CHAPTER 1

Introduction

1.1 Statement of the Problem and Significance of the Study

So far, many studies have worked on stock market to predict and analyze the price changes. Investing in stock market is one of the most popular ways to make money. However, people cannot accurately forecast the stock price changes in stock market. How to analyze and predict the trend and volatility of one or many of the stock prices is the most critical thing for investors. To pursue this challenge, this thesis will firstly propose to analyze the linkages between the movements of stock price, bond yield, market interest rate and exchange rate. Secondly, it will assess the role of investing in stock to optimize multi-asset portfolio returns. Thirdly, if the stock market is found to be a more promising way to get higher return to the financial investment, it will further make inquiry into whether or not pairs trading strategy can improve the performance of investment returns. There are some reasons for doing this research.

First of all, there are many approaches and evidences that confirm the relationship between stock market and other financial markets; for example, the relationship between stock returns and exchange rates. There are two potential theories expressing the relationship between stock prices and foreign exchange rate (FX). The first is the flow-oriented model, which argues that the international competitiveness and trade balance are impacted by the currency exchange. For example, the competitiveness of local firms is improved by domestic currency depreciation, resulting in an upward movement of stock prices in response to the increase in expected in-coming cash flows. The second is the stock-oriented model which shows that exchange rates are affected by stock price's movements and the consistent rising trend in stock prices will attract money inflow and lead to currency appreciation, or vice versa. Numerous researches

have investigated the linkages between stock index and FX market and provided interesting empirical results.

With the development of international financial markets, the stock index, exchange rate, government bond yield and interest rate can grow more interacting via capital flow and trade flow. Volatility in one market may be transmitted rapidly to another by contagion effects. Estimating and understanding the dynamic linkages have important implications for asset allocation, portfolio diversification, currency risk hedging, stock and currency market return predictability. In this thesis, a review will be made on whether or not the spillover effects exist and take place across exchange rate (against US dollar), interest rate, government bond and the stock markets. Therefore, after analyzing the relationship between the stock market and other financial markets, we may be able to predict with confidence the trend of the stock market.

Secondly, The Chinese stock market crash has occurred since June 2015. Notably, not only was Shanghai main share index down 8.49 percent of its value on 24 August, the markets in Japan, Europe and USA also suffered the meltdown. Furthermore, the Bloomberg Commodity Index has hit a low for more than 15 years. There appears to be some correlation between stock markets and commodity futures. Should investors pay attention to this correlation in their portfolios to reduce risk or increase returns? What is the role of investing in stock market in multi-asset portfolio returns? This thesis will try to answer these questions.

Thirdly, if investing in stock market has an important role to optimize multi-asset portfolio returns, what strategy could the investors use to gain more profit in stock market? This study would like to recommend pairs trading strategy. Many investors have taken a well-known strategy, which is pairs trading and it was invented at Morgan Stanley in 1987. Pairs trading is a market-neutral strategy following two-step process: first, identify two stocks whose prices have moved together historically, and second, sell the winner and buy the loser when the price relation is broken. The profit can be made and the prices of the two stocks will converge to a mean if the past is a good mirror of

the future. This study will show the benefit of using pairs trading strategy and how it works well.

The last but not least, the dynamic behavior of various financial and economic variables is invariably subject to sudden structural breaks. Developing an appropriate model, which can capture the structural breaks, is very important. This is why this study would like to use regime switching model. Markov regime-switching models have gained popularity since the end of 1980s. Previous studies have confirmed that a Markov-switching model performed better on the stock returns than linear models without switching, such as autoregressive models, moving average models, ARMA and ARIMA models. S&P monthly index data was employed by Turner, et al. (1989), who found between two regimes of a Markov-switching model, the mean, the variance or both may divide. The method to capture the time series behaviors in different regimes, known as the Markov switching model, was proposed by Hamilton (1989) which has become one of the most popular nonlinear time series models in the literature. Moreover, Hamilton et al. (1994) proposed a model with sudden discrete changes. In stock market returns and the spreads, the significant evidence of switching behavior was found by Schaller and Norden (1997) regarding the regime switching that occurred in means and variances during the Great Depression, and World War II. In an investment environment, there are no outliers. An incorrect model for investment optimization can lead to significant loss of investment. Embrechts, Lindskog and McNeil (2001) noticed that linear correlation can be understood misleadingly and should not be considered as the canonical dependence measure. We need to relax this linear assumption since many papers have presented the different structures of dependency for a long time. So the dependency may be represented as two regimes, such as high and low dependence regime. Thus we need Markov Switching technique. Why is it interesting to focus on the context of dynamic investment? Because both high and low regimes can affect asset pricing and focusing on the different regime can remove some short-term impacts in market price dynamics and distortion of performance of investment. In particular, this thesis contributes to the following three important topics:

Topic 1: On the Linkage between Exchange Rate, Stock return, Bond yield, and Interest Rate Movements in a Regime-switching Model: Evidence from Asian Countries

Topic 2: Multi-asset Portfolio Returns: A Copula-based Markov Switching Approach

Topic 3: Pairs Trading Rule with Switching Regression GARCH Model

1.2 Literature Review

1.2.1 The Linkages between Exchange Rate, Stock Return, Bond Yield, and Interest rate

There are many approaches and evidences that confirm the relationship among these four markets. For the stock and foreign exchange markets, there are two potential theories expressing the relationship between stock prices and foreign exchanges (FX). The first is the flow-oriented model, which argues that the currency exchange affects the international competitiveness as well as trade balance. It is expected that the competitiveness of local firms is improved by domestic currency depreciation, resulting in an upward movement of stock prices in response to the increase in expected in-coming cash flows. The second is the stock-oriented model which shows that exchange rates are affected by stock price movements and the consistent rising trend in stock prices attracts money inflow, which leads to currency appreciation, or vice versa. Numerous researches have investigated the linkages between stock index and FX and provided interesting empirical results. Not surprisingly, Diamandis et al. (2011) employed VECM model and found that the stock index and FX were positively related in South American countries, i.e., Argentina, Brazil, Mexico, and Chile. Tsai (2012) found that the relationship between FX and the stock index was negative in Thailand, Singapore, Malaysia, South Korea, Taiwan, and the Philippines. Tudor and Popescu-Dutaa (2012) used VAR model and found the causality relationship from FX to stock index in

Russia and Brazil, but not in China. The causality-in-variance was found to be from the stock returns to exchange rate changes in America, but from exchange rate changes to the stock returns in the Euro area and Japan, meanwhile there was a bidirectional causality in Canada and Switzerland, in the study by Caporale et al. (2014) who used bivariate DCC-GARCH model to study the banking crisis between 2007 and 2010. Enormous research studies have also been undertaken on the relationship between stock and bond markets such as those by Yang et al.(2009), Andersen et al. (2007), and Baele (2010) which commonly found positive significant relationship to exist between stock and bond markets. Another strand of the literature has brought attention to the dependency between FX and interest rates as well. The relationship is positive between FX and interest rate under the flexible prices approach (Classical School). Under the Keynesian School, the relationship is negative. Bautista (2003) suggested a strong positive correlation between interest rate and FX during the turbulent periods in the Philippines from his dynamic conditional correlation (DCC) analysis. Given risk premium as condition, conversely, Sanchez (2008) found that between exchange rates and interest rates, the relationship is negative for expansionary depreciations and positive for contractionary ones. Furthermore, they also found some evidences that stock market can be impacted by interest rate movement. Besides, there are different opinions in terms of the correlation between stock prices and interest rates. For example, higher interest rates cause the opportunity cost of money to increase, thus reducing the return and stock prices of companies. On the contrary, lower interest rates do not have an impact on stock prices oppositely. The Markov-switching vector autoregressive (MS-VAR) model was employed by Kal, Arslaner, &Arslaner (2015) for investigating whether or not the deviation of a currency from its fundamentally determined rate of return impacts the correlation between interest rates and stock market yields.

1.2.2 Portfolio optimization

The Chinese stock market crash has occurred since June 2015. Notably, not only was Shanghai main share index down 8.49 percent of its value on 24 August, the markets in Japan, Europe and USA also suffered the meltdown. Furthermore, the Bloomberg Commodity Index has hit a low for more than 15 years. There appears to be some correlation between stock markets and commodity futures. To reduce risk or increase returns, many investors include commodities in their portfolios. There is a large number of literatures documenting this issue. For example, Daskalaki and Skiadopoulos (2011) found that when investors take into account the higher order moments of portfolio returns, commodities inclusion will render benefit only in the in-sample framework but not in the out-of sample framework. Bessler and Wolff (2014) found that the performance of a stock-bond portfolio can be improved by incorporating commodities in the groups of industrial and precious metals as well as energy, whereas the performance of this portfolio cannot be improved with inclusion of commodities in agricultural and livestock products types.

So far, many studies have worked on stock and commodity portfolio returns using conventional model, such as minimum-variance portfolio optimization strategy and sample-based mean-variance optimization model. The dependence between financial asset returns is explained by those conventional models, which can only explain dependence between random variables in the linear regression. In an investment environment, there are no outliers. An incorrect model for portfolio optimization can lead to significant loss of investment. Embrechts et al. (2001) noticed that linear correlation can often be quite misleading and should not be taken as the canonical dependence measure. In order to capture heavy tail information regarding the financial market, this study provides the copula-based GARCH model to get value at risk (VaR) and Expected Shortfall (ES). The copula-based GARCH model can be used to analyze asymmetric or tail

dependence structure (see Patton, 2006 and Wu et al., 2012). There are already several papers that show its advantages. For examples, Autchariyapanitkul et al. (2014) and Ayusuk and Sriboonchitta (2014) investigated multivariate t-copula and Vine copula based GARCH models to explain portfolio risk structure for high-dimensional asset allocation issue. But most still worked on the assumption of no economic change. Hamilton (1989) proposed to relax this assumption since many papers have presented the different structures of dependency for a long time and the dependency may be represented as two regimes, i.e. high dependence regime and low dependence regime. Thus, they applied Markov Switching technique which is popular for modeling non-linearities and regime shifts. The reason for focusing on the context of dynamic asset allocation is the fact that high and low regime can affect asset pricing and focusing on the different regimes can remove some short-term impacts in market price dynamics and distortion of performance of portfolios. Ntantamis & Zhou (2015) investigated the relation between different market states (bull and bear markets) to examine whether being in a different market phase for a given commodity can provide information about whether the corresponding commodity stocks or stock market indices are in a comparative market states.

1.2.3 Speculation trading strategy

There are a great number of different studies within pairs trading framework, such as distance approach, co-integration approach and time series approach. These can be sorted into three main approaches. Firstly, the distance method utilizes nonparametric distance metrics to calculate the sum of squared deviations between two normalized stock prices as the criterion to form pairs trading opportunities. The most cited paper published by Gatev et al. (2006) found that the strategy provides average annualized excess returns of up to 11% based on the large sample of US equities. Later, Perlin (2009) furthered the analysis to examine the profitability and

risk of the pairs trading strategy for Brazilian stock market. Do and Faff (2010) replicated the original methodology of Gatev et al. (2006) and by the sample period extension to June 2008. They confirmed pairs trading strategy to be profitable for a long period of time, despite at a decreasing rate. Secondly, Vidyamurthy (2004) developed a co-integration approach. The co-integration approach describes how to figure out co-moving stocks relying on formal co-integration testing. Applying this method to pairs trading is mostly based on Gatev et al (2006) threshold rule. Vidyamurthy (2004) suggested a univariate co-integration approach, which is employed to preselect the potential co-integrated pairs, and to design the trading rule with nonparametric methods, based on statistical information. Using co-integration approach, Miao (2014) provided high frequency and dynamic pairs trading system. For co-integrated assets in a continuous-time economy, Chiu and Wong (2015) originated the optimal pairs trading strategy in a closed-form solution. Thirdly, the time series approach was developed by Elliott et al. (2005), which utilizes Kalman filter for estimating a parametric model of the mean-reverting spread, in which the formation period is ignored and the spread is assumed to follow the state space model. This approach focuses on describing mean-reversion of the spread with other time series methods rather than co-integration. Do et al. (2006) criticized and extended the method of Elliott, van der Hoek and Malcolm (2005) into the stochastic residual spread method to improve the former method. Although these methods are highly likely to be successful in quite a lot of applications, there exists a problem on the linear model assumption, which fails to represent nonlinear patterns, for instances, asymmetry, volatility clustering and amplitude dependence. Many studies mentioned that the financial data are often found to switch between different regimes. Accordingly, Hamilton (1989) proposed Markov switching model to characterize the financial data in different regimes. Bock and Mestel (2009) confirmed that the regime-switching rule for pairs trading can generate a positive return and hence it may be utilized as an alternative model to

conventional pairs trading rules. Yang et al. (2016) employed the Markov regime-switching model and used S&P 500 index daily data to compare the model with traditional methods. The results showed that his Markov regime-switching model generated the best performance. Another popular nonlinear model is known as threshold model. A three-regime threshold GARCH (generalized autoregressive conditional heteroskedasticity) model was proposed by Chen et al. (2014), in order to capture asymmetries in mean reversion of pairs spread. This study aims to employ Markov Switching Regression GARCH model to extend the Threshold GARCH of Chen et al. (2014) since Kuan (2002) noted that the threshold model allows the parameter to change the regime only on occasion and exogenous changes. Thus, this thesis provides a Markov Switching Regression GARCH as an alternative pairs trading strategy approach.

1.3 Objectives of the Study

This study provides three empirical studies, with the following objectives:

1.3.1 To analyze the relationship among exchange rate (against US dollar), interest rate, government bond yield and the stock market index from Thai, Malaysian, Singapore, Japanese, South Korean, and Chinese financial markets using the MS-VECM approach.

1.3.2 To investigate portfolio risk structure for multi-asset allocation issue including the Stock Exchange of Thailand index, Hang Seng Index, Brent oil spot price, rubber commodity price, and rice commodity price using a copula-based Markov Switching approach.

1.3.3 To identify the trading signal for stock pairs of 30 stocks in the Stock Exchange of Thailand SET50 Index taking into account the structural change in the pairs returns using Markov Switching Regression GARCH model.

1.4 Main Contributions of the Study

This study contributes to the empirical literature concerning the investment decision as follows:

1.4.1 To provide an appropriate model for examining profoundly the various relationships among these four financial markets. This study introduces the Markov Switching Vector error correction model (MS-VECM) to investigate the co-integrated structure of variables and capture the long-run correlation of the variables in the financial model and also explain the non-linearity embedded in the relationship of financial markets in each country.

1.4.2 To conduct a Markov Switching with high dimensional copula in order to measure the dependency of the variables. The high dimensional copula is extended to Markov Switching, thus the model is flexible and can capture the economic behavioral change over time. Moreover, the conditional Value-at-Risk is taken into account in the economic change, thus it will be a more accurate risk measure than the conventional method, which is measured under the one dimension.

1.4.3 To propose Markov Switching Regression GARCH model as an alternative approach in order to identify the trading signal for stock pairs. The proposed Markov Switching Regression GARCH as an alternative approach to determine pairs trading signals is more suitable for its taking into account the structural change in the pairs return.

1.4.4 To improve the portfolio performance, as it will help financial institutions and investors to make suitable evaluations and decisions on portfolio investment.

1.4.5 To estimate the parameters in the model making use of a Bayesian estimation technique which is more appropriate and more practical in the case where there are numerous unknown parameters in the model because

the computation in the conventional maximum likelihood method may be difficult. Moreover, the likelihood function is difficult to estimate in the discrete margins case (Smith, 2011). If estimation of the copula parameters is undertaken jointly with the parameters of the marginal models, the maximum likelihood estimator is difficult to reach the global maximum and is not easy to be converged.