SYMMETRIC AND ASYMMETRIC GARCH MODELS FOR FORECASTING THE PRICES OF GOLD

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To my beloved family, for your love and support.

To my friends, for your wits, intelligence and guidance in life.

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ABSTRACT

Gold prices forecasts are of interest to many people. Gold prices however, change rapidly from period to period. In short, they are not constant. The change is not only in the mean, but also in the variability of the gold prices series. Daily gold prices per ounce, from January 3, 2000 to December 31, 2010 is used in this study with the Schwarz Information Criterion (SIC), Mean Absolute Error (MAE), Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) as the forecasting accuracy measures. For the purpose of this study, gold prices from ten major consumer countries are examined. The currencies are American dollar, Australian dollar, Canadian dollar, Swiss franc, Chinese renmimbi, Egyptian pound, Euro, Japanese yen, Turkish lira and South African rand. This study considers five models from the GARCH-family namely the Generalized Autoregressive Conditional Heteroscedasticity (GARCH (p, q)), GARCH-M, Power of GARCH (PGARCH), Threshold GARCH (TGARCH) and Exponential GARCH (EGARCH). These models are analyzed by using the E-Views 6.0 software. Several combinations of p and q values are considered to develop several GARCH (p, q) models. Using the maximum likelihood method to estimate the coefficients in the models, followed by model validation and model selection criteria, it is concluded that EGARCH (1, 1) and TGARCH (1, 1) are the best models for eight of the currencies understudied.

ABSTRAK

Ramalan harga emas menarik minat ramai orang. Walaubagaimanapun, harga emas berubah dengan pesat dari semasa ke semasa. Pendek kata, harga tersebut tidak tetap. Perubahan yang berlaku bukan sahaja dalam min, tetapi juga dalam serakan bagi siri harga emas. Harga emas harian bagi setiap auns, dari 3 Januari, 2000 hingga 31 Disember, 2010 digunakan dalam kajian ini manakala Kriteria Maklumat Schwarz (SIC), Purata Ralat Mutlak (MAE), Ralat Purata Kolerasi (RMSE) dan Peratus Purata Ralat Mutlak (MAPE) digunakan untuk mengukur kejituan ramalan. Dalam kajian ini, harga emas dari 10 negara pengguna utama akan diteliti. Mata wang tersebut adalah dolar Amerika, dolar Australia, dolar Kanada, franc Sweden, renmimbi China, paun Sterling, Euro, yen Jepun, lira Turki, dan rand Afrika Selatan. Kajian ini mempertimbangkan lima model dari keluarga GARCH iaitu Heteroskedastisiti Autoregresi Teritlak Bersyarat (GARCH (p, q)), GARCH-M, Kuasa GARCH (PGARCH), Ambang GARCH (TGARCH) dan GARCH eksponen (EGARCH). Model-model ini dianalisis dengan menggunakan perisian E-Views 6.0. Beberapa kombinasi nilai p dan nilai q, telah dipertimbangkan untuk membangunkan beberapa model GARCH (p, q). Dengan menggunakan kaedah kebolehjadian maksimum untuk menganggarkan pekali dalam model, diikuti dengan pengesahan model dan kriteria pemilihan model, dapat disimpulkan bahawa EGARCH (1, 1) dan TGARCH (1, 1) adalah model-model terbaik bagi lapan mata wang yang dikaji.

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CHAPTER 1

INTRODUCTION

This chapter provides an introduction to the current study. The background of the study is presented, followed by the statement of the problem, objectives of the study and the scope of the study. This chapter then describes the contributions made to the body of knowledge and thesis organization ends this chapter.

1.0 Introduction

In the financial market, the time series data are always changing rapidly from period to period and are not constant over time. There is a change not only in the mean, but also in the variability of the time series. For example, there is a tendency of large changes of either signs in the series to follow large changes, while small changes to follow small changes. This is called volatility clustering. Such volatility behavior is important and need to be considered in activities such as modeling and forecasting of the time series.

Many real financial time series data display periods of high volatility followed by periods of relative tranquility. This makes it difficult for management to predict future value changes. The volatility of values refers to the rate at which values change. Such time series are not easy to model using common methods. The Autoregressive Conditional Heteroscedasticity (ARCH) model and its extensions

were developed with the capability to capture volatility clustering or the periods of fluctuations, and predict volatilities in the future. The ARCH class of models, pioneered by Engle in 1982 and generalized by Bollerslev in 1986 is by far the most popular class of econometric models for describing a series with time-varying conditional variance.

1.1 Background of the Study

In financial time series, when the variances are not constant, the emphasis has been given on forecasting the volatility or the time-varying conditional variance of the series. Volatility forecasts are important for many financial decisions such as the issues for policy makers, option traders and investors.

ARCH, which stands for Autoregressive Conditional Heteroscedasticity is used to capture the volatility without the assumption that variances and the error terms will be constant over time. A generalized model of ARCH, called GARCH, which stands for Generalized Autoregressive Conditional Heteroscedasticity is a commonly used process in the areas of finance and economics. It is regularly used in the analysis of time series data especially in the financial applications because it can capture volatility clustering and predict the periods of fluctuations in the future. GARCH uses past variances and past variance forecasts to forecast future variances. It has been shown to provide accurate forecasts of variances and covariance in assets returns. In other words, it has the ability to model time-varying conditional variances.

The current study aims to investigate the potential of the symmetric and asymmetric GARCH-type models to handle volatility, model and forecast the variance of financial and economic time series over time. It aims to do so by analyzing the major consumer countries in the gold market. For the purpose of the study, ten years daily data of 10 major consumer countries in national currency unit per troy ounce, from January 3, 2000 until December 31, 2010 will be used as the case studies. As identified in the literature, gold prices are not easy to model using common methods. The gold prices have been reported to range widely since 1968.

Gold is identified as a hedge against fluctuations in the U.S. Dollar market. In the past, when the USD rates went down, the gold prices remained. It was found that the gold prices were always moving in the opposite direction to the US dollar.

1.2 Statement of the Problem

Some volatile financial time series behave more or less the same. Their periods of volatility and tranquility are almost similar. They also occur at almost the same time. The current study will explore the following research questions:

Given the ability of GARCH to capture volatility, how far can GARCH models and its extension, namely Exponential GARCH (EGARCH), Threshold GARCH (TGARCH), Power GARCH (PGARCH) and GARCH-in-Mean (GARCH-M), be used to observe the time series data where periods of volatility clustering are highly persistent? What are the differences between symmetric and asymmetric GARCH models?

1.3 Objectives of the Study

The purpose of this study is to develop a model that can be used to forecast gold prices precisely. In an attempt to find the model, some specific objectives are needed. They are as follows:

a) To explore the symmetric and asymmetric GARCH-type models.
b) To develop verifying criteria for the best GARCH models of the gold prices.
c) To examine the performance and efficiency of symmetric and asymmetric GARCH-type models.
d) To develop a framework for modeling volatility using GARCH-type models.

1.4 Scope of the Study

The current study is based on the GARCH family models. The study focuses only on selected symmetric and asymmetric GARCH models which include EGARCH, TGARCH, PGARCH, GARCH and GARCH-M. Only these models are considered since they have been identified by the literature to be more appropriate for the time series in the financial markets. This study focuses on the performance of GARCH model in capturing volatility information in forecasting volatile time series. The data series used in the current study are ten years official daily data of 10 major consumer countries in national currency unit per troy ounce, from January 3, 2000 until December 31, 2010. The gold prices data are drawn from the large and active London market, obtained from the World Gold Council (WGC). The World Gold Council (WGC) is an association of the world's leading gold producers dedicated to the promotion of gold. Analyses and programming will be written using the E-Views software.

1.5 Limitation of the Study

This study was embarked in 2007. Thus the models reviewed are limited to those up to the year 2007.

1.6 Contributions of the Study

In the attempt to find a model that could give precise gold prices forecasts, contributions are made. When volatile financial time series can be verified, symmetric and asymmetric GARCH models are developed to forecast the series whether gold prices volatility depend on any external factor.

Through a case study, the ARCH model is investigated to ascertain its potential in modeling volatility. The guidelines for choosing and evaluate GARCH-type models will be developed. These guidelines will be useful for the purpose of this current research as well as for those conducting a similar study. It is needed since ways and procedures on how to identify the symmetric and asymmetric GARCH cannot be found in any literature. The details and characteristics of them can be found in Chapter 3.

The analyses and forecasting of the models will be performed using E-Views. Using this software, one-step ahead forecast for in and out-sample data will be produced.

1.7 Thesis Organization

This thesis consists of five chapters. Chapter 1 is an introduction to the current study. It describes the introduction to the current study, followed by the background of the study, statement of the problem, objectives of the study, scope of the study and limitation of the study. It then describes the contribution of the study and thesis organization ends this chapter.

Chapter 2 is a literature review of the current study. The purpose of this chapter is to review previous studies which are related to the current study. The current study focuses on GARCH-type models. The focus areas of the current study are pricing and exchange rates. Gold returns are chosen as case studies and an overview of gold market ends Chapter 2.

Chapter 3 is the research methodology for the current study. Five types of symmetric and asymmetric GARCH models which are GARCH, EGARCH, TGARCH, PGARCH and GARCH-in-Mean are discussed in this chapter. Characteristics of data that can be used in such models are presented.

Chapter 4 presents the application of five types of GARCH models to daily gold prices data and evaluates their respective performances. Finding appropriate models for volatility is of interest for several reasons. One of them is that volatility plays an important role in an investor'sdecision making process. Volatility is not only of great concern to investors but also to policy makers and regulators who are interested in the effect of volatility on thestability of financial markets in particular and the whole economy in general.

Chapter 5 presents the summary and conclusions made from the study. Suggestions for future study end this final chapter.

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