CHAPTER 6

CONCLUSION

6.1 CONCLUSION

A large amount of empirical evidence infers that hedging strategy is a dynamic process. Hedgers will use the surrounding information to decide the proportion of spot position that needs to be hedged at that point of time. Over time, investors are likely to hedge less or sometimes hedge more. Because of this dynamic process, this research intends to investigate the hedging performance results using various dynamic models. Further, the research introduces the effect of a structural break in volatility modelling, and then relates the effect to the consistency of hedging performance measurement analysis. The assumptions of no transaction cost, one period hedging strategy and FCPO prices as unbiased predictors for future expected CPO prices were considered in developing the dynamic models for the research analysis.

6.1.1 Different Mean and Variance Specification vs Hedging Performance

In the beginning, we were interested to investigate the effect of various mean and variance specifications in hedging performance measurement within the CPO market. Hence, we adopted the Intercept, VAR and VECM mean models across BEKK, CCC and DCC models in this investigation.

Based on the risk minimization evidence, the Intercept-BEKK demonstrated a larger risk reduction in three forecasting periods (5, 15 and 20 periods) for the in-sample estimation and the 20 forecasting period for the out-sample estimation. The results reveal that Intercept-BEKK estimates that <10% to 70% of risk reduction can be achieved by hedgers during the tested forecasted period. Subsequently, this evidence contends the superiority of the ECM model demonstrated by Kroner and Sultan (1993), Yang and Allen (2004), and Ford, Pok and Poshakwale (2005). Similar findings were established in the mean-variance context, where the Intercept-BEKK gave the best risk and return trade off performance against the other estimated models. Moreover, the results additionally support that the DCC model generates the second highest investors utility function followed by the CCC model.

Hence, we agree that a different specification imposed in the dynamic modelling process will provide different hedging performance results. The findings have proved that the Intercept-BEKK model gives a promising performance for both minimum variance and mean variance measurement. As such, although we acknowledge the different performance results generated by the various GARCH models the magnitude is modest.[25]

6.1.2 Structural Breaks Effect vs Hedging Performances

We further illustrated the structural break effect on the hedging performances measurements using parsimony GARCH models (Intercept-BEKK model). Since

[25] i) Across the mean models, and ii) across all the out-sample estimation models.

empirical evidence highlights the significance of identifying the correct number of structural changes and the exact break date, we employed the Bai and Perron identification test for mean series, while the IT-ICSS and Modified IT-ICSS techniques for variance series and, finally, the GrengoryHensen Test in the cointegration relationship. Furthermore, to maintain parsimony features, we modelled the structural changes in the Intercept BEKK model. We extend the break effect towards hedging performance within the minimum variance and mean variance context.

The structural breaks identification tests prove the existence of structural changes in both the mean and variance for the CPO and FCPO series. The identification results detected two structural breaks (December 1998 and July 1999) in the tested series mean. The regime shifts were identified during the post-Asian financial crisis, and the higher level of CPO production during that period. However, only four regime shifts were recognized in the FCPO variance series, dated October 1996, July and October 2001, and March 2008. Obviously, the volatility breaks were during the pre-Asian financial crisis, Post-Terrorist attack, Global Recession Period, and the volatility in CPO production. Based on the volatility clustering results, we infer that by omitting the regime shift it will fallaciously estimate the volatility persistency parameter.

Furthermore, based on the hedging ratio estimation results, the BEKK-SB model generated a stable hedging ratio and risk reduction results within the tested forecasting period. Additionally, the hedging performance evidence proves that the BEKK-SB maintains a better performance for both the degree of risk reduction and the utility

investor function measurement. Within the in-sample analysis, the results show that a 23%-43% risk minimization can be attained by the hedger, and 43%-46% within the out-sample analysis. Furthermore, the findings prove that the utility function of the hedgers did change, and that an average of 37% utility improvement can be achieved for the BEKK-SB model. However, for the out-sample analysisit is slightly lower than the in-sample analysis with an average of 27% hedgers' utility improvement.

6.1.3 Structural Breaks Effect vs Hedging Performances Consistency

Using both the general BEKK and BEKK-SB estimation results, we extend the investigation to identify the consistency of hedging performance demonstrated via hedging across 1996 to 2008. In order to illustrate the consistency of hedging performance investigation, we used the minimum variance framework, commonly referred as the risk reduction measurement. We have divided the full sampling period into six sub-periods to cater for Ex-ante Asian Financial Crisis (January 1996 to June 1997), During Asian Financial Crisis (July 1997-August 1998), Ex-Post Asian Financial Crisis (August 1998-December 1999), Technology Bubble (January 2000-September 2001), Ex-Post Terrorist Attack (September 2001-December 2002) and Oil price volatility [January 2003 onwards:1a) Pre-Mortgage Sub Prime (Pre MSP): January 2003-December 2006 and 1b) Mortgage sub Prime or Global Economic Crisis: January 2007 onwards] and we analyse the hedging ratio and the strategy consistency performance using the statistical properties throughout these sub-periods.

Among the six sub-periods, the BEKK-SB estimated that the market participants hedged 46% and 41% of their CPO position during the pre-Asian financial crisis and pre-mortgage sub-prime crisis period, respectively. However, a higher percentage was reported during the other sub-periods (53% to 55%). When the market was more tranquil, the BEKK-SB exhibited an almost similar hedging ratio with the non-break ratio. A consistent and smaller estimation range was generated from the BEKK-SB across the six sub-periods against the general model.

In the hedging performance consistency analysis, the non-break model tends to upward bias estimates for the risk reduction vis-à-vis the BEKK-SB model in a volatile market (Asian Financial Crisis and Global Economic Recession period). In the Pre Mortgage Sub-Prime period, both models indicate a similar risk reduction of almost 26% for CPO hedgers. In addition, the BEKK-SB shows marginal superior risk reduction performance during the Pre- and Post-Asian Financial Crisis, Post Terrorist Attack and Technology Bubble. When the market was less volatile, both models estimated an almost similar degree of risk reduction but not when the market was more volatile.

Generally, when potential structural changes are not considered in the second moment clustering modelling, we tend to overestimate the volatility persistency. In addition, the overestimate persistency will further translate into spurious hedging ratio and hedging performance. A less precise hedging ratio will make the hedger misinterpret the optimal proportion of futures contracts needed and may lead to

inaccurate hedging performance results. Hence, we can comfortably assert the importance of a structural break in hedging performance measurement. The non-trivial function of a structural break will not only influence the volatility persistency accuracy, but also tend to posture a more precise hedging ratio and hedging strategy performance evaluation. Hence, the structural break does matter in measuring the correct consistency of hedging strategy performance over time.

From the above findings, intuitively a general GARCH model without any structural breaks may potentially overestimate the hedging performance during a volatile market. However, an inverse finding is reported when the market is stable. For the hedging ratio results, consistent with extensive empirical evidence, we support the time varying hedging ratio characteristic. As the hedging ratio has a dynamic process, it is expected that the hedging performance also changes over time. It should be noted that at sometime within the sampling period, hedgers have almost no protection via hedging in the CPO market, however, this is only in very exceptional cases.

Overall, by hedging, market participants are able to maintain an average of 26% to 40% of variance reduction for BEKK-SB and, 26% to 42% for the general BEKK model. Therefore, we determine that hedgers can maintain the consistency of risk reduction performance regardless of whether the CPO market is explosive or not. In any economic climate that may translate into unfavourable price movement, the hedger is able to obtain a profit situation in one market (either in futures or spot market) that can further minimize the losses suffered in another market. Hence, such a position is able to

reduce the overall price risk exposed by the CPO market participants. Ultimately, we can confirm that the consistency of hedging performance evidence is equivalent to the hedging theory.

6.2 CONTIRIBUTIONS AND FUTURE RECOMMENDATIONS

6.2.1 Contributions and Future Recommendations

The research provides empirical evidence concerning hedging performance measurement for an emerging CPO market. From the overall research findings, we can conclude the following contributions and recommendations:

6.2.1.1 Academicians

i) Various specifications in the GARCH dynamic models may influence the degree of risk minimization and investors utility function. Therefore, future researchers should exercise extra caution in imposing various specifications in those dynamic models. Furthermore, a more complex model may not guarantee the best hedging performance results. In addition, sometimes the performance measurement is merely low, therefore, a parsimony concept should be adopted in the model development process.

ii) When the tested series has experienced some regime shift, this must be included in the dynamic modelling process. Without the shifts, researchers will have a tendency to upward bias the volatility persistency. The structural break effect worsens when the research is interested in estimating the hedging ratio and performance

measurement. Since the omission of these breaks may translate into an erroneous hedging ratio estimation (hedging decision), it will lead to inaccuracy in the hedging performance results. Therefore, to get more precise hedging performance measurement results, future researchers should include these breaks (with the correct number of breaks and the exact break date) in their modelling process.

iii) Future researchers can also consider the transaction cost elements in hedging performance measurement models, as our model does not cater for transaction cost. In addition, we would suggest that future researchers explore the performance of multi-period hedging strategy in many emerging commodity markets since this strategy was rarely explored by earlier researchers (only Brailsfrod *et al.,* 2001, and Haigh and Holt,2002 investigated in developed futures markets). In this research, we focus on one commodity market as the unit of analysis, hence, future researchers should consider the hedging performance investigation across multi-market evaluation. Furthermore, instead of measuring the hedging strategy performance in market level (either in finance or non-finance market),we suggest that similar hedging performance evaluation can be done but at a firm level (for example oil and gas firms, plantation firms, etc.).

6.2.1.2 Practitioner

In any form of economic climate, a consistent risk reduction can be attained by CPO market participants (on average of 26%-42% risk reduction) via hedging strategy. In practical point of view, assuming the CPO buyer is exposing a 10% increment in CPO

price. Such price increment will result in higher purchasing cost for CPO buyer. Therefore, by engaging in hedging strategy, the buyer able to reduce the additional cost exposure up to 5.8%. As such, CPO market participants should consider this strategy as one of their risk management techniques to mitigate CPO price volatility. In addition, the findings infer that hedgers tend to hedge less than 46% of their spot position during a stable sub-period and acquire smaller coverage during that period. However, during a volatile period, they tend to hedge higher (above 50% of their spot position) and gain larger risk protection. Intuitively, assuming CPO buyer has 10 CPO contracts and currently they anticipate a higher volatility movement in the CPO market**.** As such, the CPO buyer need to hedge more than 5 CPO contracts in order to gain higher risk protection during such volatile period.

6.2.1.3 Government and Regulators

Based on the research findings, hedging in the CPO market provides a sustainable risk reduction either in an explosive or stable market condition. This evidence can be used by the policymakers to materialize the hedging benefits to the existing market participants. They can disseminate the benefits of hedging strategy to investors via seasonal seminars and workshops across Malaysia. The empirical findings can be used by policymakers to promote this risk management technique and enhance the practitioner's awareness of the simplicity and effectiveness of this strategy in reducing the market participant's commodity risk exposure.

6.3 RESEARCH LIMITATIONS

The above research is however subject to few limitations. First, the research focused on modelling the hedging performances that give the best hedging performances results in CPO market and introduced the structural break effect in the modelling process. The dynamic models used are subjected to few assumptions or limitations include i) no transaction cost, ii) FCPO prices as an unbiased predictor for CPO and iii) maintaining a one period hedging strategy . In addition, since an econometric model is highly sensitive with the sampling selection period, it is foreseen that a different tested period tends to give different estimation results. It is also noted that previous researchers demonstrated many ranges of econometric modelling (eg. asymmetric and Markov switching models) to estimate the hedging performances. But a different model used by researcher will generate a different performance results. Due to that, the research does not wish to cover the asymmetric model (refer Lien, 2004), and Markov switching model (Lee and Yoder,2007). Second, the researcher acknowledges the fact that differ result may be generated if the study used the FCPO-3 month contract as compared to FCPO-1 month contract. However, since there are almost 400 missing observations in FCPO-3 month contract, hence for the purpose of this research we used the second most actively traded contract that is FCPO-1 month contract. Third, the research identified the best hedging performance measurement by comparing the forecasted risk reduction and mean variance tradeoff results. Thus, there is no statistical evidence provided in testing the best performance model selection.