

# CHAPTER 1

## Introduction

### 1.1 Statement and the Signification of the Problem

Financial econometrics is one of the most important field for conducting an analysis of the financial theory and empirical finance. This field integrates the knowledge of finance, economics, mathematics and statistics. The topics applied in financial econometrics are risk management, volatility estimation, estimation and inferences of financial models and theory, hedging strategies, a term structure model, portfolio analysis and financial simulation.

According to the risk and return in the stock market, it is particularly important for practitioners such as global investors, speculators, financial analysts, financial institutions and governments to master in an event where there are unforeseen and unknown circumstances that are beyond control. Theoretically, the conventional portfolio theory is evaluated by using standard statistics, such as mean and variance, under the assumption of Gaussian distribution. Markowitz (1952) introduced the portfolio optimization problem for selecting the optimal weights of the portfolio investment with the objective function to minimize the variance of the portfolio given the expected return of the portfolio. Investors used this method to make decisions for investment strategies not only in a single market, but also across multiple markets. Hence, the investors tend to move their investment from the markets with a high risk to the markets with low risk due to protecting their wealth.

The market risk can be represented by the market volatility. It is a very important measurement in finance and an important factor to set up asset allocation. In financial econometrics, the GARCH models are the volatility models and can be used to compute the financial risk. For simplicity, the traditional GARCH model assumed that

the Gaussian innovations can be improved upon to the GARCH models with different types of innovation. Subsequently, Bollerslev (1990) and Engle (2002) improved the GARCH models into the pattern of multivariate random series and estimated the conditional linear dependence of volatility with multivariate normality, namely the constant conditional correlation (CCC) and Dynamic conditional correlation (DCC) multivariate GARCH respectively. In the area of financial application, many studies applied CCC GARCH and DCC GARCH to study some topics that were related to international diversification, Lee et al. (2006), Chiang et al. (2007), Syllignakis et al. (2011), Ayusuk (2012) and Hwang et al. (2013). However, the weakness of this approach is that they employed GARCH with Gaussian distribution, which is not necessary true for studying about financial data. Meanwhile, the GARCH models can be used to forecast the volatility and can be used to simulate the portfolio selection. Moreover, the GARCH models can also be used to calculate the value at risk and expected shortfall for further risk management analysis.

Global financial markets have an instant change in investment behavior that favors an increase in capital flow across many countries. Many researchers focused on the topic about international stock markets, international diversification and the emerging stock markets. As Grubel (1968), Levy and Sarnat (1970) examined the international investment of the US investor. The investor can obtain the advantages from international diversification. Recently, Fletcher and Marshall (2005) studied the linkages and dynamic effect among emerging markets, U.S. and Japan markets. They found that the relationship between international market have increased in the 1990s. They also suggested that international investors should focus on the Pacific Basin markets for diversifying the portfolio. Herrero and Vzquez (2013) studied the international portfolio diversification in global banking and they found that the diversification gains from the operations in oversea as in emerging countries. Chiou (2007) examined the benefits from international diversification by comparing in the emerging countries and developed countries. They suggested that local investors in emerging countries got benefit more than the developed countries. Andreou et al. (2013) investigated the linkages of stock and foreign markets in emerging countries. They found that Asian financial crisis had an effect on volatility in both markets.

Graham et al. (2012) examined the co-movement between the U.S. and the emerging markets. This result suggests that investors should concentrate in emerging markets for diversification benefit.

To enhance the benefits of the portfolio allocation from the international markets, this thesis applied the most recent portfolio analysis methodologies, namely extreme value theory, evidence theory, information theory, copula approach and risk modeling to analyze portfolio investment across the international stock markets. In particular, this thesis contributes to the following three important topics:

Topic 1: Risk, return and international portfolio analysis: entropy and linear belief functions

Topic 2: Risk analysis in emerging Asian markets using canonical vine copula and extreme value theory

Topic 3: Copula based volatility models and extreme value theory for portfolio simulation with an application to Asean stock markets

## **1.2 Literature Review**

This thesis used the financial econometric approach to analyze the stock markets such as copula approach, extreme value theory, entropy, belief function theory and the GARCH models.

### **1.2.1 Portfolio Analysis Method**

Traditionally, portfolio selection method was started by Markowitz (1952). The goal of this method is to the minimum variance portfolio subject to the minimum target returns that investors would like to obtain from portfolio return, and there are some assumptions such as the normally distributed return series and no short selling constraints. Several researchers applied this method in applications of the portfolio optimization as Tobin (1958), Konno and Kobayashi (1997), Gokgoz and Atmaza (2012), Guidi and Ugur (2014), etc. Alternatively, Jaynes (1963) introduced entropy function, which is an uncertainty measurement

for random variables and it can be applied to choose the optimal portfolio weight. Berra and Park (2008) applied the entropy method to optimize the portfolio selection with an application to the international stock markets. According to the portfolio performance evaluation, the Sharpe ratio is a one tool, which is introduced by Sharpe (1966) to measure the portfolio performance that is described in a unit of return per unit of risk.

### **1.2.2 Copula Approach**

Copulas function is the recent approach to describe the dependence structures between random series, which was introduced from Sklar's theorem. In applications of the financial analysis, Embrechts et al. (2002) first illustrated the copula function for dependence measure between random data with application in finance and insurance. Then, Jondeau and Rockinger (2006) applied the copulas with GARCH model to measure the conditional dependencies for example of European stock markets. In original work of Joe (1997), Bedford and Cook (2001) (2002), Aas et al. (2009) introduced the copulas in term of Vine structures, which can be measured dependence structures with different bivariate copula families in high dimensional data series. In applications of Vine copulas, Nikoloulopoulos et al. (2012), Low et al. (2013), Zhang (2014) and Sriboonchitta et al. (2014 a) (2014 b) applied the Vine copulas to investigate the dependence between international markets and they also used the Vine copulas to simulate the data set for risk management.

### **1.2.3 Extreme Value Theory**

EVT is a statistical tool, which can be handled the data with the extreme deviations from the median of probability distribution. It is very important and useful for modeling rare events. Embrechts et al. (1999) provided the example for understanding in extreme value theory with applications to finance and insurance. Bali (2003), Wang et al. (2010), Ren and Giles (2010) and Jesus et al. (2013) showed EVT to calculate VaR for risk management by using the maximum likelihood estimation procedure. The

EVT based method can combine the ideas from GARCH models to estimate the current volatility of the time series and EVT for estimating the tail of the innovations distribution before estimating VaR. McNeil and Frey (2000) introduced EVT based method (or conditional EVT models) to forecast VaR by using historical simulation and threshold methods to estimate the innovations distribution of financial returns. Karmakar (2013) applied this method to estimate VaR for different percentiles for negative and positive BSE India returns. Furio and Climent (2013) found that GARCH-EVT model is more accurate than the GARCH models assuming Gaussian or Student's t distribution innovations for VaR simulation analysis. Meanwhile, Allen et al. (2013) used both unconditional and conditional EVT models to forecast VaR. Marimoutou et al. (2009) found that these models perform better than other methods, such as GARCH; historical simulation and filtered historical simulation of interest involves the financial model such as the capital asset pricing model, and the Fama-French three factor model. Hence, EVT can be an alternative of an effective framework to estimate the tail of financial series of the extreme financial events, such as the Asian financial crisis, Subprime crisis and European debt crisis

### **1.3 Objectives of the Study**

The objectives of this thesis are as follows:

- 1.3.1 To apply a new portfolio selection methods under the risk and return by using entropy methods and the linear belief function with an application to international stock markets.
- 1.3.2 To apply a high dimensional copula based volatility models with extreme value theory to evaluate the portfolio's risk with applications to international stock markets that is in during the global financial crisis period and post global financial crisis period.

1.3.3 To analyze the dependence structure between the stock markets and to select the country allocations of portfolio investment.

#### **1.4 Main Contributions of the Research**

The contributions of this thesis are as follows:

1.4.1 The findings provide the appropriate methodology for the portfolio selection methods to improve the portfolio performance.

1.4.2 The findings confirm the usefulness of the copula approach based on volatility models with EVT for evaluating the portfolio's risk in the general and extreme market events.

1.4.3 The findings can be useful for the investor and financial institutions to make decisions and evaluations for an international portfolio investment. Thus, it will be beneficial to improve the portfolio's performance.



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