A STUDY OF RELATIONSHIP BETWEEN COMMODITY PRICE AND STOCK PRICE USING MS-VAR AND MS-VECM MODELS

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS

ADF	-	Augmented Dickey Fuller
AIC	-	Akaike Information Criterion
EIA	-	Energy Information Administration
ECM	-	Error Correction Mechanism
EM	-	Expectation-Maximization
GDP	-	Gross Domestic Product
GP	-	Log index for the gold price
HQ	-	Hannan-Quinn Information Criterion
IMF	-	International Monetary Fund
JCI	-	Jakarta Composite Index
KLCI	-	Kuala Lumpur Composite Index
KPSS	-	Kwiatkowski-Philips-Schmidt-Shin
MS-AR	-	Markov switching autoregressive
MS-VAR	-	Markov switching vector autoregressive
MS-VECM	-	Markov switching error correction model
MSMH-VAR	-	Markov switching mean adjusted heteroskedasticity vector autoregressive
MSIH-VECM	-	Markov switching intercept adjusted heteroskedasticity vector error correction
OLS	-	Ordinary Least Square
OP	-	Log index for the oil price
RM	-	Ringgit Malaysia
RGP	-	Return of the gold
RJCI	-	Return of the Indonesia stock index

RKLCI	-	Returns of the Malaysia stock index
RSETI	-	Return of the Thailand stock index
RSTI	-	Return of the Singapore stock index
ROP	-	Return of the oil
SC	-	Schwarz Information Criterion
SETI	-	Stock Exchange of Thailand
STI	-	Straits Times Index
U.S.	-	United State
VAR	-	vector autoregressive model
VECM	-	vector error correction model
WTI	-	West Texas Intermediate

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SATU KAJIAN HUBUNGAN ANTARA HARGA KOMODITI DAN HARGA SAHAM DENGAN MENGGUNAKAN MODEL MS-VAR DAN MS-VECM

ABSTRAK

Siri masa kewangan dan ekonomi sentiasa menunjukkan kelakuan tidak pegun seperti ketidakseimbangan dan pertukaran rejim. Pertukaran data dan data lompat adalah kebiasaan dalam model siri masa. Krisis Kewangan Asia 1997 dan Krisis kewangan 2007/2008 adalah contoh keruntuhan saham yang menyebabkan kejadian perubahan saham. Oleh itu, model linear tidak lagi sesuai untuk digunakan dalam menganggarkan siri masa. Tesis ini membincang tentang ujian pegun, ujian titik putus dan ujian kointegrasi Johansen untuk mengkaji ciri-ciri siri masa. Tesis ini dipersembahkan dalam dua bahagian. Bahagian pertama mengkaji hubungan antara pulangan minyak dan empat pulangan saham ASEAN iaitu KLCI, STI, SETI dan JCI. Beberapa spesifikasi termasuk min diselaraskan selepas peralihan rejim, pintasan diselaraskan selepas peralihan rejim, rejim bergantung parameter autoregresif dan rejim bergantung heteroskedasticity model MS-VAR akan digunakan dalam kajian ini untuk menangkap kebarangkalian peralihan siri masa dari satu rejim ke rejim yang lain. Keputusan model pemilihan ujian kriteria menunjukkan model MSIH-VAR dapat mengesan perubahan rejim lebih baik berbanding dengan spesifikasi model MS-VAR yang lain. Ini kerana model MSIH-VAR mampu mengesan semua perubahan kebarangkalian peralihan. Bahagian kedua menggunakan pelbagai spesifikasi model MS-VECM untuk mengkaji hubungan antara pulangan emas dan empat pulangan saham ASEAN. Keputusan menunjukkan bahawa pintasan diselaraskan selepas peralihan rejim model MS-VECM dapat memberikan keputusan yang lebih tepat dalam klasifikasi rejim. Tujuan menggunakan model MS-VAR dan model MS-VECM adalah kerana model perubahan Markov boleh mengkaji

perubahan rejim. Tambahan pula, model MS-VECM boleh menganggarkan perubahan rejim siri masa berkointegrasi dan mampu mengkaji kesan mekanisme pembetulan keseimbangan kepada pengukuran kitaran perniagaan. Keputusan model anggaran menunjukkan bahawa pulangan minyak mempunyai hubungan yang negatif dengan pulangan pasaran saham. Tambahannya, pulangan emas dan saham juga dilaporkan mempunyai hubungan yang negatif apabila mempertimbangkan mekanisme pembetulan keseimbangan dalam analisis.

A STUDY OF RELATIONSHIP BETWEEN COMMODITY PRICE AND STOCK PRICE USING MS-VAR AND MS-VECM MODELS

ABSTRACT

Financial and economic time series always show nonlinear properties such as asymmetry and regime switching. Structural change as well as break is often reported in the series. The 1997 Asian Financial Crisis and the 2007/2008 Global Financial Crisis are the examples of the presence of the regime shifts in the financial series. Thus, linear models are no longer suitably used to estimate the series. Stationary, breakpoint and Johansen cointegration tests are used to examine the properties of the series. The analyses in this study are divided into two parts. The first part examines the relationship between oil and four selected ASEAN stock returns, namely KLCI, STI, SETI and JCI by using the MS-VAR model. Several specifications including mean adjusted after regime shift, intercept adjusted after regime shift, regime dependence autoregressive parameter and regime dependence heteroskedasticity of the MS-VAR model are used in the present studies to capture the transition probabilities from one regime to another. From the model selection criteria tests, the MSIH-VAR model is able to detect the transition probability better than other specification of the MS-VAR model. The second part examines the relationship between the gold and the four selected ASEAN stock returns by using the several specifications of the MS-VECM model. The results indicated that the MSIH-VECM model results in a major change in regime classification. The purpose of use the MS-VAR and MS-VECM models in estimating the time series is the Markov switching models able to estimate the changes of the regime. Furthermore, the MS-VECM model is able to estimate the shifts in regimes of cointegrated time series and able to investigate the effects of the equilibrium correction mechanism to the measurement

of the business cycle. The estimated model revealed that oil return has a negative relationship with the stock returns by using the MS-VAR model. Additionally, gold and stock returns also reported has a negative relationship when considers the equilibrium correction mechanism in the analysis.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides the conceptual framework of the study and thus serves as an introductory phase of the thesis. It consists of a section that delivers the background and the statement of the purpose of study. This chapter also highlights the research objectives and questions, scope, significance and limitation of the study and concludes with an outline of the organization of the thesis.

1.2 Motivation of Study

In this study, the MS-VAR and MS-VECM models are applied to determine the impact of oil and gold returns on four selected stock returns, namely Malaysia (KLCI), Singapore (STI), Thailand (SETI) and Indonesia (JCI). Commodities are the primary inputs to many manufactured goods and services; therefore, changes in commodity prices can affect manufactured goods and services. Moreover, oil and gold prices often relate to inflation. Zhang and Wei (2010) revealed that the rising prices of crude oil stimulates inflationary pressures. Whereas gold prices are expected to rise due to the increasing demands of gold, since gold is known to be a safe haven investment (Ghazali *et al*., 2013).

The reason for using the Markov switching models in estimating the financial data is that it might also encounter problems such as missing values, regime switching, jumps or breaks in the series. Excluding changes in regime for the measurement of variance decomposition may produce biased results. Also, abandoning the shift in regime may give overstated results (Bianchi, 2012). Therefore, linear models are no longer suitable to be used in analyzing the financial series; and nonlinear time series models are proposed to solve these kinds of problems.

Fan and Yao (2005) claimed that the nonlinear time series is not a linear stochastic process, but it is generated by nonlinear dynamic properties such as time variation, higher moment structures, asymmetric cycles, jumps or breaks in the time series sequence. The Markov switching autoregressive (MS-AR) model is one of the more popular nonlinear time series models that was proposed by Hamilton in 1989. The MS-AR model is then extended to the Markov switching vector autoregressive model (MS-VAR) and later to the Markov switching error correction model (MS-VECM) by Krolzig in 1997.

According to Krolzig (1997), the MS-VAR model becomes increasingly prominent in applications since it is able to detect the difference in terms of average growth rates in economic and financial data. The MS-VAR model is reliable in analyzing the business cycle. It provides useful information on the financial relationship because of its properties to detect the high level regime. Therefore, the perception of the current state of financial market can be improved (Anas *et al*., 2004).

In the MS-VAR model approach, the correlated Markov chain model is able to analyze multiple time series variables and also provide useful information for capturing the long-run economic relationship. Therefore, the MS-VECM model is important to be included in the study, for a better understanding of the nature of interrelationship among the components in the model (Anas *et al*., 2004).

Besides, the MS-VECM model is able to estimate the time series model based on the number of the regimes, lags, intercept, autoregressive parameters and variance. Furthermore, it is more flexible to the market's mood due to its time-varying dynamic properties and it can estimate the parameters both endogenously or exogenously, endogenously by some of the parameters and exogenously by some other observable or unobservable parameters. Therefore, there got several types of representation MS-VECM model. Further discussion will be in Chapter 3.

Therefore, the MS-VAR and MS-VECM models are used to estimate the relationship between oil prices, gold prices, and stock prices since the series might exhibit switching behavior. As documented in many studies, including Lo and Wang's (2000) study, aggregate price series seems to be non-stationary. The economic and financial issues such as the recession in the year 1990, the 1997 Asian financial crisis, and the United States bear market in 2007 caused several structural changes in the market.

The main objective of the Markov switching models is to capture the turning points, jumps as well as breaks in the series, thus the switching behavior or breaks that might exist in the series are concerned. The 1997 Asian financial crisis, also

known as the Asian contagion, is one of the events that has affected the switching behavior in the series. This crisis greatly impacted the shares and currency markets of Malaysia, Thailand, Indonesia and the Philippines. The causes of the debacle are many and disputed including economic bubble fuelded by hot money in Thailand, the devaluation of the Chinese remnimbi, inflation and appreciation od rge real exchange rate. This issue triggered most of the Asian countries' economy, causing a recession on stock market and currency in Malaysia, Thailand, Indonesia and other Asian countries. Malaysian Ringgit, Thai Baht, Indonesian Rupiah and Philippine Peso sharply declined in the early period of the Asian financial crisis. Then, the downward pressures hit the South Korean Won, Singaporean Dollar, Taiwanese Dollar and Hong Kong Dollar (Nanto, 1998).

Before the crisis, Malaysia was a popular investment destination. However, the 1997 Asian financial crisis caused an immediate decline of the Malaysian Ringgit until the government pegged the exchange rate regime of RM 3.80 against the $1 U.S. Dollar until the year 2005. Although Malaysia's economy recovered in 2005, the asset values were not returned to pre-crisis levels (Rajan, 2012).

The economy market of Singapore is a small open market and relies on neighboring countries. Therefore, the large depressions in the Asian countries have affected the Singapore's economy (Nanto, 1998).

Thailand was the first Southeast Asian country to face the Asian financial crisis. Before the crisis, Thailand had a flexible market and was receptive to foreign investments. According to Julian (2000), the collapse of asset prices and the baht

became more serious when the investment bankers began to recall their loans. Moreover, investors started selling off their stocks, forcing the Thai Finance Minister to request a loan from the International Monetary Fund (IMF) (Julian, 2000).

Tamnunan (2010) revealed that Indonesia faced a financial collapse during the crisis in 1997. A depression more than 13% of Gross Domestic Product (GDP) was shown in 1998. Furthermore, many financial institutions, including the national banking sector faced bankruptcy or collapsed when the rupiah fell.

Table 1.1 GDP Growth Rates

Year / Country	Early 1997	1998
Singapore	8.3	-1.4
Malaysia	7.3	-7.4
Thailand	-1.4	-10.5
Indonesia	4.7	-13.1

(Source: IMF WEO April 2006)

Table 1.1 presents a comparison of the real GDP growth rates of the sample countries that are used in this thesis before and when the financial crisis happened. From the table, the GDP reported dramatically decreased. Therefore, we claim that the data generating process for the price series would be characterized by changing the mean, implying two different regimes that is growth regime and recession regime. This is crucial since the regime shifting is a source of nonlinearities in the time series process. Further motivation will be the use of intercept adjusted after regime shift Markov switching model since it can detect the smooth transition from one regime to another. The structural changes could affect the estimation of the variables, hence time-varying parameter and heteroskedasticity are also included in the present thesis to capture structural changes.

1.3 Concepts and theoretical model

1.3.1 Oil price

Crude oil is the most important commodity in the world. Many oil products and its derivatives are used in modern life, ranging from transportation to plastics. There is a general misconception among the investors about the types of oil prices and how they affect global trading. Although there are several countries produce oil, but oil is an oligopoly market form that just has three types of crude oil price in the world oil market. The West Texas Intermediate (WTI), Brent Blend and Dubai Crude is the major benchmarks for the world oil price.

The price of WTI crude oil is the U.S. benchmark in oil pricing. The spot price of WTI is recorded at Cushing, Oklahoma since it is a major trading hub for crude oil over three decades. On the other hand, Brent crude oil is a type of petroleum classifying extracted from the North sea and it is also used as the pricing benchmark for other oil classifications in many countries, including those in Europe. The Dubai crude is extracted from Dubai and as a price benchmark because it is one of only a few Persian Gulf crude oil available immediately.

Nows, the price of WTI crude oil is cheaper compared to the Brent's, due to the Libyan crisis that reduced the supply to the European region, but increased the storage for WTI in Oklahoma (Dutram, 2011). Furthermore, the data used in this thesis are the WTI type of oil.

The oil price is included in this study, since Bhar and Hammoudeh (2011) described that oil price positively leads to the stock market in a normal state. Moreover, the price of oil is treated as one of the factors affecting the level of economic activity at the global and national levels. For instance, almost all the recession in the United States is affected by the increase of oil prices. Hamilton (2011) reviewed that 10 out of 11 United State recessions were associated with the oil price hike. Moreover, the depression in global economic growth in the past decade coincided with the appreciation of oil prices, with the 1990s Asian crisis being the only exception.

The manner in which oil prices affect emerging and developing economies has received surprisingly attention compared to advanced economies. Hamilton (1983), Hamilton and Lin (1996), Chaudhuri and Daniel (1998), Sauter and Awerbuch (2003), Halaç *et al*. (2013) are some studies that discussed the effect of oil prices to the role of monetary policy, costs or firms, labor market, exchange rate and the intensity of oil in production.

Additionally, to provide a broader and more encompassing view on the impact of oil price shocks, Rasmussen and Roitman (2011) described that the relationship between oil prices and macroeconomics aggregates across the world. Global macroeconomic conditions is the factor of oil demands and high oil prices are always related to a large negative effect on global economic growth.

1.3.2 Gold price

Gold is unique among commodities. It does not perish or extirpate over time, giving it unique properties as a very long-term store of value. Gold is a precious metal which plays a prominent role in both the investment and consumer world. During the crisis, gold can act as a safe-haven asset and store of value. In addition, gold is also a popular investment instrument. Investors believe that gold is a liquid asset which can be used to buy a low-value stock or pay other assets. Furthermore, gold is also believed to have less risk compared to other commodities (Sin Chew Jit Poh, 26th September 2011).

Roache and Rossi (2009) described that gold prices can affect economic activity in different ways, such as interest rates, exchange rates, and stock markets. Moreover, the price of gold is sensitively related to supply and demand. Furthermore, gold prices always relate to inflation. For instance, gold price recorded a high average value of $871 in 2008 where the Global Financial Crisis in 2007/2008, also known as the worst financial crisis since the 1930 Great Depression, impacted a total collapse of the world economy and inflation in many countries is also shown in the same year. This situation is supported by Do *et al.* (2009), that the demand of gold is increased when the economy is in a recession period or when the economy is in inflation.

According to the report of the World Gold Council (2013), the supply of global gold reached 4477 tones in 2012 with approximately two thirds coming from the gold mining industry. For the gold mining industry, there is a different method to

rank the total fiscal contribution of gold mining companies either by calculation of gold production or by the cost per ounce when mining gold. While market capitalization that calculates the sum of capital holding's value of the company is the most common method in determining the ranking of the gold mining companies.

There is a common misconception by inexperienced investors that the current gold price or also known as the gold spot price is determined by the London Gold Market Fixing Ltd. The gold spot price is calculated based on the most recent average bid price that provided by the worldwide traders which is not same with the gold real time price that show in the websites. The London Gold Fixing price is a fixed price agreed by all members of the London Bullion Market Association and five members of the London gold pool. The price is fixed twice a day and the fixed price is changed at the exact instance when it is agreed. Thus, it can be traded at different prices within seconds.

1.3.3 Kuala Lumpur Composite Index (KLCI)

The Kuala Lumpur Composite Index (KLCI) is a stock market index of Malaysia. This index is derived from the 30 largest companies by full market capitalization listed on the Main Board with approximately 813 listed companies on the Main Board of Bursa Malaysia in 2014, which are chosen to be representatives of the performance of Malaysia's stock market and thus as a benchmark that reflects the growth of the economy in Malaysia. The Malaysia stock market is an average of 753.19 index points from 1977 to 2014. The highest index point recorded is 1887.07 in May 2014 and the lowest recorded is 89.04 in April 1977 until October 2014.

1.3.4 Straits Times Index (STI)

The Straits Times Index (STI) is calculated based on the market-value weighted stock market index. It comprises of 30 top performing companies listed on the Singapore Exchange. The average of the Singapore stock market is 2460.93 index points from 1999 to 2014. Furthermore, the highest index point recorded is 3875.77 in October 2007 and the lowest recorded is in March 2003, that is 1213.82 index points.

1.3.5 Stock Exchange of Thailand (SETI)

The Stock Exchange of Thailand (SETI) is the national stock exchange of Thailand. There are 584 companies listed on the market board. SETI is calculated based on a major stock market index of the performance of all common stocks. From the year 1987 until 2014, the stock exchange of Thailand composite index is an average of 777.20 index points. The Thailand stock market reached the highest record at 1754 index points in January 1994 while the lowest record was 207 index points in September 1998.

1.3.6 Jakarta Composite Index (JCI)

The Jakarta Composite Index (JCI) is a modified capitalization-weighted index of all stocks listed on the regular board of the Indonesia Stock Exchange. In Indonesia, the stock market is an average of 1195.35 index points ranging from the year 1983 until 2014. The highest record of the stock market in Indonesia reached 5246.48 index

points in September 2014 while the lowest point recorded was 61.56 index points in November 1986. There are approximately 515 companies listed on the Indonesia Stock Exchange board and the JCI is estimated based on the performance of all companies listed on the Indonesia Stock Exchange.

1.4 The Relationship between Oil Price, Gold Price and Stock Market Index

After the Global Financial Crisis in 2007, oil prices had reached the peak of $ 135 per barrel in June 2008 and recorded $ 78 per barrel in November 2014. On the other hand, gold prices stood above $ 1100 per ounce in recent years. The forces behind the phenomenon of "oil and gold rush" are goaded by the strong demands of emerging markets especially for those oil and gold exporting countries. The historical evidences show that the demand of oil and gold will rise when the global economy is in the slump period (Liao and Chen, 2008).

Huang *et al*. (1996) revealed that there is a theoretical linkage between oil and stock prices. For instance, the United States is a net consumer of oil, therefore, increasing the oil prices will affect the balance of payments, reduce the pressure of foreign exchange rates for the U.S. dollar and increase the expected domestic inflation rate pressure. This fact is also supported by Hamilton (1983), Gilbert and Mork (1984), Mork *et al*. (1994), who expect changes in oil prices to be correlated with the changes in stock prices. However, Huang *et al*. (1996) found that the changes in the future price of oil and the changes in stock prices do not have a

significant negative relationship. This is different from the findings of Jones and Kaul (1996), Park and Ratti (2008) and Wang *et al*. (2010).

Le and Chang (2011) studied the relationship between the stock market index and oil prices in Japan, Singapore, South Korea and Malaysia via unrestricted vector autoregression (VAR) model. The empirical analysis used the monthly data from January 1986 until February 2011. They found that there is a unidirectional casualty from oil prices to stock prices but not vice versa. This can be referred to Anoruo and Mustafa (2007) that the stock market will decline when oil price is appreciated, but the movement of the stock market will not affect the crude oil price.

Gatuhi and Macharia (2013) used a linear regression model in analyzing the monthly data of exchange rates, interest rates, stock market indices, oil prices and the total oil consumption country during the period 1986-2005. They found that the price of oil can affect the stocks; the increase in oil prices would mean a rise in oil based products, hence reducing the demand and profit. Moreover, inflationary pressures are always related to the increasing price of oil. Besides, they also reported that oil prices have a negative relationship on the interest rates, and a non-significant positive relationship on the exchange rates, stock market index and total oil consumption.

Historically, gold is well known as a safe haven and is a popular investment commodity. Moreover, the price of gold has always reported higher when the stock market undergoes a recession. Merton (1973) revealed that there is a negative relationship between gold and stock returns, but it is a weak one. Moreover, Merton also found that gold can be treated as a hedge and decrease the volatility of the

portfolio. However, Sumner *et al*. (2010) revealed that gold returns are decreased when the stock returns is in a recession period. They found that gold and stock have a positive relationship under the regular conditions of the market, but a negative relationship during the oil crisis in 1979, the stock market downturn in 1980-1981, the technology bubble in 2000 and the economic effect which arose from September 11 attacks.

1.5 Research background

According to a report by the US Energy Information Administration (2014), Malaysia is the second largest oil producer in Southeast Asia. Besides, Malaysia is the fourth highest in Asia Pacific of oil reserves after China, India, and Vietnam. The energy industry is a key sector of the country's economic growth. Malaysia aspires to be one of Asia's energy top players by 2020. Since oil is an important commodity in Malaysia, the movement of oil prices could have influenced the performance of the stock market.

Due to its strategic location, Singapore appears to be one of the Asia's major petrochemical and refining hubs. Another reason for Singapore is superiority is that it has world-class refining and storage system. In 2013, Singapore imported more than half of the crude oil from United Arab Emirates, Saudi Arabia and Qatar. Then, the imported crude oil is channeled to the petrochemicals and refining sector. Furthermore, Singapore acts as one of the top ten exporters of refined products in

Asia during year 2013 and most of these products are exported to Malaysia, Indonesia and Australia.

Although Thailand has limited domestic oil production and reserves and it relies on the import of oil, it has a significant portion of oil consumption. Additionally, Thailand is the second largest oil importing country in Southeast Asia after Singapore. Thus, the prices of oil have a direct proportional effect on Thailand economic activities.

Indonesia has a prominent role in exporting oil, since it ranks fourth in the oil exporting countries in Southeast Asia, after China, India and the United States. In 2012, the petroleum share in Indonesia decreased. However, it still accounts the highest portion of Indonesia's energy mix of 36%. Moreover, the oil and gas sector in Indonesia affected the nation's economy, since the revenues from these two energy sectors account for 24% of the total state revenues in 2012. Additionally, Indonesia was ranked as the 24th largest crude oil producer in the world in 2013.

According to Liao and Chen (2008), gold is a popular investment and a defensive asset against inflation. Gold is a special commodity where the changes in price depend on the market supply and demand. Like oil, gold prices are closely related to the strength or weakness of the market performance. Relevant papers that investigated the effect of gold prices on the stock market include Liao and Chen (2008) and Mishra *et al*. (2010).

Thailand placed fourth on the world's top gold exporters after the United Arab Emirates, Japan and Turkey in 2013. In Asia, Thailand, Malaysia, and Singapore are the world's top gold importers, ranked at 4th, 6th, and 8th place respectively. Besides, Thailand, Malaysia and Indonesia are reported to have 3000 kilograms, 2794 kilograms and 130000 kilograms of gold production in 2009. According to Horng and Huang (2013), the gold price market and the volatility of stock market of Malaysia and Thailand is an asymmetric effect model. Hence, there is a significant impact on gold prices in Malaysia and Thailand stock market prices.

1.6 Statement of Purpose

The purpose of this study is to capture the financial relationship by modeling the financial time series to determine the effect of oil and gold prices on the stock returns in Malaysia, Singapore, Thailand and Indonesia. The reason of choosing these countries is due to the close geographical position as neighboring Asian countries and there might have a dynamic relationship between the countries in the stock price effect.

The MS-VAR and MS-VECM models are applied in examining the financial relationship. In addition, a comparison on the specifications of Markov switching models' result using the MS-VAR and MS-VECM models are also included in this thesis.

1.7 Research Questions

This study is guided by the following research questions:

(1) What are the impacts of changes in commodity prices of oil in determining the stock returns of Malaysia, Singapore, Thailand and Indonesia?

(2) Which specification of the MS-VAR model is superior in modeling the condition in (1)?

(3) What are the impacts of changes in commodity prices of gold in determining the stock returns of Malaysia, Singapore, Thailand and Indonesia?

(4) Which specification of the MS-VECM model is superior in modeling the condition in (3)?

1.8 Research Objectives

This study embarks on the following objectives:

i) To investigate the effect of oil returns on stock returns in Malaysia, Singapore, Thailand, and Indonesia by using the MS-VAR model. The mean adjusted, intercept adjusted, regime dependence autoregressive parameter and regime dependence heteroskedasticity of the MS-VAR model are examined to find the outperform form of MS-VAR model in estimating the relationship. Research questions (1) and (2) are used to examine this objective.

ii) To examine the effect of gold returns on stock returns in Malaysia, Singapore, Thailand and Indonesia by using the MS-VECM model. The same specifications as

stated above are used in the MS-VECM framework. Research questions (3) and (4) are used to evaluate this objective.

1.9 Significance of the Study

This study enhances our understanding on the effects of oil returns and gold returns effect on the stock market returns in Malaysia, Singapore, Thailand, and Indonesia. Moreover, this study provides new insight into a better specification of Markov switching models in capturing the stochastic behavior of financial time series data in Malaysia, Singapore, Thailand and Indonesia with respect to the time-varying and its properties.

Besides, this study will serve as a basis for future studies. It would be useful as a blueprint to investors, policy makers, and academicians on the financial relationship between oil prices and gold prices and Malaysia, Singapore, Thailand, and Indonesia's stock returns.

1.10 Limitations of the Research

Markov switching models are a nonlinear model, thus it is not easy to implement them in empirical research. It can only be applied for certain nonlinear patterns, such as level shift, asymmetry, and volatility clustering. Besides, other commodities such

as coco and silver are not included because oil and gold prices are the major effect on stock prices (Sauter and Awerbuch, 2003; Sadorsky, 2003; and Wang *et al*., 2010).

1.11 Definitions of Term Used

(a) Aggregation

Aggregation is the act of grouping several items together or summing of the whole amount. The series observed may represent an accumulation of underlying quantities over a period of time (Chan, 2002). For example, daily returns can be thought of as the aggregation of tick-by-tick returns within the same day.

(b) Missing values

Missing values are also known as unequally spaced data (Chan, 2002). In statistics, missing values or missing data are common occurrences when there is no data value stored for variable in the current observation. Moreover, missing values may cause serious problems in analysis, for a small amount of data input may introduce bias and cause misleading results (Adèr and Mellenbergh, 2008).

(c) Multivariate time series

Instead of being a one-dimensional scalar, X_t can be a vector with each component representing an individual time series. For example, the returns of a portfolio that consist of p equities can be expressed as $X_t = \{X_{1t, \ldots,} X_{pt}\}'$, where each X_{it}, $i = 1, \ldots, p$, represents the returns of each equity in the portfolio (Chan, 2002).

(d) Regime switching

The behavior of a series could change over time in terms of its mean value, volatility or to what extent its current value to the past value. The changes for a period time before reverting back to its original behavior are typically termed as regime switching or regime shifting. Regime shift is defined as rapid reorganizations from a stable state to another in an ecosystem. However, this idea was then widely used in the economic and financial field to describe the substantial changes in the series behavior (Krolzig, 1997).

(e) Structural break

Structural break usually happens in a series when an unexpected shift appears. Structural break in a series may lead to large forecasting errors and unreliability of the model in general. Besides, the parameters are assumed to be time varying if too many unknown breaks occur in a time series (Damodar, 2007).

1.12 Organization of the Thesis

This thesis is divided into seven chapters. Chapter 1 presents the background of the study, statement of purpose and significance of the study. Moreover, the research objectives, research questions and limitation of the statistical methodology being employed are also described in this chapter. Chapter 2 provides information on the evidence of previous studies on the relationship between stock prices and commodity prices. In addition, reviews of literature relevant to the statistical methods that will be used in this study will also be discussed in Chapter 2. Chapter 3 explains the data and

its characteristics, research design, and methodologies of the study. Furthermore, identification of the variables, definition of terms and the statistical software will be highlighted in Chapter 3. Chapter 4 discusses the preliminary results of the study. Chapter 5 reports the outputs of investigating the relationship between oil and stock returns using the MS-VAR model. Chapter 6 reports the outputs of investigating the relationship between gold and stock returns using the MS-VECM model. Chapter 7 summarizes all the findings, discusses the implication of the results and gives suggestions for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter describes numerous past studies that are pertinent to the present research. Moreover, it also presents the background of study and reviews the related literature, including the description of the Markov switching model, Markov switching vector autoregressive (MS-VAR) model and Markov switching vector error correction (MS-VECM) model.

2.2 Background of Model

For the past two decades, the nonlinear time series models gain its popularity in the economic and financial fields. Markov switching models which are nonlinear models, are commonly applied in economic time series and financial time series.

The 1973 to 1974 and 1979 to 1980 oil price shocks were examples of the structural changes in oil price. This event brings in a profound impact to all the countries in the world especially oil producing countries. The Black Market, which causes the stock market crash around the world in October 1987 and the Asian Financial crisis that causes the exchange rate and shares in Asia countries to drop

drastically in the year 1997. These events are examples of structural break in the time series model.

Commodity prices such as gold and oil are always related to the movement of the stock market price and the market exchange rate. Economic conditions can lead to the changes in prices of stocks and commodities, which includes the price of oil and gold. In turn, changes in price influence the demand for commodities and the gain of companies which will then determine the performance of macroeconomics as a whole. Historical evidences have shown that when the global economy was in the recession period, the demand of oil and gold increased.

Although oil and gold are both considered as limited reserves, oil belongs to basic energy sources which may affect a country's economy as stated by Sauter and Awerbuch (2003) while gold is a popular investment. Both commodity prices reflect on a country's stock market price. Labys and Granger (1971) were the pioneers to study the behavior and the implication of the commodity prices on the stock market index. The theoretical behavior of commodity prices was further discussed and developed by Deaton and Laroque (1992).

Hamilton (1983) analyzed the oil price shock in the United States (U.S.) business cycle and found that an inverse direction between the oil price and U.S. output growth for the period of 1948 until 1980. The oil price shock is one of the factors on damping the economic growth since the second world war. Hamilton (1983) observed a decline in output growth after the increment of oil prices in year 1973 to 1980. This effect is more pronounced in the periods of inflation.

Changes in oil prices will affect economic activities through changes in commodity prices. Based on the capital market theory, oil has a major effect of macroeconomic growth. According to Hamilton and Lin (1996), the future cost stream will increase when economic activity and asset values are at a high risk condition. Therefore, there will be a large decrease in macroeconomics after an increase in oil prices. This condition is supported by the report of U.S. Energy Information Administration (EIA) that there was a decrease of 0.7% of the gross domestic product in the U.S. after the sharp rise of oil prices during 1999-2001.

According to Sauter and Awerbuch (2003), most of the oil prices increased during 1945-1985. The movement of the oil price showed a different pattern from 1986. The pattern was due to a radical price change in the level of oil and volatility. This is supported by Park and Ratti (2008), who used a vector autoregressive (VAR) model to examine the linear and nonlinear specifications of the oil price shock. They found that the shocks of oil price influenced the real stock returns in the U.S. and 13 European countries over the year 1986 to 2005. Therefore, an immediate decline of the real stock returns may happen due to oil price shocks.

The increase of the oil prices in 2005 and 2006 were due to the booming demand from Asia, especially China and India. These two countries were the main principal players on the global energy scene and more than 10% of global oil is consumed by these two countries (Sauter and Awerbuch, 2003). Oil price shocks had brought in a greater implication to oil-importing countries, especially in those countries that had a weak framework policy, low foreign exchange reserves, and limited international capital market. To overcome the oil price shock, the authorities

of many countries maintained high industrial production and export revenues, but keep interest rates at low levels.

Halaç *et al*. (2013), using a Fully Modified Ordinary Least Square (OLS), also known as Dynamic (OLS), estimated the weekly time series of the U.S. crude oil, nominal exchange rates and two stock market indices namely, Istanbul Stock Exchange and National 100 Price Index from January 1991 to February 2010. They revealed that fluctuation in oil price is expected to affect the costs of firms since oil price is vital to many production processes. Meanwhile, it is still difficult to evaluate the effects of oil price shocks on different variables of the macroeconomic environment, especially in the stock market because of the existence of breaks and time varying data.

Jones and Kaul (1996) were the first investigators to analyze the international stock market reaction to oil price shocks through predicting the stock returns due to the current and future changes in real cash flows. Their findings reflected that oil prices in Canada, Japan, the United Kingdom and the United States stock market have a negative relationship with stock market prices. This can be seen from the finding that during the postwar period, oil prices had a significant detrimental effect on the stock market of each country.

Sadorsky (1999) extended the studies by Mork (1989), Hamilton (1996), and Jones and Kaul (1996) on the impact of oil price shock on the short-term interest rate and real stock returns. Using the impulse response function and VAR model, oil prices showed a significant negative relationship with real stock returns based on the