in the stock returns in the studied market. Another recent examination of the GARCH-jump model was by Fowowe (2013), who examine how the crude oil price affects the Nigerian Stock Exchange. With the GARCH-jump model, he measures the volatility of returns and the effect of extreme news in the studies market. He found that the relationship is negative among crude oil price and the Nigerian Stock market. However, the result was insignificant.

In recent studies, the latest VAR-GARCH model is frequently employed to understand the linkages of how the crude oil price affects the returns and volatility of the stock markets. Lin et al. (2014) test the volatility transmission and dynamic volatility mechanism between crude oil price and Ghanaian stock market. They use a VAR–GARCH, DCC–GARCH and VAR–AGARCH approach to examine the relationship. In addition, they examine the optimal hedge ratios for the oil-stock portfolio for the selected market.

To compare their result within the West African countries, they also included the Nigerian Stock market in their study. Their outcomes show a major volatility spillover and how the markets are dependent on each other. However, the spillover had more effect on the Nigerian Stock market than the Ghanaian stock market. Also, their findings reveal that oil can be an essential part of a diversified portfolio of stocks.

Another investigation by Jones & Collins (2018) also includes the multivariate DCC-GARCH model for the time-varying correlation among crude oil and stock returns. The correlation was close to zero or negative before the financial crisis. However, the correlation became positive after the financial crisis and continued to have a positive correlation until the first half of 2017 at the time they conduct their research. They found that the main reason behind this change is quantitative easing which they tested with a threshold model.

The developed markets got numerous attentions in different studies for the relationship among crude oil and the stock market. Ciner (2001) investigates the relationship between oil future price and the S&P 500 index return using linear and nonlinear Granger causality test with VAR. He used the daily data from oil futures contracts and the S&P 500 stock index. However, his findings suggest that there are no linear causalities in oil and stock return, but he discovers nonlinear causality with the oil price shocks and returns of the United States stock market. Also, he suggests that the linkage among the stock market and crude oil price was stronger in the 1990s. Odusami (2009) test the same nonlinear crude oil impact in the United States market by using daily data from 1996 to 2005 with GARCH model. He also suggests that crude oil shocks have a nonlinear impact on the returns of the United States stock market. Besides, the stock market negatively affected by its lagged value and oil price in the study period. Moreover, he examines if the volatility of the stock return of the United States market is dependent on the outcomes of the Organization of Petroleum Exporting Countries (OPEC) meetings, but he did not find any significant relation.

The nonlinear linkage among the crude oil and stock market returns on the United States and 13 European countries was tested by Park & Ratti (2008). They use multivariate VAR analysis with both linear and a non-linear specification with monthly data from 1986 to 2005. Their outcome reveals that a rise in the crude oil price results in a significant short-term rise in the interest rate of the United States and 8 of the 13 European countries. Moreover, they find the presence of asymmetric impacts on the stock returns

of positive and negative oil price shocks for oil importing countries except for the United States and Norway. The asymmetric effects on the said relationship were also examined by Chiou & Lee (2009) where they test both the asymmetric impact of stock returns from oil price and the importance of structural changes in this dependency relationship. Their Autoregressive Conditional Jump Intensity model with structure changes suggest that the increased variations in crude oil prices have asymmetric impacts on returns of the S&P 500.

Besides, Joo & Park (2017) suggest that the fluctuation of crude oil price has an adverse effect on the returns to the stock market of the Hong Kong, Korea, Japan, and the United States. Their investigation period was from 1996–2015 which includes the dot-com bubble and the global financial crisis. They use the time-varying characteristic equation of the means with a dynamic conditional correlation (DCC) bivariate GARCH-in-Mean model to find the effects of uncertainty between the returns of the stock market and crude oil market. They found a significant impact which is depended on the degree of correlation among stock return and crude oil price. Their findings are similar to Lu et al. (2017).

Moreover, Lu et al. (2017) find the time-varying causality among West Texas Intermediate index and S&P 500. They analyzed how the West Texas Intermediate index affects the S&P 500 index. They also test the spillover effect among global crude oil markets. Their findings show the presence of both negative and positive causal effects among the West Texas Intermediate index and the return of the S&P 500. Therefore, both oil price and stock markets are interdependent. Moreover, they found that the effects of Brent oil and West Texas Intermediate become stronger whenever a significant event occurs in major oil-exporting countries. In addition, their impulse response result suggests that the information of the market has an impact positively on the spillover effects in the world oil markets. In addition, Ågren (2006) also test the volatility spillover impact between crude oil price and returns of the stock market. He found significant volatility spillover effect in Japan, Norway, the United States, and the United Kingdom market, however, the impact is weak in the case for the Swedish market.

A critical study on how crude oil price affects the returns of European industrial sector indices with time-varying correlation is conducted by Degiannakis et al. (2013). They analyze the data for 10 European sectors with a time-varying multivariate heteroskedas-

tic framework. The result suggests that the oil price and the sectors indices change over time, and the main reason for the change are based on their industry factors. They conclude with the remarks that the causes of the shocks in the crude oil market and the industry type are the essential factor for the level of correlation between industrial sector returns and oil prices.

Besides, Zarour (2006) examines how the crude oil price shocks affect the returns of stock markets of Saudi Arabia, Bahrain, Oman, Abu Dhabi & Kuwait using VAR analysis. He uses daily data from 2001-2005. The period is considered appealing to research because during this time the price of oil has been doubled which led to a considerable surplus in cash in these markets which affected favorably in their performance. His findings suggested that an increase in crude oil price also raises the predictive power of the future oil price. Also, impulse response function shows the increase in crude oil price leads to shocks of the oil market and the reaction of the Saudi market to the oil price shocks is more severe than the other four markets.

The newly generalized VAR-GARCH model was implemented by Arouri et al. (2011a) to test volatility transmission of crude oil to the stock markets in the United States and Europe. They found that the spillover is unidirectional from the oil market to the European stock market. However, there is a bidirectional spillover from the crude oil market to the United States stock market. They also conducted optimal weights and hedge ratios for the oil-stock portfolio in the selected markets. Besides their outcomes are supported by Arouri et al. (2012) where they only test the effects of crude oil price fluctuations on European equity markets. Also, Arouri et al. (2011b) examined the same relationship with the Gulf Co-operation Council (GCC) countries and found a significant linkage between the volatility and return spillovers among crude oil and returns of the Gulf Co-operation Council countries stock markets.

Another study on the Gulf Cooperation Council (GCC) countries is conducted by Mohanty et al. (2011) where they analyze the said relationship at the aggregate stock market level. They analysis both the country-level as well as the industry-level stock return data from Gulf Cooperation Council countries and found the country level the stock market has a substantial positive impact on the shock of oil price on all countries except Kuwait. On the other hand, the shock of crude oil price is strongly positive for only 12 countries from 20 studies countries when analyzing at the industry level. They also con-

firm the presence of asymmetric effects on stock market returns during the studied period for both country level as well as the industry level.

Besides, another work in this same context was published by, Maghyereh & Al-Kandari (2007). They investigate the said relationship with the Gulf Cooperation Council countries. In addition to the previous study, they consider non-linearity by employing rank test with the newly developed nonlinear cointegration analysis. All the previous studies including Zarour (2006) concluded that oil price and Gulf Cooperation Council countries are not related. However, this study argues that that result was based on a linear relationship. In this study, he proved that oil price changes affect the Gulf Cooperation Council in nonlinear relation.

The different type of crude oil shocks has a different influence on market returns. In the United States, Kilian & Park (2009) examine the sources of crude oil shock have a significant impact on how the market reacts. They found that supply-side shock in the oil market has a weaker effect on the economy whereas the demand-sided shock can predict the changes in the stock price more clearly. Besides, the demand-sided shock is a key driver for the long run variation in the U.S. market.

The volatility linkages were tested between crude oil price and the Lebanese stock market with the VAR-GARCH model by Bouri (2015a). He also conducts a sub-period analysis during the global financial crisis for a better comparison. The outcome suggests a weak unidirectional return and volatility transmissions between the crude oil market and the Lebanese stock market. However, the previous research by Arouri et al. (2011a), concluded unidirectional transmission of volatility and return to the stock market from oil returns for oil-exporting countries. Besides, the sub-period analysis shows the interrelationship become stronger during the global financial crisis and decrease significantly in the post-crisis period. In the same year, Bouri (2015b) examine how the shocks in crude oil volatility impact the stock markets of oil-importing Middle Eastern and North African (MENA) countries. He uses an ARMAX–GARCH framework to model the conditional variance and mean of the returns. Therefore, the autocorrelation effects, movements, and day-of-the-week effects in international markets can be determined. The result suggests that there is a volatility spillover effect on the stock market in Jordan from the oil market and vice versa. Whereas, oil volatility cannot predict the volatility of the Lebanese stock market.

Further examining the linkage among crude oil market and the stock market, Jones & Kaul (1996) examine the relationship by applying the cash flow valuation model. They used quarterly data from the US, Japan, the United Kingdom, and Canada from 1947-1991. Their findings present that the market returns of the United Kingdom and Japan are affected by oil price changes. Whereas the United States and Canadian stock market did not affect by oil price change, but the oil price shocks affect the cash flows for production facilities. One of the interesting articles in similar context was from Driesprong et al. (2008) where they investigate the same relationship with fifty stock markets of emerging and developed countries. They used monthly and weekly data for thirty years period. Their findings suggested a significant relationship between the oil price and the stock markets. Also, they found that the countries who consumed high oil per capita had a substantial impact on predicting stock market reaction than others. In addition, they suggested that as the lag value increases, the relationship became stronger. Maghyereh (2006) study a similar relationship with 22 emerging markets using Vector Autoregression (VAR) model with daily data from 1998 to 2004. However, his findings were not significant in these countries. Therefore, the study did not support Basher (2006). However, he found that if the monthly lags are included the relationship becomes stronger and his outcomes showed minimal forecast error variance.

Nowadays, a mass number of economic researches are focused on the market sector returns. As a result, the market participants have a clear idea about the volatility transmission mechanism. Malik and Ewing (2009) examine how the volatility transfer from the oil prices to the industrials, financials, technology, healthcare, and consumer services sector. They used the weekly data from January 1, 1992, to April 30, 2008, and a bivariate GARCH model to assess the transmission of volatility between oil prices and those sectors. The outcomes present significant evidence that the shocks transform volatility among crude oil prices and a few of the tested market sectors. Another paper which plots the bivariate and univariate GARCH model with structural breaks are studied by Ewing & Malik (2016) where they test how the volatility of the crude oil price affects the stock market of the United States. They found major volatility spillover between these markets when the structural breaks are present, but without the structural breaks, there is no sign of volatility spillover.

Chen et al. (1986) study the microeconomic advancement and how the stock returns are depended on the microeconomic advancement. They concluded that the industrial production, interest rates, bond yield, and inflation rates have a major effect on the return of stock market whereas they did not find any evidence that oil price influence the stock markets. However, Hamilton (1983) research on the United States economy and found that oil price shocks and the United States economy are interrelated. He researches in the recession period after world war II using a VAR model and found that there is a major adverse effect on the market returns with the shocks in the oil market. Moreover, he also concluded that the shocks in the crude oil price also contribute to the recession.

Including the industry index returns, a crucial study was conducted by Faff & Brailsford (1999) to evaluate the effect of oil price on the Australian stock market. They used the data from 1983 to 1996 and concluded that crude oil has a major effect on many production industries either positively or negatively. The found a positive linkage of crude oil price with the oil companies whereas the relationship is negative with Paper and Packaging industry and Transport and Banking industry. Also, their findings showed that the financial market also offers to hedge against oil price risk which is supported by Nandha and Faff (2008). Besides, Nandha and Faff (2008) use thirty-five DataStream global industry indices from and examine the negative impact of shocks of crude oil price on the returns of the stock market. They conclude that an increase in crude oil price has an adverse effect on the returns in all the sectors except mining, and oil and gas sectors.

Separating the effects of crude oil on the stock market returns with oil-importing and oil-exporting countries present an interesting outcome. Wang, Wu, & Yang (2013) found that the response of an oil price shocks to stock market significantly depends on if the country is oil producer or oil importer and also if the oil price is dependent on demand side or supply side in the market. Moreover, the level of importance of oil in an economy also plays a crucial role in how the shocks affect a country. Their result suggests that the oil-producing countries are more vulnerable to the demand uncertainty than to the oil-importing countries. Also, the oil-producing countries suffer through high co-movement during positive demand shocks whereas the oil importing countries are immune to this context.

In a similar context, Antonakakis, Chatziantoniou, & Filis (2017) also finds the significant impact of shocks of crude oil towards the stock market returns for both oil–

exporting and net oil–importing countries from 1995 to 2013. They extended Diebold and Yilmaz (2014) dynamic relationship test using structural forecast error variance decomposition to identify the various type of oil shocks. They conclude that the crude oil shocks on the demand side have a stronger effect on the market returns compared to the shocks in the supply side. Besides, a positive oil demand shocks lead to the economic development of a country. In addition, Bastianin et al. (2016) examine the said relationship on the G7 countries to test the relationship between oil demand and supply impact on the financial volatility. They did not find any significant impact of the stock market returns on the oil supply shock. However, oil demand shocks have a substantial impact on the volatility of the tested markets.

The regime-switching into the stochastic volatility (SV) framework has adapted by Vo (2009) for explaining the volatility of oil prices. He uses the Bayesian Markov Chain Monte Carlo method to plot the proposed model. The test confirms that regime-switching is present in the crude oil market. Besides, when the regime-switching are included in the SV framework, the forecasting power of said model increases significantly. Moreover, regime-switching stochastic volatility can explain the critical developments affecting the crude oil market. On a similar note, the regime-switching model also tests by Lee & Chiou (2011) to examine the impacts of the crude oil shock on the market returns. They analyze the asymmetric effects with the consideration of jumps. Their result suggests that the S&P 500 returns impact negatively due to the high fluctuations in oil prices of WTI. However, if the price changes are low, then the S&P 500 does not have any significant impacts on WTI. Therefore, they suggest having a well-diversified portfolio to avoid the risk of hedging against oil price.

Another study about two-stage Markov regime-switching model is done by Zhu et al. (2017). They reveal that the crude oil shocks have a less effect on the low-volatility regime, but the effect is significant in the high-volatility regime due to the changes in demand and supply. Besides, they also suggest that the consequences of demand shocks are more severe than supply shocks in the stock market which is consistent with the findings of Wei & Guo (2017). Wei & Guo (2017) reveals that the returns of the stock market increases due to the positive demand shock whereas the stock return decrease due to the positive oil-related demand shock.

Besides, Kilian (2009) defines that crude oil shocks are mainly three types which are oil supply, oil-specific demand, and, aggregate demand. He conducted the test on the Chinese economy with the data from 1996 to 2015 and revealed that the oil price shocks have an unstable impact in the sample period. However, after dividing it into the subsample, the result shows oil demand-side shock of crude oil has a favorable effect on the Chinese market until 2006. However, the impact becomes negative from 2007 to the rest of the studied period. He also proves the weak impact of the monetary policy from the crude oil shocks on the stock market.

One of the interesting researches on the energy sector is studied by Constantin and Gruici (2010) where they examine the impacts of crude oil on the stock market. They also consider the impacts of the global financial crisis in their study. They applied cointegration tests with the daily data of West Texas Intermediate, Brent oil, World Energy Index and MSCI index and found a significant relationship between the oil spot price and the MSCI energy index. Another research to test the relationship between oil price and the firm returns is done by Narayan & Sharma (2011) where they examined how the crude oil price has a different effect on firms based on their sectoral location. They found a significant lagged effect of crude oil price on firm returns. Moreover, they conclude that the impact of crude oil on the firm depends on the size of the firm.

The investigation of Papapetrou (2001) on Greece stock market continuously supports the effect of oil price on the stock returns. He used a multivariate VAR model for testing the dynamic relationship with interest rates, industrial production, real stock returns, real oil prices, and the employment rate. The empirical result suggests that the development of oil price is essential to the Greek economy and the changes in oil price have a direct effect on the real economic activities and employment rate. Besides, it is also an indication of explaining stock price movements.

Dagher & El Hariri (2013) conducted another study about the dynamic relationship among the oil price and the stock market returns. They use the vector auto-regression test to analyze the relationship between Brent oil and several Lebanese stocks. Their findings reveal that crude oil price is Granger causing stock prices, but the stock prices are not Granger causing to the crude oil price. Moreover, their test of the orthogonalized impulse response function suggests a positive response of oil price to a shock in crude oil prices immediately, but the shock resolves in the long run. Finally, they conclude

that the impacts of the crude oil price shock on the Lebanese stock market are positive but insignificant.

The forecasting power of the crude oil to determine the market returns are examined by Angelidis et al. (2015). They suggest that returns and volatility of crude oil can forecast the return of the US stock market and volatility. In the same year, Alsalman & Herrera (2015) examine the asymmetric and symmetric responses of oil price and U.S. stock market for both positive and negative crude oil price. They have not found any asymmetry for aggregate stock returns. Also, they conclude that oil price innovations are expected and realized demand is the critical driver for the asymmetries.

The cointegration analysis study by Hammoudeh et al. (2004) reveals three market integration and portfolio diversification system, which are, pure oil industry equity system, pure oil price systems and mixed oil price/equity index system. They suggest that both mixed oil price/equity index system and pure oil industry equity system is favorable than pure oil price systems for market integration and portfolio diversification in the long term. They found that the spillover of the oil futures market has a volatility impact on the price of a few oil sectors but the volatility-dampening impact on the price of others. Moreover, the day effect of volatility reveals an interesting result. They found a significant presence of the Friday effect whereas the Monday effect is insignificant on the volatility of oil stocks.

The forecasting and modeling the volatility of the oil price is one of the important tasks for the macroeconometric models. The stylized volatility facts are identified by Kang et al. (2009) where he examines three oil markets namely Brent oil, Dubai, and West Texas Intermediate. They use conditional volatility to test the long memory or volatility persistence in the models. They conclude that the FIGARCH and CGARCH methods can take into account the persistence better and provide greater performance in out-of-sample volatility forecasts compare to the IGARCH and GARCH methods. Therefore, the FIGARCH and CGARCH models are preferred for forecasting persistence in the crude oil prices volatility.

The study of Liu et al. (2013) studies cross-market uncertainty transmission where they investigate for both short-term and long-term uncertainty transmission for OVX, VIX, EVZ, and GVZ. They reject the presence of long-run equilibrium among the volatility

indices and confirm that the OVX is significantly dependent on other uncertainty indices which implies the uncertainty shocks in other market influence the investor's volatility expectation in the crude oil market. Also, they found the presence of short-term transmission among the crude oil market and other important economies. Another paper about volatility and shock transmission mechanism is conduct by Malik & Hammoudeh (2007) where they study about the shock transmission mechanism of the United States equity market, world crude oil market, and equity markets of Bahrain, Saudi Arabia, and Kuwait. They found that the crude oil market always transfers volatility to the Gulf equity markets. However, between the Gulf equity markets, only the market of Saudi Arabia also transfer volatility to the crude oil market. Therefore, the result suggests that the volatility of the crude oil market has a major influence in the Gulf equity markets.

5. DATA AND METHODOLOGY

This research investigates the empirical evidence of the impact of crude oil price on the stock return of emerging markets. This chapter will provide a description of data with the methodology to be applied in this particular paper.

5.1 Methodology

This study follows the methodology of the paper by Chan and Maheu (2002) that employs GARCH-jump model. The GARCH type model is frequently used in different papers for modeling financial time series (Arouri et al. 2011b). However, GARCH-type models only take into account the impacts of standard data on returns of assets, but they do not take into account the impacts of surprising or irregular news events such as market crashes, earnings delays, and similar events (Chan & Maheu 2002; Maheu & McCurdy 2004; Kao et al. 2011). The combination of the jump specification with a GARCH parameter will provide a GARCH-jump mixture model to overcome these limitations.

The primary benefit of using the GARCH-jump model is that it can capture surprising news or abnormal information. The study period consists of a few market crashes, and the paper is examining the effect in the emerging markets where it is quite common to have surprising news. As a result, this GARCH-jump model can capture the effect of these events which arise due to surprising news or abnormal activities. Moreover, a test for the unit root was also conducted as it identifies if there is a stochastic trend in the series. The Augmented Dickey-Fuller test and Phillips and Perron test are used in this study. Moreover, the asymmetric impact is also analyzed in this paper to check if the positive oil price affects the stock returns more than the negative oil price.

The estimated model of this paper takes the following form:

(1) $$R_t = \mu + \varphi R_{t-1} + \delta RW + \epsilon_t$$

(2) $$R_t = \mu + \varphi R_{t-1} + \delta RB + \epsilon_t$$

where R_t is the log of stock return at *t* time, *RW* refers to the log returns for WTI, *RB* refers to the log return for Brent oil and ϵ_t is the error term at *t* time. As described by Chan & Maheu (2002), the return innovation is decomposed to comprise two stochastic components:

(3) $$\epsilon_t = \epsilon_{1t} + \epsilon_{2t}$$

The first innovation ϵ_{1t} represents stochastic volatility takes the following form:

$$\epsilon_{1t} = \sqrt{h_t} z_t, z_t \sim \text{NID}(0,1)$$

(4) $$h_t = \omega + \alpha \epsilon^2_{1t-1} + \beta h_{t-1}$$

The second innovation ϵ_{2t} represent the jump component which includes the irregular price fluctuations with $E(\epsilon_{2t} | I_{t-1}) = 0$ where I_{t-1} represents the data. Now, ϵ_{2t} is explained as the difference among the jump innovation, and the proposed size of the innovation between *t* and *t-1* time which is given as follows:

(5) $$\epsilon_{2t} = \sum_{l=1}^{n_t} U_{tl} - \theta \lambda_t$$

where U_{tl} stands for the jump size in a normal distribution with mean θ and variance $d^2, \sum_{l=1}^{nt}$ is the jump innovation, and n_t refers to the sum of jumps. It is predicted that n_t is assigned as a Poisson variable along ARJI model given by:

(6) $$\lambda_t = \lambda_0 + \rho \lambda_{t-1} + \gamma \xi_{t-1}$$

where λ_t is the jump intensity parameter which is time-varying and conditional $\lambda_t > 0, \lambda_0 > 0, \rho > 0$ and $\gamma > 0$.

According to Chan and Maheu (2002), the log-likelihood can be given as follows:

$$L(\Omega) = \sum_{t=1}^{T} log\, f(R_t | I_{t-1,} \Omega)$$

where $\Omega = (\pi, \mu, , \delta, \omega, \alpha, \beta, \theta, d, \lambda_o, \rho, \gamma)$

5.2 Data and descriptive statistics

The primary objective of this research paper is to extend the existing research by analyzing the relationships among crude oil price and stock returns in the emerging market with GARCH-jump model, and to the Basher & Sadorsky (2006) research work in particular. Basher & Sadorsky (2006) focused on the relationship of crude oil risk and returns of emerging markets. This paper will enhance the previous work of Basher & Sadorsky (2006) by including one of the most important emerging markets, China. Besides, the global financial crisis will also take into account to the outcome of this paper.

The sample period of this study spreads from January 1988 to June 2017 (including both extremes). The period is quite interesting for conducting research as it has seen some ups and downs in both crude oil markets and stock markets. For instance, Iraq's invention to Kuwait in 1990, then in the early 2000's the markets suffered from the dot-com bubble, later the global financial crisis in 2007-2008.

The daily data of oil market indices were obtained from West Texas Intermediate and Brent oil for the above mention period. West Texas Intermediate consists of the basic commodity element of New York Mercantile Exchange's oil futures contracts whereas Brent oil is a major benchmark index for oil purchases worldwide. In addition, the daily stock market data was collected from Morgan Stanley Capital International (MSCI) emerging market index which includes 23 emerging countries.

The Descriptive statistics for the variables employed in the research are presented in Table 1. The outcome of the indices calculated by the mean returns. Interestingly, the average mean returns for all the indices are positive, and the return of the stock market index is highest (0.030) among all the indices. Moreover, the table shows a total median, minimum, maximum, standard deviation, variance, kurtosis, skewness, Jarque-Bera test and number of observations. The standard deviations between the indices express that the variations in West Texas Intermediate are more severe (2.437) than the stock market and Brent oil indices. Therefore, it is more volatile.

The table presents a negative skewness (skew to the left) for all of the indices, which means the distribution is asymmetric around the mean. Moreover, the kurtosis is also higher than 3. Therefore, a combination of high kurtosis (higher than 3) and negative skewness is present in the data, implying, a high possibility of extreme negative returns.

A risk-averse investor will prefer a distribution with low kurtosis which represents returns are near to the mean. Although it is possible to get positive extreme retunes with high kurtosis. However, in that case, skewness should be positive. As the study period falls into the timeline of many crises such as the dot-com bubble, the global financial crisis followed by the global recession, the outcome of the skewness and kurtosis are the reflection of that. Besides, the Jarque-Bera analysis rejects the null hypothesis of the normal distribution.

Table 1. Descriptive statistics.

	Return of Stock Index	Return of WTI	Return of Brent oil
Mean	0.030	0.013	0.013
Median	0.085	0.00	0.00
Maximum	10.073	18.833	23.361
Minimum	-9.994	-40.686	-23.160
Std. Dev.	1.128	2.437	1.902
Skewness	-0.556	-0.718	-0.318
Kurtosis	10.736	18.035	29.285
Jarque-Bera	19585.76	73138.23	221642.3
Probability	0.00	0.00	0.00
Observations	7695	7695	7695

6. EMPIRICAL RESULTS

This chapter presents the empirical investigation of the data with detailed analysis. First, the unit root test is conducted to identify if the data is stationary, then, the GARCH-jump model is employed for both Brent and West Texas Intermediate, followed by, analysis of sub-period and examination of asymmetric impacts.

6.1 Unit root test

The empirical model used in this paper is built on a stationary method. Consequently, it is essential to check if the return sequence analyzed are combined of zero. This analysis will test the presence of unit root before conducting the empirical study of how the crude oil price impacts the return on the stock market in emerging economies. In this paper, the most common the Augmented Dickey-Fuller test and the Phillips-Perron test are conducted for checking the unit root in the data series.

Table 2. Augmented Dickey-Fuller test and Phillips-Perron unit root tests.

	Augmented Dickey and Fuller		**Phillips and Perron**	
	Level	**1st difference**	**Level**	**1st difference**
Stock	-1.44 (0.56)	-70.48*** (0.00)	-1.41 (0.58)	-70.09*** (0.00)
Brent oil	-1.60 (0.48)	-30.99*** (0.00)	-1.65 (0.46)	-90.79*** (0.00)
WTI	-1.13 (0.41)	-92.08*** (0.00)	-1.73 (0.42)	-92.19*** (0.00)

*The table represents the result for Augmented Dickey-Fuller and Phillips-Perron tests. The null hypothesis of Augmented Dickey-Fuller and Phillips-Perron tests is that the data is unit root process. ***, **, and * indicate the significant level of 1%, 5%, and 10% respectively.*

The result of unit root test is presented in table 2. Both the Augmented Dickey-Fuller and Phillips-Perron test rejected the null hypothesis of a unit root at a 1% significant level. Therefore, both Augmented Dickey and Fuller, as well as Phillips and Perron test, suggest that no unit root and non-stationary indices. However, the first difference series are stationary in the data for the study period.

6.2 Estimation results of GARCH-jump model

This part represents the empirical evidence of the study which estimates the GARCH-jump model. The results are presented in Table 3.

Table 3. Estimation of GARCH-jump model.

	West Texas Intermediate		**Brent Oil**	
Variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
$\boldsymbol{\mu}$	0.099*** (0.00)	8.372	0.103*** (0.00)	9.128
$\boldsymbol{\varphi}$	0.222*** (0.00)	18.477	0.223*** (0.00)	19.503
$\boldsymbol{\delta}$	0.031*** (0.00)	7.995	0.004 (0.513)	0.655
$\boldsymbol{\omega}$	0.006** (0.001)	3.396	0.005** (0.003)	2.973
$\boldsymbol{\alpha}$	0.036*** (0.00)	5.468	0.035*** (0.00)	5.067
$\boldsymbol{\beta}$	0.939*** (0.00)	105.778	0.942*** (0.00)	103.309
$\boldsymbol{d^2}$	1.041*** (0.00)	10.469	1.005*** (0.00)	10.350
$\boldsymbol{\theta}$	-0.354*** (0.00)	-4.671	-0.339*** (0.00)	-4.349
$\boldsymbol{\lambda}$	0.025*** (0.00)	3.980	0.028*** (0.00)	3.554
$\boldsymbol{\rho}$	0.907*** (0.00)	39.896	0.907*** (0.00)	39.616
$\boldsymbol{\gamma}$	0.551*** (0.00)	5.660	0.561*** (0.00)	5.601
Log-Likelihood	-3720.9057		-3746.5834	

*The table presents the estimates for WTI and Brent Oil against the emerging stock market. The sample period is from January 1988 to June 2017. Numbers in the parentheses in the p-value. ***, **, and * indicate the significant level of 1%, 5%, and 10% subsequently.*

The outcomes reveal that West Texas Intermediate has an impact on the returns of the emerging stock market as evidenced by its high coefficient (δ) which is statistically significant. On the other hand, the point estimate of Brent oil is not statistically significant. As the effect of West Texas Intermediate on the stock returns is positive and statistically significant at 1% level, a rise in the oil price of West Texas Intermediate indicates a rise in stock market returns as well. Furthermore, the findings also suggest that fluctuations in the West Texas Intermediate crude oil series have a positive impact on the stock returns. Although the effect of Brent oil is positive, but not statistically significant, therefore Brent oil does not have any significant impact on the returns of the emerging stock markets.

The result is persistent with the previous study by Luo and Qin (2017) and Bouri (2015a) who conclude that a rise in crude oil will generate a rise in market returns. Therefore, a rise in oil price will produce in a rise the total demand for oil and a booming economy, which can significantly impact the major emerging economies like India, China, Russia, South Africa, Brazil, and others.

Moreover, the GARCH frameworks are statistically significant implying the presence of GARCH and ARCH impact in the data for both West Texas Intermediate and Brent oil. The summation of α and β also demonstrates a large scale of endurance in the return variation for both West Texas Intermediate and Brent oil indices.

Besides, as seen from table 3, the jump components are statistically significant in both West Texas Intermediate and Brent oil indices. Therefore, the presence of jumps is confirmed in the returns of emerging stock markets and the jumps are time-varying. Moreover, the adverse values of the jump mean represent that the jump variance presented by surprising or irregular news events has an adverse effect on stock returns, whereas, the positive values of the jump behavior refer that fluctuation presented by surprising or irregular news events has a significant positive impact on the return (Fowowe 2013). The jump intensity components (ρ, γ) are statistically significant in the outcomes which reveal the jump intensities vary over time.

In addition, the components (λ, ρ, γ) of the table 3 satisfy the following, $\lambda > 0$, $\rho > 0$ and $\gamma > 0$. Therefore, the GARCH-ARJI model is a preferred alternative for presenting the behavior of jump in the stock market. Besides, the high values of ρ and γ represent a high degree of endurance in the intensity of jump components.

6.3 Sub-period analysis

The result of the sub-period analysis is presented in Table 4 for the West Texas Intermediate and Table 5 for Brent oil. The sample has been divided into two parts. The first sub-sample indicates the global financial crisis time from 1st January 2008, to 30th June 2009, and the second sub-sample refers to the post-crisis time from 1st July 2009 to 30th June 2017. The financial crisis period has distinguished by the NBER guidance. The sub-period analysis will benefit from analyzing the impacts of the financial crisis while testing the connection among the oil price indices and the emerging stock market.

Table 4. Estimation of Sub-period analysis for West Texas Intermediate.

	Crisis Period		**Post-crisis Period**	
Variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
$\boldsymbol{\mu}$	0.296** (0.04)	0.147	0.047*** (0.00)	0.005
$\boldsymbol{\varphi}$	0.145*** (0.00)	0.016	0.219*** (0.00)	0.022
$\boldsymbol{\delta}$	0.194*** (0.00)	0.055	0.221*** (0.00)	0.006
$\boldsymbol{\omega}$	-0.016 (0.15)	0.012	-0.001*** (0.00)	0.000
$\boldsymbol{\alpha}$	0.137 (.08)	0.077	0.099*** (0.00)	0.003
$\boldsymbol{\beta}$	0.872*** (0.00)	0.148	0.922*** (0.00)	0.002
$\boldsymbol{d^2}$	-0.003 (.95)	0.049	0.146*** (0.00)	0.035
$\boldsymbol{\theta}$	-0.207*** (0.00)	0.005	-0.091 (.06)	0.049
$\boldsymbol{\lambda}$	1.556 (0.50)	2.295	0.061*** (0.01)	0.023
$\boldsymbol{\rho}$	0.866*** (0.00)	0.044	0.632*** (0.00)	0.225
$\boldsymbol{\gamma}$	0.513*** (0.00)	0.097	-0.116 (.93)	1.322
Log-Likelihood	-502.59		-688.17	

*The table presents the sub-period estimates for West Texas Intermediate against the emerging stock market. The crisis period is from 1st January 2008, to 30th June 2009 whereas the post-crisis period is from 1st July 2009, to 30th June 2017. Numbers in the parentheses implies the p-value. ***, **, and * indicate the significant level of 1%, 5%, and 10% subsequently.*

The key findings of the sub-period analysis during crisis and post-crisis period for the West Texas Intermediate on the emerging economic markets are following.

Firstly, the effects of the West Texas Intermediate on the emerging economies remain extremely significant at 1 percent level throughout crisis and post-crisis period. Secondly, the magnitude of the West Texas Intermediate index (δ) on the emerging stock markets is lower (0.194) in the crisis time than the post-crisis time (0.221). As the relationship is positive and significant in both cases, therefore it implies that a rise in the oil price of WTI affects positively to the changes in the emerging stock markets throughout the crisis and post-crisis period, but the magnitude is lower in the crisis time. Moreover, the coefficient's size was (0.031) in the full period analysis which increases almost seven times in the post-crisis period. Thirdly, the jump components have a more significant impact over the crisis time than the post-crisis time. Thus, the jumps are time-varying are primarily affected by the crisis period. Therefore, there is a significant effect of the financial crisis of West Texas Intermediate to the stock return of emerging markets.

Table 5. Estimation of Sub-period analysis for Brent oil.

	Crisis Period		**Post-crisis period**	
Variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
$\boldsymbol{\mu}$	-0.024 (0.49)	0.035	0.072*** (0.00)	0.022
$\boldsymbol{\varphi}$	0.191*** (0.00)	0.056	0.158*** (0.00)	0.029
$\boldsymbol{\delta}$	0.023 (0.59)	0.041	0.019 (0.33)	0.020
$\boldsymbol{\omega}$	0.034*** (0.01)	0.012	-0.001 (0.25)	0.001
$\boldsymbol{\alpha}$	0.198*** (0.00)	0.050	0.055*** (0.00)	0.017
$\boldsymbol{\beta}$	0.764*** (0.00)	0.039	0.928*** (0.00)	0.018
$\boldsymbol{d^2}$	0.000 (1.00)	0.790	0.265*** (0.00)	0.064
$\boldsymbol{\theta}$	3.491*** (0.00)	0.719	-0.111*** (0.01)	0.045
$\boldsymbol{\lambda}$	0.007 (0.17)	0.005	0.121 (0.56)	0.210
$\boldsymbol{\rho}$	0.886*** (0.00)	0.086	0.816*** (0.00)	0.286
$\boldsymbol{\gamma}$	0.590*** (0.00)	0.113	0.202 (0.36)	0.219
Log-Likelihood	-443.1538		-673.9105	

*The table presents the sub-period estimates for Brent oil against the emerging stock market. The crisis period is from 1st January 2008, to 30th June 2009 whereas the post-crisis period is from 1st July 2009, to 30th June 2017. Numbers in the parentheses implies the p-value. ***, **, and * indicate the significant level of 1%, 5%, and 10% subsequently.*

The Sub-period findings for Brent oil on the emerging economic markets are presented in table 5. The magnitude of Brent oil (δ) on the emerging economic markets is higher (0.023) in the crisis period whereas it is lower (0.019) in the post-crisis period. Moreover, the magnitude of Brent oil (δ) on the emerging economic markets was (0.004) during full period analysis which increased almost five times in the post-crisis time. However, the impacts of Brent oil on the emerging economic markets remain insignificant in all cases. Therefore, there is no effect of the Brent oil on the emerging economic markets during both crisis and post-crisis period which is consistent with the full period analysis.

Besides, the jump components have a more significant impact throughout the crisis time than the post-crisis time which is similar to the West Texas Intermediate. Thus, the time-varying jumps presents are mainly affected during the crisis period. Therefore, there is a significant effect of the financial crisis of Brent oil to the emerging market stock returns.

6.4 Asymmetric impacts of West Texas Intermediate

So far, both the full period and the sub-period analysis have confirmed that the West Texas Intermediate has a major effect on the stock return of emerging markets. Now, it will be worth testing whether the impact of West Texas Intermediate on the emerging markets is asymmetric. The test of asymmetric impacts will help to find if the positive oil price affects the stock returns more than the negative oil price in the West Texas Intermediate index. Moreover, the fluctuation of crude oil price can lead to periodic variations in investments. It is, therefore, necessary to test if asymmetric impacts are present in the crude oil indices on the stock return of the emerging markets.

To test the asymmetric effects the original mean equation presented in Equation (1), has been drawn-out as follows:

$$R_t = \mu + \varphi R_{t-1} + \delta_1 RW_t^+ + \delta_2 RW_t^- + \epsilon_t \quad (7)$$

Where, RW_t^+=max$(RW_t, 0)$ is a positive changes of the price in West Texas Intermediate and RW_t^-=min$(RW_t, 0)$ is a negative changes of the price, where $RW_t = RW_t - RW_{t-1}$. Then testing H_0: $\delta_1 = \delta_2$ will examine the presence of asymmetric effects.

Table 6. Estimation of West Texas Intermediate for testing asymmetric impacts.

Variable	Coefficient	t-statistic
$\boldsymbol{\mu}$	0.040*** (0.00)	6.608
$\boldsymbol{\varphi}$	0.222*** (0.00)	19.491
$\boldsymbol{\delta_1}$	0.037*** (0.00)	5.132
$\boldsymbol{\delta_2}$	0.025*** (0.00)	3.698
$\boldsymbol{\omega}$	0.001*** (0.00)	3.193
$\boldsymbol{\alpha}$	0.036*** (0.00)	5.273
$\boldsymbol{\beta}$	0.940*** (0.00)	104.424
$\boldsymbol{d^2}$	0.447*** (0.00)	10.259
$\boldsymbol{\theta}$	-0.153*** (0.00)	-3.970
$\boldsymbol{\lambda}$	0.026*** (0.00)	3.558
$\boldsymbol{\rho}$	0.907*** (0.00)	42.701
$\boldsymbol{\gamma}$	0.554*** (0.00)	5.692
Log-Likelihood	-3720.3735	
Test of Asymmetry	1.06	

*The table presents the estimates of West Texas Intermediate for testing the null hypothesis of no asymmetry against the emerging stock market. The sample period is from January 1988 to June 2017. Numbers in the parentheses implies the p-value. ***, **, and * indicate the significant level of 1%, 5%, and 10% subsequently.*

The result of the model (7) which is presented in Table 6, supports the outcome presented in Table 3. Now to measure and analyze the coefficients δ_1 and δ_2, the likelihood ratio (LR) test is carried out. The null hypothesis of the likelihood ratio test is $H_0 : \delta_1 = \delta_2$. Then, the highest likelihood function L($\tilde{\Omega}$) was received by plotting the constrained equation. Moreover, L($\hat{\Omega}$) is the highest likelihood function for the unconstrained equation. If the null hypothesis is fulfilled, then the likelihood ratio statistic (= 2 L($\tilde{\Omega}$) / L($\hat{\Omega}$)) pursues the chi-square distribution.

The result of this likelihood ratio (LR) test, reported in Table 6, confirms that the impact of West Texas Intermediate oil index on the stock returns is not asymmetric as seen from statistically insignificant point estimate. This is implying that increases or decreases in oil price have a homogeneous effect on the equity returns in the emerging markets. Therefore, both the specifications of linear and non-linear to West Texas Intermediate

returns indicate a major effect of West Texas Intermediate on the stock return of world emerging markets.

Besides, the findings of table 6 continue supporting the existence of extreme ARCH and GARCH impacts. Moreover, the jump intensity parameters (λ, ρ, γ) remain statistically significant which is representing jumps are time-varying in the West Texas Intermediate oil index.

6.5 Asymmetric impacts of Brent oil

Although the full period and the sub-period analysis failed to confirm the impact of Brent oil on the emerging market stock returns, it can be worth checking if the result presents different outcome considering the asymmetric impacts.

To test the asymmetric effects the original mean equation presented in Equation (2), has been drawn-out as follows:

(8) $$R_t = \mu + \varphi R_{t-1} + \delta_1 RB_t^+ + \delta_2 RB_t^- + \epsilon_t$$

Where, RB_t^+=max$(RB_t, 0)$ is a positive change of the price in WTI and RB_t^-=min$(RB_t, 0)$ is a negative change of the price, where $RB_t = RB_t - RB_{t-1}$. Then testing H_0: $\delta_1 = \delta_2$ will examine the presence of asymmetric effects.

The outcome of the model (8) is given in Table 7. The result of likelihood ratio (LR) test, reported in Table 7, indicate that the impact of Brent oil price on the emerging market stock returns is asymmetric as the null hypothesis $H_0 : \delta_1 = \delta_2$ is rejected and LR test is significant at 5% level. This is implying that increases or decreases in oil prices in Brent oil index would have a heterogeneous effect on the returns of the emerging markets.

Therefore, the returns of the stock market significantly impacted by the positive changes of Brent oil index, but the adverse changes in Brent oil index do not influence the returns of the stock market. Therefore, there is a presence of asymmetry in the Brent oil index to the returns of the emerging market stock price given the data period.

Table 7. Estimation of Brent oil for testing asymmetric impacts

Variable	Coefficient	t-statistic
$\boldsymbol{\mu}$	0.042*** (0.00)	9.125
$\boldsymbol{\varphi}$	0.223*** (0.00)	19.768
$\boldsymbol{\delta_1}$	0.015* (0.06)	1.909
$\boldsymbol{\delta_2}$	-0.009 (0.22)	-1.232
$\boldsymbol{\omega}$	0.001*** (0.00)	2.997
$\boldsymbol{\alpha}$	0.034*** (0.00)	4.920
$\boldsymbol{\beta}$	0.942*** (0.00)	102.710
$\boldsymbol{d^2}$	0.434*** (0.00)	11.022
$\boldsymbol{\theta}$	-0.145*** (0.00)	-4.369
$\boldsymbol{\lambda}$	0.028*** (0.00)	3.593
$\boldsymbol{\rho}$	0.908*** (0.00)	41.904
$\boldsymbol{\gamma}$	0.570*** (0.00)	5.505
Log-Likelihood	-3744.2622	
Test of Asymmetry	4.64**	

*The table presents the estimates of Brent oil for testing the null hypothesis of no asymmetry against the emerging stock market. The sample period is from January 1988 to June 2017. Numbers in the parentheses implies the p-value. ***, **, and * indicate the significant level of 1%, 5%, and 10% subsequently.*

6.6 Robustness test

The daily data was used for the empirical findings of the previous section. The robustness of the outcomes can be check by outlining the same frameworks using weekly data which will help to reevaluate the result between the different data frequency.

Comparing the findings of Table 8 with the results in Table 3, the outcomes are pretty similar. Firstly, the estimated values on the intercept term for West Texas Intermediate statistically significant positively at 1% level as reported by both tables. Secondly, the coefficient for Brent oil still has still a statistically insignificant impact on the emerging markets oil price. Thirdly, the summation of α and β still represents an extreme persistence in the return variations for both West Texas Intermediate and Brent oil. Lastly, the jump specifications are all still significant for both of the tables examined. Therefore,

the presence of the jump is confirmed in both models. After estimating and comparing the results with different data frequency, it can be concluded that the main findings of the study remain similar and the outcomes are independent in different data frequency.

Table 8. Estimation of West Texas Intermediate and Brent oil using weekly returns.

	West Texas Intermediate		**Brent Oil**	
Variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
$\boldsymbol{\mu}$	0.043*** (0.00)	9.101	0.045*** (0.00)	9.239
$\boldsymbol{\varphi}$	0.222*** (0.00)	19.047	0.223*** (0.00)	19.312
$\boldsymbol{\delta}$	0.031*** (0.00)	7.862	0.004 (0.51)	0.654
$\boldsymbol{\omega}$	0.001*** (0.00)	3.426	0.001*** (0.00)	2.978
$\boldsymbol{\alpha}$	0.036*** (0.00)	5.230	0.035*** (0.00)	5.097
$\boldsymbol{\beta}$	0.939*** (0.00)	103.766	0.942*** (0.00)	105.070
$\boldsymbol{d^2}$	0.452*** (0.00)	10.337	0.437*** (0.00)	9.596
$\boldsymbol{\theta}$	-0.154*** (0.00)	-4.337	-0.147*** (0.00)	-4.092
$\boldsymbol{\lambda}$	0.025*** (0.00)	3.563	0.028*** (0.00)	3.502
$\boldsymbol{\rho}$	0.907*** (0.00)	41.012	0.907*** (0.00)	43.961
$\boldsymbol{\gamma}$	0.551*** (0.00)	5.456	0.561*** (0.00)	5.528
Log-Likelihood	-2317.2143		-2328.6558	

*The table presents the estimates for West Texas Intermediate and Brent Oil against the emerging stock market using weekly return. The sample period is from January 1988 to June 2017. Numbers in the parentheses implies the p-value. ***, **, and * indicate the significant level of 1%, 5%, and 10% subsequently.*

7. CONCLUSION

The primary purpose of this research was to examine the impact of oil price indices on the emerging stock markets. Moreover, this study broadens the knowledge between oil indices and emerging stock markets in different periods. Brent oil and West Texas Intermediate is used for capturing the impacts of oil price whereas the MSCI emerging market index is used for capturing the stock market effects. The GARCH-jump model is plotted to understand the movements of the stock market returns. The outcomes present a significant and positive effects of oil price variations of West Texas Intermediate on stock markets whereas the effects of Brent oil on the stock markets remain insignificant during the study period.

Additionally, the oil price of West Texas Intermediate has positive effects on emerging market stock returns for both the global financial crisis time and post-crisis time, but the magnitude of the impacts is more significant during the post-crisis time. Therefore, there is a significant post-crisis effect in West Texas Intermediate to the stock market returns. However, Brent oil remains insignificant during the sub-period analysis. Besides, the West Texas Intermediate does not have asymmetric effects on the stock return of emerging markets. On the other hand, Brent oil found to have asymmetric effects on the changes of stock return on emerging markets. The outcomes, therefore, enhanced the understanding of crude oil on the emerging market returns which is tested in many existing works of literature for various markets (Noor & Dutta 2017; Park & Ratti 2008; Cong et al. 2008; Soytas & Oran 2011 and others)

The outcomes support the study of Basher & Sadorsky (2006) as the study demonstrates the presence of significant connection among the crude oil price and the stock return of emerging markets. While the oil price of West Texas Intermediate is positively affecting the stock return of emerging economies, implying an increase in West Texas Intermediate index will cause an increase in stock market returns as well, but the Brent oil remains insignificant to the stock market returns in the study. This association is relatively stronger in crisis time and post-crisis time. Moreover, the relationship is symmetric in the case of West Texas Intermediate, but Brent oil present asymmetric impacts of positive and negative shocks on the emerging markets.

The findings also suggest jump parameters are all significant, as evidenced by the estimates for GARCH-jump models for both West Texas Intermediate and Brent oil returns. Therefore, the existence of the jump is confirmed in the returns of the stock mar-

ket which are time-varying. The jump coefficient indicates that the variance in jump infers that volatility driven by surprising or irregular news events has a positive impact on the return volatility while the negative values of the jump mean refers that the behavior of jump mainly directed by surprising or irregular news events has a negative impact on returns. Moreover, the jump intensity parameters were statistically significant in every occasion suggesting that these jump intensities vary over time.

To sum up, the findings of the paper suggest a significant connection between the West Texas Intermediate index to the return of the emerging stock markets. Furthermore, the outcomes also confirm the relationship become strong during the global financial crisis and stronger during the post-crisis period. The distribution is found symmetric for West Texas Intermediate, but asymmetric effects are present in Brent oil. Besides, the jump effect in stock returns can forecast the movements of stock price, and the time-varying jump was present which can lead a possible crash in the emerging economies (Noor & Dutta, 2017).

The empirical findings could be used to predict the returns of the stock market in the emerging economies which can help the investor and policymakers to form an investment decision. The study has several implications for researches as well. For instance, the study document that the price of West Texas Intermediate is affecting positively with the emerging market stock returns. Therefore, the future research could further examine the relationship including the oil price volatility index (OVX) into the GARCH-jump framework to test the relationship, which will be interesting to see how the emerging market behaves after considering the oil price volatility index. Besides, similar research can also be carried out in developed markets to observe the effects considering GARCH-jump framework.

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