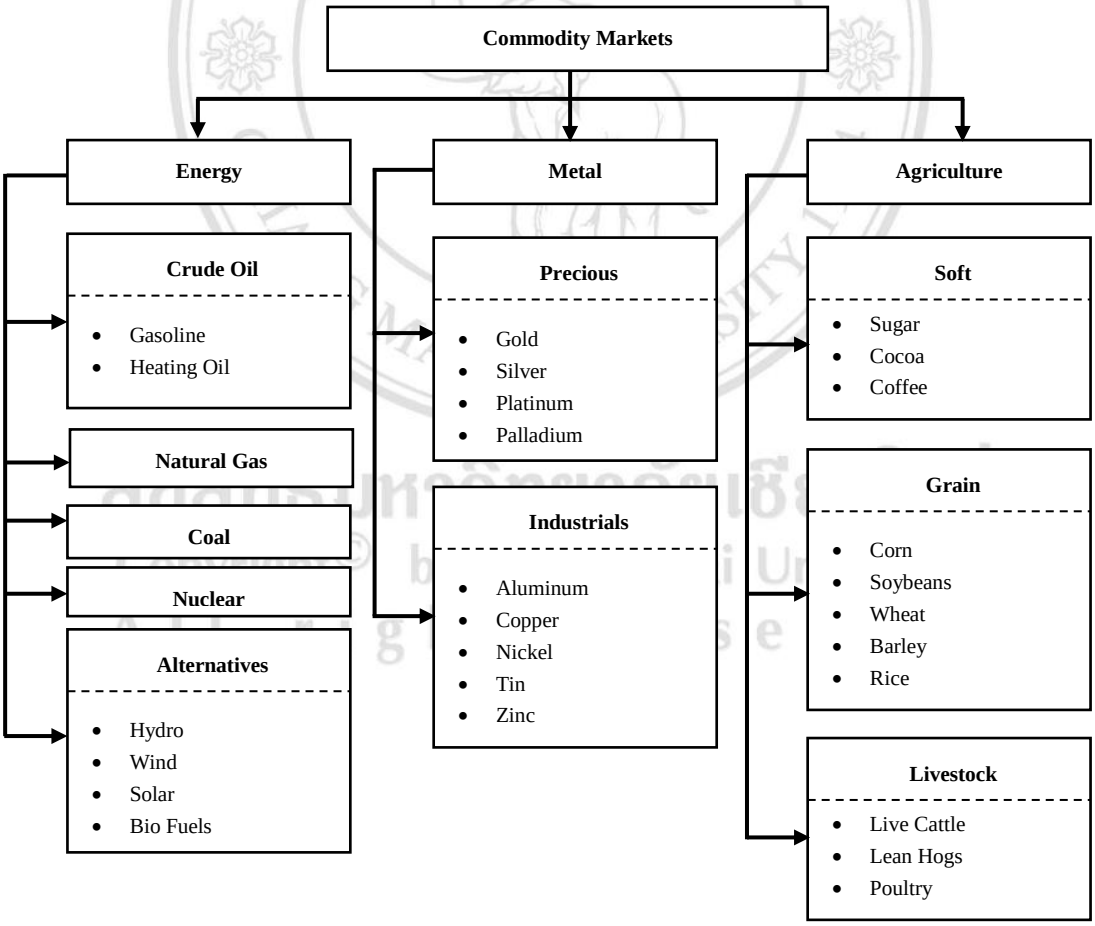
CHAPTER 1

Introduction

1.1 Principle and Rationale of the Study

Commodities are necessary to the economy of the world. For instance, rice and coffee feed global populations, metals and fuels are for driving industry, natural gas is good for the economy and the environment, etc. The commodities market is divided into three main groups consisting of energy, metals, and agriculturals which can be seen in Figure 1.1.



Source: Heiden, 2006.

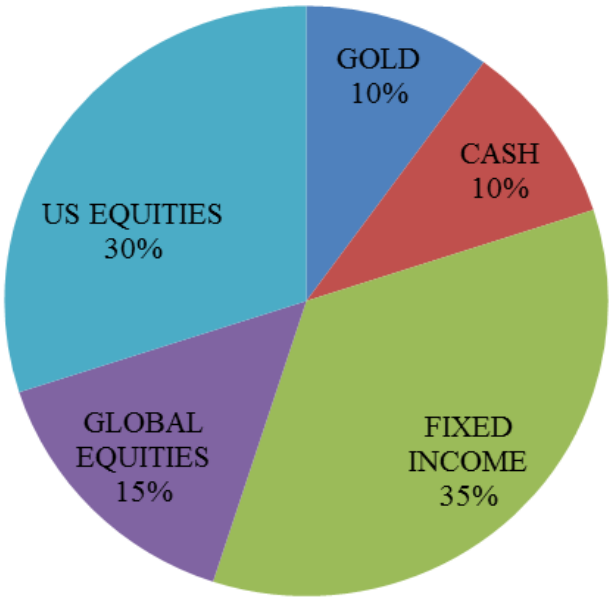
Figure 1.1 Overview of the different Commodity Types

First of all, the energy group represents the importance to driving industry, such as coal that drove industrialization through the 18th and 19th century. In terms of crude oil, it is the major natural resource of industrialized nations that generate fuel for vehicles and airplanes, and heat for driving machinery. Alternative energy, including hydro, wind, solar, and bio fuels, comes from sources which do not create pollution as fossil fuels (like oil, coal, natural gas), or do not create other materials being harmful to environment and people. Second, the commodity group is the metals which are classified as the industrial and the precious metals. Gold represents the first mentioned sub-group that played the role as a world currency and the major metal that was used in construction, building, and industries, including aluminum, nickel, lead, copper, and zinc. Finally, the third group is the agriculturals. It is divided into grains, softs, and livestock products. These commodities' characteristic is the seasonality and the sensitivity to epidemics and weather conditions. Moreover, the agriculture has a important role in all life of economy. It is associated with the production of essential food crops, and creates employment opportunities to a large percentage of the population (Heiden, 2006). All in all, it can be seen that the commodities market has a critical role in each sector and also has a significant impact on stimulating the economy domestically and globally.

In terms of commodity and financial markets, they have a high volatility, which brings both risk and opportunity to traders and investors. The volatility that occurs in commodity markets is caused by several reasons, such as the political situation or weather, that leads to supply disruptions and results in fluctuation in commodity prices. Further, the changes in demand for the industry's product using commodities as an input may lead to volatilitys in the commodities' prices.

Precious metals in the commodity markets are important for industry such as their use in jewelry, medicine, electronics, etc., which they can be expressed in term of gold, platinum, palladium and silver. In addition, the demand for precious metals is not driven only by their actual use but also by their role as a store of value and investments. Precious metals such as gold have been attracting a lot of attention because they have never been worth zero. They give the safe haven for investor in economic uncertainty and financial instability times, and they serve as a hedge against unexpected inflation. When they are included in portfolio investment, they have been described as a proven

asset diversifier; they can reduce the all-risk of the investment portfolio. Additionally, the APMEX (2012) data represents the necessity of precious metals like gold that can be one of the effective ways to balance and diversify portfolios (Figure 1.2). Because some poor situation periods such as during the decade of 2000-2009, stocks had zero or negative returns (as measured by the S&P 500), while precious metals had positive returns.



Source: APMEX, 2012.

Figure 1.2 Investment ratio of 4 main asset included gold

The illustration about the background of precious metals can be explained (FideliTrade Incorporated, 2015) as follows:

1) Gold

Gold is the famous of all precious metals. It has been recognized all over the world for its beauty, liquidity, industrial properties, and investment qualities. Normally, gold is accepted as a financial asset that will purchasing power and store its value during inflationary periods and times of social, political, or economic depression. Gold provide both institutional and individual investors a portfolio safety net that protects against a depressing situation. Gold is found around the world in more than 76 countries. In 2015, the largest gold producing country is South Africa, followed by the United States, Australia, and Canada. Since then, approximately 3.8 billion ounces of

gold is a material that cannot be destroyed. Meanwhile, approximately 432 million ounces are estimated to still exist in the investment form jewelry, bars and coins, and other decorative items.

2) Silver

Silver was a standard in the world monetary system that played a key role as both an industrial commodity and financial investment asset. Investors can buy physical silver in either coin form or bullion bar, with the metal majority presently that is bought in the Canada, Germany, and United States. In emerging markets, investment demand for silver is also unstable. However, silver tends to be held in the form of, accessories, religious, and jewelry items that easily decay. In terms of demand for manufacture, silver has many physical characteristics making it an important component in various products which is used in everyday living. The main applications of silver are in photographic films and papers, jewelry and silverware, and electrical contacts and connectors. Silver is also used in dental alloys, mirrors, brazing alloys, medical instruments, batteries, and mechanical bearings. Mexico is the largest country for silver producing, followed by the United States, Peru, and Canada. Further, silver has been accepted by some investors as a great opportunity for longer term investment strategy.

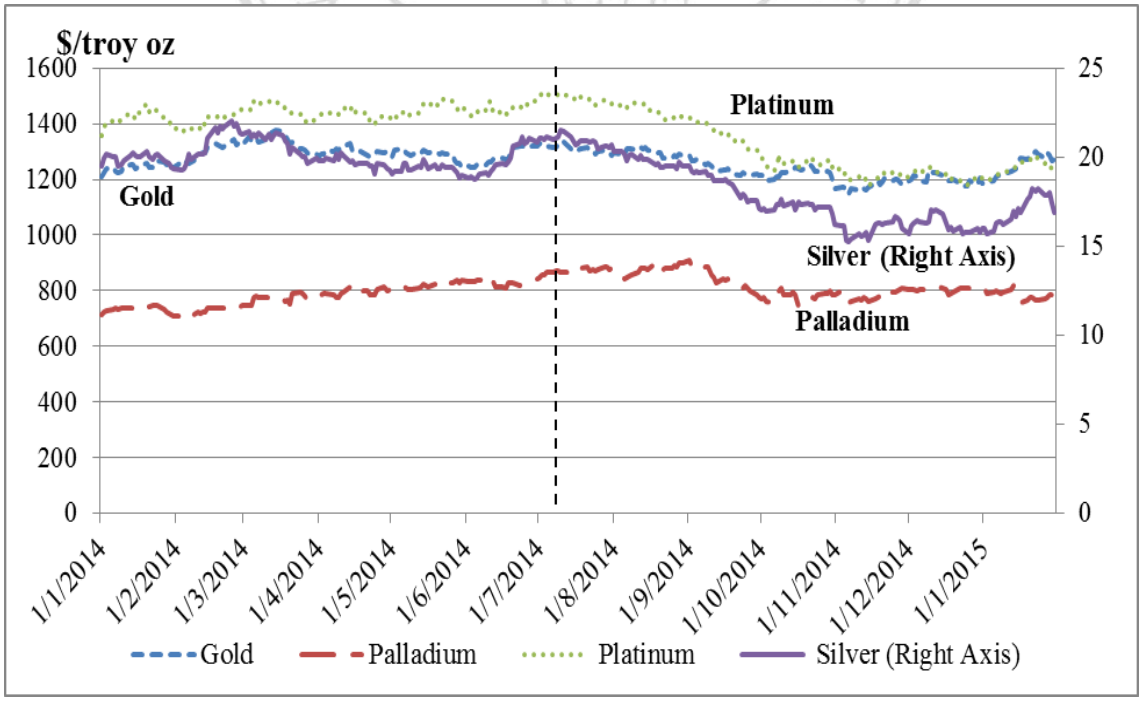
3) Platinum

Platinum is one of six metals that comprise the metals category referred to as the “platinum group metals”. The other five consist of rhodium, palladium, iridium, ruthenium, and osmium. Approximately 67% of total supply of platinum comes from South Africa, with important amounts also come from Russia and Canada as a nickel mining product. Other outstanding platinum productions include the Australia, Finland, United States, and the Philippines. Currently, platinum is consumed in the platinum jewelry production more than other application. In Japan, demand for platinum jewelry is particularly strong. Moreover, platinum is used in automotive factories designed to reduce the pollution caused exhaust and also used in petroleum and chemical refining catalysts, and in the dental and electronics sectors. Platinum is a rare item because one ounce of pure platinum is produced by ten tons of raw ore being mined for industrial usage. So, platinum has been attractive as an investment alternative to competing assets such as bonds, stocks, and currencies.

4) Palladium

Palladium is first an industrial metal and often used in a number of products as an alloy of platinum. In Russia, the world's total supply of palladium approximately 55% is produced as a nickel mining co-product. South Africa is the second largest palladium's source with smaller amounts produced in Canada followed by, the United States, Brazil, Australia, Finland, and Zimbabwe. Palladium is used in many electric components and connectors is also combined with gold such as mixed with gold to create dental alloys, and to add its corrosion-resistance properties and slow down the color of the alloy.

According to Hilliard Lyons (2015), precious metals are a good way to hedge from inflation. Concern about inflation in the future is a factor affecting commodity prices to be higher. During economic crisis times and inflation affected currency values, holding metals was spreading portfolio risk. In addition, the information of equity institutional demonstrates about holding precious metals in a retirement account which is a plan for retirement. The clients who understand the importance in diversifying their retirement investments can accumulate wealth preservation to retired security.



Source: Thomson Reuter DataStream, 2015.

Figure 1.3 Precious metal prices

Even though precious metals are a good asset to hedge from many poor situations, precious metal price still had an uncertainty situation in 2014. Precious metal prices are shown in figure 1.3, representing the average percent change of each precious metal price in 2014. This figure illustrates that silver prices decreased more than 19%, platinum prices decreased more than 11%, palladium prices increased by around 11%, and gold prices decreased only 1.4% compared with the previous year. Moreover, figure 1.3 demonstrates the prices from the first half through the second half of 2014. For the first half, the figure shows the strength of precious metal prices which increased between 7% and 17% due to a neutral US dollar and the stability of demand for precious metals. In the second half of 2014, precious metal price decreased between 5% and 25%, which US dollar strength was the main reason of the decreased price in the second half of 2014. However, silver, gold, and platinum had an increasing start to 2015 (Quarterly Commodity Outlook, 2015).

The information described above represents the importance of precious metals associated with investment and the situation of volatility that may occur in commodity markets which brings opportunity and risk to traders and investors. It is thus necessary to estimate the rate of return expected to receive and the risks of investing before making a decision.

In addition, from the risk mentioned above, the risk means the chance that a return of investment will be different from expectation. The risk is the possible losing small or large of the investment and is usually measured by calculating average returns or the standard deviation of the historical returns.

Risk management is one way to prevent the risk that may occur, which from the literature review about Value at Risk (VaR) estimating, VaR is a way to measure risk. It is an instrument in financial markets for the measurement and evaluation of the portfolio market risk associated with financial asset and commodity price movements, which represent the form of the worst loss to be expected of a portfolio over a given time horizon at a given confidence level. There are three approaches that are used to estimate portfolio VaR consisting of Historical Simulation (HS), Variance Covariance (VC), and Monte Carlo Simulation approaches.

There are many examinations about VaR which have a different application to estimate VaR, and each of these works have advantages and disadvantages. The literature review shows the works that applied VaR with other models. Hammoudeh et al. (2011) examined the volatility and correlation dynamics in price returns of gold, silver, platinum, and palladium using Value at Risk estimation. The results were useful for participants in the global financial markets that are needed for investment in precious metals at high volatility. Demiralay and Ulusoy (2014) predicted the Value at Risk of four major precious metals (gold, silver, platinum, and palladium) with FIGARCH, FIAPARCH, and HYGARCH, or long memory volatility models, under normal and student-*t* innovations' distributions. The results showed that these models perform well in forecasting a one-day-ahead VaR and have potential implications for portfolio managers, producers, and policy makers. Chen and Giles (2014) analyzed the risk of investment in gold, silver, and platinum by applying Extreme Value Theory and adopted Value at Risk and Expected Shortfall. These measures were obtained by fitting the Generalized Pareto Distribution, using the Peaks-Over-Threshold method, to the extreme daily price changes. The results showed that silver was the most risky metal among the three considered, and platinum was riskier than gold.

Bob (2013) used VaR to estimate portfolio using an approach combining Copula functions, Extreme Value Theory (EVT), and GARCH models. The result in this application had better performance than a general estimate. Besides, Ghorbel and Trabelsi (2009) used ARMA-GARCH-EVT Copula approach for estimating VaR in multivariate financial data. They found that their approach can provide a better dependence structure in the multivariate data and obtain accurate VaR estimates. However, Leonard (2007) stated that the risk measure of VaR was not an identity method in estimation because its accuracy depended on the ability to analyze the true portfolio loss distribution, and the models of estimation such as Historical Simulation or Variance-Covariance could not give accurate estimates that have high confidence level. Although Monte Carlo simulation has the advantage in modelling the loss distribution and the potential in accurate estimates, it is hard to compute for portfolios that have a high number of risk factors.

Further, Artzner et al. (1997) stated that VaR estimate cannot tell anything about the potential size of the loss, and it has some failing. They proposed "Expected Shortfall

(ES)" to measure the expected loss given which the loss exceeds VaR, and this ES closely had a relationship with VaR. Yamai and Yoshiba (2002) illustrated that ES is easily decomposed and optimized while VaR is not, and they also showed that ES requires a larger sample size than VaR for the same level of accuracy.

From the previous explanation about the pros and cons of precious metals, the occurrence of risk from investment, or the methodology for risk management, this thesis studies the risk that occurs with investing in precious metals which will focus on gold, silver, platinum, and palladium using VaR and ES estimate. VaR and ES methods were used to study precious metals market because this market also has unstable represented in Figure 1.3. The precious metal studies from literature review had only using risk analysis and forecasting data which had an advantage for hedging in the future but there was no an analysis in the optimal portfolio for precious metal. Thus, this thesis also estimates VaR and ES by applying with ARMA-GARCH models, Extreme Value Theory, and Copula model for more efficiency and precision. Moreover, we will also find portfolio optimizations based on ES and compare portfolios to choose the optimal portfolio. Because of commercial banks and individual investors, one of the major concerns is to minimize the risk of the investment portfolio.

1.2 Purpose of the study

1.2.1 To estimate Value at Risk and Expected Shortfall of precious metal price by applying Extreme Value Theory Copula Model and GARCH Model.

1.2.2 To find portfolio optimizations based on Expected Shortfall and compare portfolios to choose the optimal portfolio.

1.3 Advantages of the study

1.3.1 For Investors: The study result can be used as an advantage for those who wish to study and are interested in the investing in the commodity market and can use the study result with the investment decision.

1.3.2 For Macro unit: In the economy, the study result can indicate the estimated risk in the investment that is associated with the commodity market, which is necessary to the economy of the world and can be a recommendation to the economic development agency.

1.4 Definition

Precious metals are metals being considered to have a high economic value and be a rarity. These metals are driven by various factors consisting of their rarity, use as an investment commodity, and uses in industrial processes. Precious metals in this case consist of gold, platinum, palladium, and silver.

Risk management refers to the practice of identifying potential risks in future by analyzing risks and taking hedging steps to investigate, control, and minimize the impact of poor situation or to maximize the opportunities positive.

Value at Risk or VaR is a statistical procedure used to measure financial risk level with an investment portfolio. Risk managers use value at risk to control and measure the risk level which the firm undertakes.

Expected Shortfall or ES is a risk measure used in more specifically in financial risk measurement, to evaluate the market risk or credit risk. Moreover, expected shortfall considers the risk or loss above the VaR level.

Portfolio Optimization is the choosing various asset proportions process in order to be held in portfolio which aims to make the best portfolio.

1.5 Research Designs, Scope and Methods

1.5.1 Scope of the Study

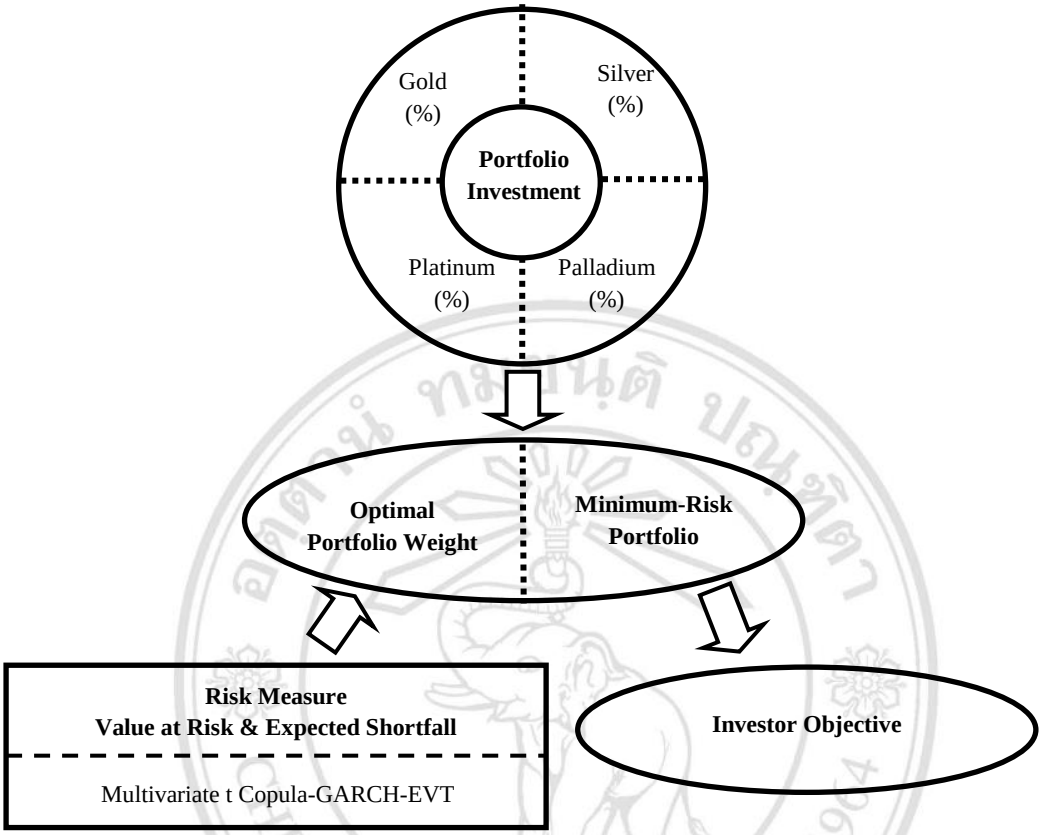
1) Content Scope

This thesis considers risk management in precious metals by applying GARCH Model, Extreme Value Theory, and Copula Model to estimate and analyze the risk, and find how to manage risks that occur in the precious metal.

2) Population Scope

The data used in this study is the precious metal price over the period 1st January 2007 to 30th June 2015. All precious metals data are traded at the London market, and their prices are measured in US dollars per troy ounce. The precious metals data in the London market are used because this market is the world's largest market.

1.5.2 Conceptual framework / Model



Source: By Author, 2015.

Figure 1.4 Conceptual framework