Chapter 6

Conclusion

6.1 Summary of the Study

In this dissertation, the fractionally integrated and the alternative long memory conditional volatility models are employed for financial assets volatility such as the individual stock returns and the stock price indexes. These linear models are commonly used and tested models for capturing long memory in volatility.

To investigate an appropriate volatility model and correlation among volatility of different assets, the daily data of the ten most active trading value stock prices traded in the Stock Exchange of Thailand (SET) are implemented. In addition, to investigate for long memory property in asset volatility and volatility applications, the daily indexes based on four stock markets namely, Indonesia, Malaysia, Thailand, and Singapore in South-East Asia are used.

The univariate GARCH and Multivariate GARCH are compared to determine correlation between asset pairs.

The empirical results of the univariate volatility -- GARCH and GJR -- models evidence the leverage effects occur in stock volatility for most return series. Therefore, in the long run, the asymmetric volatility model, -- the GJR model – is superior to GARCH model. The empirical evidence of the multivariate model, the Constant Conditional Correlations (CCC) model employed to observe increasing correlation in terms of market situations for large systems of time series shows that the estimated correlations among stocks are all positive between 0.32 and 0.63. The Dynamic Conditional Correlations (DCC) model is used for the conditional correlations are not constant or time-varied. The empirical results show moderate correlations between the ten assets in portfolio. All correlations are positive. By the way, the positive correlations would yield potential gain from investment and hardly to diversify risk for the portfolio. From the DCC model, the conditional correlations between the ten stocks are time-varyied.

Moreover, to incorporate volatility spillover effects, the VARMA-GARCH model is used. The evidence for the highest volatility spillovers is BANPU which would affect volatility of most stocks. The asymmetric effects analyzed by the VARMA-AGARCH model are statistically significant in five stocks named KBANK, PTT, PTTCH, SCB, and TTA. This means positive and negative shocks have the same impact on conditional volatility. Therefore, the VARMA-AGARCH model which captures the asymmetric effects is superior to the VARMA-GARCH model.

In conclusion, the analyses of the multivariate volatility models for portfolio in Thailand demonstrate the correlation among volatility of different stocks. The VARMA-AGARCH model which can capture the asymmetric spillovers effects is appropriate in volatility modelling for asset returns.

A feature of asset returns, financial time series could capture is volatility persistence. A shock in volatility with long memory called long run persistence of shocks. It is important to justify whether daily data has long memory. In VaR calculation, voltility is measure daily in order to obtain a clear economic interpretation, such as trading strategies. The long memory property of financial asset volatility has become important implications for volatility modelling and forecasting by using daily data.

This dissertation evidences the long memory in the stock market volatility. The results suggest that the fractionally integrated models for long memory are preferred to conditional volatility models, GARCH models. Especially, ARFIMA-FIEGARCH model is superior to ARFIMA-FIGARCH and ARFIMA-GARCH models. In extension, the HAR model of Corsi (2009) is used to confirm the long memory properties in the data. This model measures the interrelations of volatility over different time horizons and permits to reveal the dynamics of the different market components. This HAR can capture long memory since the study showed that volatility over longer time intervals have stronger influence on those over shorter time intervals than conversely.

The empirical estimates in stock indexes, GARCH(1,1) and GJR(1,1) for the HAR(1,5) models are preferable. Therefore, the long memory properties of the data are captured adequately and the conditional volatility is sensitive to the long memory of the conditional mean specifications.

For volatility applications, Value-at-Risk (VaR) forecasts are illustrated in this thesis. VaR is a well-known instrument in risk management. VaR is the 1% quartile of the lower returns distribution (a negative return).

The VaR for the single-index models and the long memory -- the fractionally integrated and the HAR -- models are estimated under the normal distribution assumptions and *t*-distribution. The estimations showing the fractionally integrated models are preferred to conditional volatility GARCH-type models for volatility estimations in portfolio returns. From the highly statistically significant estimations, the FIGARCH model performs far better for volatility modelling and VaR.

To find an appropriate model for VaR, the size of the average capital charge and the magnitude of the average violations are used to compare the forecasting performance of both the univariate conditional volatility and the long memory models. In the context of daily capital charges, it was found that the conditional volatility models under the normal distribution assumptions lead to lower average daily capital charges by taking into account the Basel Accord penalties while higher number of violations. In contrary, the conditional volatility and the long memory models under the *t*-distribution lead to lower number of violations. There is a trade-off between the number of violations and daily capital charges -- a higher number of violations leading to a higher penalty and lower daily capital charges through lower VaR. However, it is not clear which model is appropriate for capital optimization. Penalties imposed under the Basel Accord are too relaxed, and tend to favour models that had an excessive number of violations. The numbers of violations should be highly considerable in the sense of accuracy VaR forecasts.

6.2 Suggestions for Further Study

The volatility modelling and forecasting literature is still very flourish. There are several points where future research could seek to make developments. First, forecast evaluation from the well-performed volatility models could be conducted. Sometime, it is not clear which model is far better. Therefore, the other models could not be ignored. The combining forecasts of different models as a linear combination of all the forecasts would improve further forecast accuracy.

The second is about the new frontier in volatility that improves both time series methods and understand better the other causes of volatility such as trading volume, market behavior, and trading decisions. Therefore, understanding the market trends and behaviors is necessary to volatility forecast accuracy.

Furthermore, studying a broader economy and financial market in term of market size and complication in structure of various assets, would increase the international linkage among countries. Therefore, the study to measure volatility should not conduct only in the single equation or single asset but also in the multiple assets. Moreover, the dynamic or time-varying volatility and nonlinear models are also the importance of the volatility frontier to improve forecasting performance, McAleer *et al.* (2009) develop the multivariate conditional volatility to capture the asymmetric and spillovers effects for multiple assets.

For the long memory property in financial time series, process with long memory volatility is usually obtained by employing fractional difference operators as in the class of FIGARCH models. There are some problems with the fractionally integrated models. Fractional integration is easy for mathematic but hard for a clear economic interpretation. It is not trivial to estimate and not easily extendible to multivariate process and not able to reproduce the multifractal behavior. Corsi (2009) introduces the Heterogeneous Autoregressive model to replicate the stylized facts and simplify the estimation of long memory process which possibly posses a clear economic justification and interpretation. The simple additive volatility models could be extended to multivariate process.

Finally, the dissertation considers only model-based volatility measures and applications from the univariate conditional volatility models, the fractionally integrated and the alternative long memory models. The VaR computation described in this thesis is explored for multi-asset as the portfolio returns as a univariate variable, so called single index model in McAleer and da Veiga (2008a, 2008b). This approach does not provide insight about the tail relationship between assets, so the portfolio VaR by the multivariate approach for the conditional correlation coefficient, the key measure used in portfolio diversification, would continue as mentioned.