AIC 2018: EMERGING ISSUES IN ECONOMICS AND FINANCE

Dependence Modelling using GARCH, EGARCH, and Copula Models: A Case Study on Malaysia Stock Markets

Nurul Hanis Aminuddin*
School of Mathematical Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

Ruzanna Ab Razak
Quantitative Methods Unit, Faculty of Management, Multimedia University, 63100 Cyberjaya, Selangor, Malaysia

Noriszura Ismail
School of Mathematical Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

*Corresponding author’s Email: nurulhanis.fst@gmail.com

Peer-review under responsibility of 4th Asia International Conference 2018 editorial board
(http://www.utm.my/asia/our-team/)
© 2018 Published by Readers Insight Publisher,
Lat 306 Savoy Residencia, Block 3 F11/1, 44000 Islamabad, Pakistan,
info@readersinsight.net

This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Research Highlights

The research results show four important findings. First, the Islamic and conventional pair have similar characteristics such as leptokurtic and have negative returns. This finding is in line with past study from Razak, Ismail, and Aridi (2016). Secondly, the KLCI-FBMHS pair experience strong correlation and positive relationship. This signify that the co-movement between both indices are weaker during the crisis period as compared to the normal period. Besides, the diversification between Islamic-conventional pair is worthwhile during stable period. Thirdly, the ARMA-EGARCH outperform ARMA-GARCH model and the time-varying Gaussian copula is chosen as the best dependency model for this study. It can be concluded that there are asymmetric effects for Malaysia indices and the time-varying dependency model is more appropriate as compared to static copula. Finally, the results imply that different input models (ARMA-GARCH and ARMA-EGARCH) have identical dependence structure but slightly different value of parameter estimated.

Graphical Abstract

Figure 1: Graphs of dependency by using dynamic copulas with a) ARMA-GARCH models and b) ARMA-EGARCH models for KLCI-FBMHS pair
Research Objectives

According to Ning (2010), wrong specification of marginal models will result in inaccurate estimation of copula model and negligence of some stylized facts. Hence, this study will consider few models as an input model including: ARMA model to estimate conditional mean components, GARCH and EGARCH models for the estimation of conditional variance part, and four type of error distributions to capture the fatter tails issue. Hammoudeh et al. (2014) stated that dynamic copula is more appropriate as compared to its constant version due to the occurrence of financial events. Therefore, this study will also investigate either dynamic copula model outperforms its constant version or vice versa with the uses of KLCI (conventional) and FBMHS (Islamic) index as a sample data. This paper also discusses the current trend of Malaysia stock markets and the dependency of Islamic and conventional series. Specifically, this paper will inspect the impact of input models towards the parameter estimation of marginal and copula models for KLCI and FBMHS returns series by considering the ARMA-GARCH model and the ARMA-EGARCH model. This study also investigates the dependency of Islamic-conventional pair for Malaysia indices by using static copula and time-varying copula approach.

Methodology

This paper employs Inference Function of Margin (IFM) approach as proposed by Joe (1997) to estimate the dependency of bivariate data. The IFM method involving two phases which are estimates the best marginal model for each univariate series and measuring the dependency by using static and dynamic copulas. The closing prices of Malaysia indices represented by KLCI (conventional) index and FBMHS (Islamic) index for the period of 21 May 2007 until 28 September 2018 are used as a sample data. Due to the existence of stationary issue, the closing price series were transformed into returns series. Besides, to tackle the stylized facts such as volatility clustering, leverage effects, and fatter tails, we use ARMA-GARCH model and ARMA-EGARCH model with four type of error distributions (normal, student $t$, skewed normal, and skewed student $t$) as input models. Next, we extract the residuals of selected marginal models for KLCI and FBMHS series and convert it into pseudo observations. Finally, Gaussian copula, Symmetric-Joe Clayton (SJC) copula, and their dynamic version are employed to measure the dependency between KLCI-FBMHS pair.
In order to choose the best model, this paper referred to the lowest value of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

Results

The preliminary analysis shows that KLCI and FBMHS index have negative mean and median. Besides, the value of mean for KLCI index is somewhat higher as compared to the average value of FBMHS index. However, the value of coefficient of variation and standard deviation for Islamic index are slightly higher than its conventional counterparts. In term of distributions, both indices experiences; the value of Kurtosis more than 12, the skewness value greater than 0, and the p-value of Jarque-Bera (JB) test are significant. The AR(1)-GARCH(1,1) and the AR(1)-EGARCH(1,1) with $t$ distributions well-fitted KLCI and FBMHS index. The results of marginal model for both series are; the sum of alpha ($\alpha$) and beta ($\beta$) parameter for GARCH model are close to one, the parameter of leverage effects is significant and positive, the value of Ljung-Box Q-statistics test and Langrage Multiplier test are not significant, and ARMA-EGARCH outperform ARMA-GARCH model. In term of dependency, the value of parameter $\delta$ are close to one for Gaussian copula, the upper tail of SJC copulas are slightly greater than lower tail, the value of $\omega$ are higher than $\beta$ for time-varying Gaussian copula, and the value of parameters $\omega^t$ are lower than $\omega^u$ for time-varying SJC copula.

Findings

Generally, both series have leptokurtic distributions and high persistence volatility. Besides, KLCI and FBMHS series is strongly correlated. The findings are consistent with Aminuddin, Razak, and Ismail (2018). This paper also highlights some important findings including; the KLCI index is riskier than FBMHS index, the Islamic series is slightly more volatile than its conventional counterparts, the previous day’s return for Malaysia indices affects the current return, positive events greatly influence the volatility of future index as compared to negative
events, and the structure of dependency for both (upper and lower) tails has slight change over the period of study.

Acknowledgement

Thanks to the institutions (Universiti Kebangsaan Malaysia and Ministry of Higher Education) who supported this research under the grant number GUP-2017-011. We also like to express our appreciation to the reviewers for their recommendations.

References


