

**NONLINEAR RELATIONSHIP BETWEEN OIL
PRICE SHOCKS AND STOCK MARKETS IN
ASEAN COUNTRIES**

SOON KING YOU

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THE DEGREE OF MASTER OF ECONOMICS**

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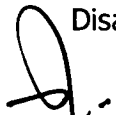
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DECLARATION

I hereby declare that the material in this thesis is my own work except for quotations, excerpts, equations, summaries and references, which have been duly acknowledged.

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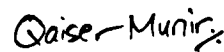
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ABSTRACT

Rising crude oil price can increase production cost and the cost of doing business. Thus, oil price change can influence stock return by changing the expectation on the future cash flows of company. Oil price shock is defined as the log change in oil price, whereas the first difference in the log of oil price is known as oil return. This study aims to examine the long-run and short-run relationships between crude oil return and stock market return for the period of 1987:5-2017:11, in all the ASEAN countries that currently have local stock exchange operations. In addition, it is an attempt to identify whether there has been a structural break in the relationship between crude oil return and stock market return in each of the ASEAN countries analysed. On top of that, this study attempts to investigate the dynamic relationship between crude oil return and stock market return based on a two-state Markov switching model that takes into account regime shifts between low and high volatility regimes. In this study, the methodology used includes the traditional unit root tests without structural break, then Zivot-Andrews one-structural break unit root test, followed by Autoregressive Distributed Lag (ARDL) cointegration test, Gregory and Hansen cointegration test with one-structural break, Toda and Yamamoto causality test, and two-state Markov Switching Dynamic Regression (MSDR) model. This study shows the following findings: 1) The Zivot-Andrews unit root test results confirm the stationarity of the variables at first difference; 2) The Gregory and Hansen cointegration test shows that there is cointegration relationship between crude oil return and stock market returns, and that the variables are moving together in the presence of structural breaks for almost all ASEAN countries, except for Hanoi Stock Exchange and Ho Chi Minh Stock Exchange of the Vietnam stock market; 3) The ARDL cointegration analysis has validated the existence of long-run and short-run relationships between both the variables in most of the ASEAN countries analysed, except for the cases of Ho Chi Minh Stock Exchange, Laos Securities Exchange, and Philippines Stock Exchange; 4) The causality analysis indicates that there exists unidirectional causality that runs from crude oil returns to stock market return, implying that oil price shocks can be a factor that changes the stock market returns in the context of ASEAN; 5) The Markov switching model validates a non-linear relationship between crude oil return and the stock market returns in all these ASEAN countries. For Cambodia, Vietnam, Indonesia, Malaysia, Philippines, Thailand, and Singapore, there is significant positive impact of oil price shocks to the stock markets in both the lower volatility and higher volatility regimes. On the other hand, for Myanmar and Laos, oil price shocks significantly and negatively affect the stock markets, in both the lower volatility and higher volatility regimes. These findings are of particularly useful to explain the variations among the oil-exporting and oil-importing countries in the region, and to suggest policy implications for investment strategies as well as for future research.

ABSTRAK

HUBUNGAN TIDAK LINEAR ANTARA KEJUTAN HARGA MINYAK DAN PASARAN-PASARAN SAHAM DI ASEAN

Peningkatan harga minyak mentah boleh meningkatkan kos pengeluaran dan kos menjalankan perniagaan. Oleh itu, perubahan harga minyak dapat mempengaruhi pulangan saham dengan mengubah jangkaan pada aliran tunai masa hadapan syarikat. Kejutan harga minyak ditakrifkan sebagai perubahan log harga minyak, sedangkan perbezaan pertama dalam log harga minyak dikenali sebagai pulangan minyak. Kajian ini bertujuan untuk mengkaji hubungan jangka panjang dan jangka pendek antara pulangan minyak mentah dan pulangan pasaran saham di semua negara ASEAN yang kini mempunyai operasi bursa saham mereka tempatan, untuk jangka masa 1987:5-2017:11. Di samping itu, ia adalah satu usaha untuk mengenal pasti sama ada terdapat perubahan struktur dalam hubungan antara pulangan minyak mentah dan pulangan pasaran saham bagi setiap negara ASEAN yang dianalisis. Di samping itu, kajian ini cuba menyelidik hubungan yang dinamik antara pulangan minyak mentah dan pulangan pasaran saham di negara-negara ASEAN berdasarkan analisis penukaran Markov dua-keadaan yang mengambil kira pertukaran rejim antara rejim kemeruapan yang lebih rendah dan rejim kemeruapan yang lebih tinggi. Dalam kajian ini, metodologi yang digunakan termasuklah prosedur ujian akar unit tradisional tanpa perubahan struktur, ujian akar unit Zivot-Andrews dengan satu perubahan struktur, ujian kointegrasi Autoregressive Distributed Lag (ARDL), ujian kointegrasi Gregory dan Hansen dengan satu perubahan struktur, ujian kausalitas Toda dan Yamamoto, dan model dua-keadaan Markov Switching Dynamic Regression (MSDR). Kajian ini menunjukkan penemuan-penemuan berikut: 1) Keputusan ujian akar unit Zivot-Andrews mengesahkan kepegungan semua pembolehubah pada perbezaan pertama; 2) Ujian kointegrasi Gregory dan Hansen menunjukkan terdapat hubungan kointegrasi antara pulangan minyak mentah dan pulangan pasaran saham dan pembolehubah-pembolehubah bergerak bersama dengan adanya perubahan struktur untuk hampir semua negara ASEAN, kecuali Bursa Saham Hanoi dan Bursa Saham Ho Chi Minh di pasaran saham Vietnam; 3) Analisis kointegrasi ARDL membuktikan kewujudan hubungan jangka panjang dan jangka pendek antara kedua-dua pembolehubah di kebanyakan negara ASEAN yang dianalisis, kecuali kes-kes Bursa Saham Ho Chi Minh, Bursa Sekuriti Laos, dan Bursa Saham Filipina; 4) Analisis kausalitas menunjukkan bahawa terdapat kausalitas sehalu yang berlaku dari pulangan minyak mentah ke pulangan pasaran saham, menyiratkan bahawa kejutan harga minyak boleh menjadi faktor yang mengubah pulangan pasaran-pasaran saham dalam konteks ASEAN; 5) Model penukaran Markov mengesahkan hubungan tidak linear antara pulangan minyak mentah dan pulangan pasaran saham di semua negara-negara ASEAN ini. Bagi Kemboja, Vietnam, Indonesia, Malaysia, Filipina, Thailand, dan Singapura, terdapat kesan positif terhadap kejutan harga minyak ke atas pasaran saham di kedua-dua rejim kemeruapan yang lebih rendah dan rejim kemeruapan yang lebih tinggi. Sebaliknya, bagi Myanmar dan Laos, kejutan harga minyak menjejaskan pasaran saham dengan ketara, di kedua-dua rejim kemeruapan yang lebih rendah dan rejim kemeruapan yang lebih tinggi.

Penemuan-penemuan ini amat berguna untuk menjelaskan variasi di antara negara-negara pengekspor minyak dan pengimport minyak di rantau ini, dan untuk mencadangkan implikasi dasar, implikasi untuk strategi pelaburan, dan implikasi untuk penyelidikan di masa depan.

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LIST OF ABBREVIATIONS

ADF	-	Augmented Dickey Fuller
AIC	-	Akaike Information Criterion
ARCH	-	Autoregressive Conditionally Heteroscedastic
ARDL	-	Auto Regressive Distributed Lag
ARMA	-	Autoregressive Moving Average
ASEAN	-	Association of Southeast Asian Nations
BURSA	-	Bursa Malaysia Berhad
CAPM	-	Capital Asset Pricing Model
CCR	-	Cumulative Continuous Returns
CSX	-	Cambodia Securities Exchange
DCF	-	Discount Cash Flow Model
DF	-	Dickey Fuller
EGARCH	-	Exponential Generalized Autoregressive Conditional Heteroskedasticity
EIA	-	International Energy Agency
FBMMES	-	FTSE Bursa Malaysia MESDAQ Index
FDI	-	Foreign Direct Investment
GARCH	-	Generalized Autoregressive Conditional Heteroskedasticity
GDP	-	Gross Domestic Product
G7	-	Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States
GCC	-	Gulf Cooperation Council
HOSE	-	Ho Chi Minh Stock Exchange
HNX	-	Hanoi Stock Exchange
IMF	-	International Monetary Fund
JCI	-	Jakarta Composite Index
KLSE	-	Kuala Lumpur Stock Exchange
KPSS	-	Kwiatkowski, Phillips, Schmidt and Shin
LSX	-	Lao Securities Exchange
MSM	-	Markov Switching Model

NASDAQ	-	National Association of Securities Dealers Automated Quotations
NBER	-	National Bureau of Economic Research
NOPI	-	Net Oil Price Increases
OLS	-	Ordinary Least Squares
OPEC	-	Organization of Petroleum Exporting Countries
PP	-	Phillips-Perron
PSE	-	Philippines Stock Exchange
RM	-	Ringgit Malaysia
ROA	-	Return on Assets
ROE	-	Return on Equity
SES	-	Stock Exchange of Singapore
SETI	-	Stock Exchange of Thailand
STI	-	Straits Times Index
U.S.	-	United States
USD	-	US Dollar
VAR	-	Vector Autoregressive
VECM	-	Vector Error Correction Model
WTI	-	West Texas Intermediate
YSX	-	Yangon Stock Exchange

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Crude oil is arguably one of the most crucial resources in today's modern economics, as it represents an important energy sources in many countries. Most recently, the total worldwide oil consumption is above 90 million barrels per day (Energy International Agency (EIA)). In fact, crude oil price had shown surprising changes in the last few decades. Oil price had increased about 80 percent between the end of first quarter 2007 and the end of second quarter 2008. The decreased in oil price was about 50 percent between July and October 2008. Oil price had ended 2015 at US\$37.13 per barrel. The record indicated the lowest level since early 2009. However, oil price rebounded as it increased about 45 percent between the end of 2015 and the end of 2016. In addition, crude oil prices ended 2017 at US\$60 per barrel, the highest end of year price since 2013. Can such changes in oil price be referred to as oil price shocks?

In fact, the oil price shocks can be both oil price increases and decreases, unless evidence is provided showing either increases or decreases are more statistically significant in affecting economic activity and stock market. Some past studies had focused on the disparities between oil price increases and decreases in terms of their impacts and thus the findings were depending on the evidence of the empirical works, for examples, Mork (1989), and Hamilton (2000). Mork (1989) suggests that oil price shock should be defined as the increase in oil price as well as

the decrease in oil price. It is noted that oil price shock has become a major concern for the world economy, as an oil price increase or decrease may significantly impact on economic activity and change the value of an asset. Since asset values are the present discounted value of the future net earnings of firms, both the current and the expected future impacts of an oil price shock is absorbed quickly into stock returns. Through the study, oil price shocks had been identified as a crucial factor for the fluctuations in global stock markets.

Nevertheless, as indicated by Hamilton (2000), oil price increases are imperative and can be more meaningful than oil price decreases. The relationship between economic activity and oil price change was found to be nonlinear, and the effect of oil price increases was more significant than decreases. In addition, oil price increases were less predictable if the increases simply corrected earlier decreases. In this study, attention is not paid on differentiating the impacts of oil price increases or decreases, but to concentrate on the relationship between oil return and stock market return. Hence, oil price increase and decrease are considered as oil price shocks.

The theoretical ground of the link between oil price shocks and stock market returns is supported by the connections between stock market and economic activity, as well as between oil price and economic activity.¹ In brief, stock market and economic activity are related based on the understanding that the fundamental valuation of stock is based on the discounted value of expected cash flows (Harvey, 1989). Meantime, the size of the expected cash flows of stock is determined by the strength of an economy. Thus, stock price can indicate the expectations about real

¹ The influence of oil price shocks on stock market, as well as the connections between stock market and economic activity, and between oil price and economic activity are discussed in Chapter 3, Sections 3.2.1, 3.2.2 and 3.2.3 on pages 32 to 36. The main interest of this study is to understand the link between oil price shocks and stock market, that is, by examining the long-run and short-run relationships between the proxy variables namely, crude oil return and the stock market returns of all ASEAN countries that currently have local stock exchange operations. The connections between stock market and oil price with economic activity are also discussed to provide a better understanding about the link that relates stock market with oil price shocks.

economic activity. In other words, the changes in stock price may reflect the alterations in these expectations. The above explanation clearly relates stock market to real economic activity. Next, oil price can affect economic activity through its effect on production and business costs. From the microeconomic perspective, crude oil is a main energy source and it is used as input in production and in doing business (e.g. used as fuel for transportation). Furthermore, according to Huang *et al.* (1996) and Jones *et al.* (2004), stock price is influenced by oil price as a change in oil price can alter the expectation on the cash flows of a company.

Apparently, the empirical works that study oil price shocks (i.e. proxy by crude oil return) and stock market (i.e. proxy by stock market return) is expanding. So far, economists have not reached to a consensus on this relationship. Even though the presumption of oil price effect on stock market is strong, there are still mixed results in past studies about whether the impact of oil price shocks is significant. For instance, oil price shocks were found to have a deteriorating effect to the stock markets in Canada, the United States (U.S.), United Kingdom, and Japan (Jones and Kaul, 1996); This negative effect was not validated by Huang *et al.* (1996), as the relationship between oil price shocks and the U.S. stock market could not be established by the study for the period of 1979 to 1990. Huang *et al.* (1996) suggest that the case of oil-producing or oil-consuming country can give a different result in studying how oil price may impact on stock market. For a net oil producer country, higher oil price tends to cause higher earnings from oil proceeds. Inversely, oil price increase tends to reduce the net oil consumer country's earnings. As stated by Nandha and Faff (2008, pp. 986):

"Oil prices seem to affect stock markets, at least under certain conditions. First, oil is a fundamental driver of modern economic activity, and second, there is a general market perception that stock markets react to oil price shocks. Higher oil prices might affect the global economy through a variety of channels, which include transfer of wealth from oil consumers to oil producers, a rise in the cost of

production of goods and services, and impact on inflation, consumer confidence and financial markets”.

Despite of oil-producing and oil-consuming country consideration, the effect of oil price on stock market return can be asymmetric (Sadorsky, 1999; Cong *et al.*, 2008; Arouri and Fouquau, 2009; Ono, 2011; Zhu *et al.*, 2016). There are different types of asymmetric specifications, namely positive and negative oil price returns, net oil price increases (NOPI), and scaled oil price increases and decreases (SOPI and SOPD). Some of the past studies suggest that a positive oil price shock leads to a negative impact on stock market in the case of oil-importing countries (see e.g. Killian and Park, 2009; Basher *et al.*, 2012). For oil-exporting countries, stock markets tend to respond positively to oil price increases (Park and Ratti, 2008). Once knowing how stock markets may react to oil price shocks in different way, this can help investors to decide whether to take long or short position when market is in a bearish or bullish trend.

Researchers have attempted to examine the asymmetric effect of oil price shocks using a Markov switching model (see, Aloui and Jammazi, 2009; Chen, 2010; and Balcilar *et al.*, 2013). With the model, the "net oil price increase" variable is used to capture real return volatility and the probability of regimes transition (Aloui and Jammazi, 2009). It is believed that higher oil price can lead to higher probability of the transition, in particular, moving from a bull market to enter a bear market. In addition, an increase in oil price can cause stock market to stay in a high variance regime for a longer period (Chen, 2010). According to Balcilar *et al.* (2013), the study of stock market and oil price shocks indicates three types of regime, namely, low, high, and crash volatility. The regime transition order moves from low to crash then to high volatility.

Markov switching model has several advantages as suggested by a few landmark studies. The model is a method used for modelling non-stationary and nonlinearity in time series, while allowing different structural breaks in one regime to another. Hamilton (1989, 1990) had mentioned that, failing to account for nonlinearity in estimation may result in spurious results. Besides that, Markov switching model is used to differentiate the classical business cycle phases from other cyclical economic fluctuation phases (Chauvet, 2000). Moreover, as suggested by Anas *et al.* (2004), the model can increase the reliability in business cycle analysis. For instance, the useful information regarding the relationship between oil return and stock market return in high-volatility and low-volatility regimes. As the information is about the current state of an economy, it is helpful in policy making. Policy makers may use this information in planning an expansionary or contractionary policy.

In conducting this present study, the advantages of a Markov switching model as outlined above have been carefully considered. The use of this model is mainly for adding new evidence of the relationship between crude oil return and stock markets returns for the selected ASEAN countries.

The literature on oil price shocks and the ASEAN countries' stock markets is only a handful. A few past studies had focused on the topic exclusively for the case of ASEAN countries (Ibrahim, 2014; Guliman, 2015; Koh, 2015; Nasr, 2016). The past studies had provided mixed results. Koh (2015) found that stock returns were significantly sensitive to the oil return. Guliman (2015) did not find a significant connection between oil price and stock prices. Structural break and the asymmetric effect of oil price shocks are among the aspects that need attention in the context of ASEAN. These aspects are been less studied in the past as only a few related studies can be found. Zhu *et al.* (2016) captured the existence of structural break in the case of Asia-Pacific Regions. Chen (2010) applied the Markov switching model in the case of U.S.

ASEAN is one of the brightest spots in the global economy. In 2015, the ASEAN's combined GDP stood at US\$2.4 trillion, making it world's sixth-largest economy (ASEAN, 2016). The effect of oil price in altering stock market return is a contemporary issue and it is pertinent to ASEAN, as crude oil consumption of the region had increased sharply after the 1973-1975 recession. Against this background, this thesis focuses on the relationship between crude oil return and the stock market returns of all ASEAN countries that currently have local stock exchange operations. The analysis of this study is based on standard econometric methodology that takes into account models' specifications required for the long-run and short-run relationships between oil return and the returns of selected stock markets, as well as for capturing structural breaks and regime switching.

1.2 Problem Statements

Unexpected oil price change can be one of the pervasive economic forces that systematically influence stock market return (Chen *et al.*, 1986). Crude oil is used in the production of goods, hence rising oil price tends to increase production cost and lower the expectation on a company's future cash flows (Kalyanaraman, 2015). It is known that inputs are variable in the long-run, but fixed in the short-run (Pindyck and Rubinfeld, 2009; Landsburg, 2002). Considering that crude oil is an input in production, oil price shocks may change a company's profits and it will be reflecting in the future cash flows of company which the latter is a concern of investment. Thus, the relationship between crude oil return and stock market return can be complex. The above issue is addressed for ASEAN countries' stock markets in this present study. Till date, the context of ASEAN has not been sufficiently explored (see, e.g., Tabar, 2013; Ibrahim, 2014; Guliman, 2015; Koh, 2015; Nasr, 2016), therefore no clear consensus is provided for the region so far.

Second, past study indicates that stock market may react to oil price change in a nonlinear pattern (Kisswani and Elian, 2017). Hence, failing to account for

nonlinearity in estimation may result in spurious results. As mentioned by Enders (2015), macroeconomic variables usually exhibit the pattern of downward rigidity. More specifically, business cycle tends to induce downturns that are sharper than the recoveries in variables like output growth rate and unemployment rate. As stock market is associated with real economic activity, therefore there is a need to take into account nonlinearity in the data series.

The individual stock markets of ASEAN countries had been subject to structural changes in the last few decades, in which oil price shocks could be one main reason of structural breaks². The last few decades witnessed several historical events that resulted in large changes in crude oil prices, for examples, the Iraq invasion of Kuwait and U.S. which led to an oil boycott on 2 August 1990, the Middle East tensions in September-December 1990, the First Gulf war in January 1991, the Second Gulf war in March 2003 (Park, 2007), and the recent 2014-2015 oil price slump. Structural break may affect the relationship between crude oil return and stock market return. Hence erroneously excluded breaks may lead to misleading inference in the time series analysis. Figure 1.1 and 1.2 of Malaysia Stock Market (FTSE KLCI) and Straits Times Singapore Stock Market (STI) show that oil price shocks could be one main reason of the structural breaks in 1998 and 2009.

Apart from structural break, it may be possible the interactions between crude oil return and the stock market returns in ASEAN countries exhibit the Markov switching process or regime switching behaviour. The reason is the individual stock markets in the region can show different response towards oil price shocks, when separating the regimes of low volatility and high volatility. This is another aspect to be considered when nonlinearity is concerned.

² Structural breaks can be defined as the sudden events which can change the structure of an econometric model (Kapetanios and Tzavalis, 2004).

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