PORTFOLIO OPTIMIZATION UNDER MARKET UPTURN AND MARKET DOWNTURN: EMPIRICAL EVIDENCE FROM THE ASEAN-5

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Abstract – The objective of this study is to explore the dependency between stock, commodities, and bond to find an optimal portfolio allocation during market upturn and market downturn for each five ASEAN countries such as Thailand, Singapore, Malaysia, Indonesia, and Philippines by using Markov Switching Copula model. We are interested in examining whether comparison between “having regime switching” and “without regime switching”, which one can be better estimation for each markets? The results found that Thailand, Singapore, Malaysia, and Philippines were fit well without regime switching on conditional student-t copula distribution, thereby oil can serve as safe haven for Thailand, wheat for Singapore, bond for Malaysia, and wheat for Philippines, respectively. Only Indonesia was fit with regime switching on conditional normal copula distribution. Therefore, bond indicates to be the best defense asset in market downturn from gold and market upturn from JCI (Stock index) respectively.

Keywords – Market upturn-downturn, Markov Switching Copula, ASEAN 5, Stock market, Commodities market, Bond market

I. INTRODUCTION

ASEAN-5 are the first established collaboration between five leading countries in the ASEAN community to achieve economic integration. It comprises of 5 nations from Malaysia, Indonesia, Philippines, Thailand, and Singapore. The financial system of ASEAN community is driven by these five countries. ASEAN-5, an emerging market, has been attracting a lot of investors who expect a high return on investment. Normally, foreign investors prefer to hedge risk from their domestic investment, especially
during the recession, by moving to invest in emerging countries such as ASEAN-5.

In 2014, [5] found an increasing of stock market of Thailand SET index rise to 20.18%, 18.14% in Indonesia JKSE index, and 22.7% in Philippines PSE index which are higher than 2.68% in Global Down. It implied that capital market of ASEAN are continue growing. This refers to the theory of Keynes that people will need to speculate their wealth with expectation on returns from yield (profit from dividend) and capital gains (a price higher than purchasing price) to protect the income shock and uncertainty of financial system.

There was an evidence that interprets to the correlation of commodities and traditional assets prices if they were the opposite directions of each other. By the way, there was also an identification to the correlation of the traditional assets whether they were the same direction between stock and bond [5]. Another evidence were during Asian currency crisis in the middle of 1997, there was the inverted correlation of the traditional assets between bonds and stocks which was vary from the previous evidence as mentioned before. This situation led the investors intended to sell stocks and buy bonds when bond prices were rising during economic recession.

There was the historical study revealed to gold evidence since the world stock market crash in 1987 that gold was using to hedge against the diminishing of equity markets that led gold price appreciate at that period of time. The correlation between gold and stock were opposite directions of each other. Thus, gold was often believed that it was an optional asset to diverse risks from stock collapse.

In accordance the relationship between oil and gold market, they are positive correlations, but oil is negative correlation with stock trends, a recently literature of [9] found the significant positive correlation coefficient between oil and gold price are 0.9295 during 2000-2008. This implies that oil and gold are a coherent relationship with each other.

As the correlation of oil and wheat is that oil caused grain prices increased as the same direction. Also, oil prices had the relationship with U.S dollar, when oil prices increased, it led U.S dollar depreciated therefore it was a reason to increased supply in different types of grain, especially wheat [7]. So, the correlation between oil and wheat was not the opposite direction.

Moreover, there was an evidence of the traditional assets as stocks and bonds that they were a hedged assets of each other and they were able to maintain the value of wealth and increase transactions of money across assets. By the way, they are the alternative assets that better obtain expected return than normal deposit at the bank [4]. The investors therefore use notes and stocks to trade off returns as saving assets due to the expectation to increase the future interest rate, and returns from the gap of rising stock prices (capital gains). By the way, the correlation of bonds and stock are also extremely determined by uncertainty of expected inflation and expected interest rate relative to macroeconomic factors. This will significant to the investor decision to allocate assets on their portfolio [2].

Also, there were demonstration of the dependency between assets allocation that pointed out the correlation of returns between bull and bear market of international equity markets [3]. They stated that the correlation of international equity market would increase in bear market, but would not increase in bull market. Moreover, [1] also found that in market downturn period has higher dependency among assets than market upturn period. It related to the hypothesis [10] which responded to the dependency between
multi-assets on portfolio separately in two differential regimes. Thus, we need to extend more an investigation on market upturn and market downturn in ASEAN-5 market by using Markov Switching Copula model to find the aggregation strategy of stock, commodities, and bond in portfolio. Especially the recently year after global financial crisis in 2008, the inflation level has changed to be negative below zero percent in some developed countries. It may significant to changing the direction of market. ASEAN-5 economy may receive some impacts from external recession economy which can be the signal for market directions. Since, there are reasonable of links and co-movement of global capital markets on integrations across national capital markets especially for the stock traded activities [7].

All of these efforts to explain that the allocation of multi-assets in portfolio is a suitable instrument to prevent risks as a tool of risk diversification. There are many studies previously suggest that adding a variety of assets in portfolio is a good strategy for maximum benefit. The diversification risks can help to hedge risk against fluctuations of varying times. The understanding about the correlation of assets will be the noticeable benefits strategies for investors. Since, there are the correlation of three assets have been explained from the previous evidence that commodities and stock have negative significant relationship, while stock and bond have the opposite correlation base on uncertainty of inflation and interest rate indication. The suggestion of dependency among all assets will be helpful for the investors to understand the strategy of investment during uncertainty of markets.

III. CONTRIBUTION TO LITERATURE

The study of [10] found the result that the value of dependence matrix parameter of regime 1 was higher value than regime 2. Thus, they described by referring to the study of [1] that the dependence of all assets in the time of market upturn is less than the certain time of market down turn. So, [10] applied the conclusion to their assumption that the high dependence regime was the market downturn regime and low dependence regime was the market upturn regime. Furthermore, they also found that the period of market downturn corresponded to the time of crisis which results in the decline of commodity price and reduction of demand in commodity market. They stated that the investor face to the risk of loss in market upturn higher than market downturn. [6] found the significant between stock (Thailand, Indonesia, and Philippines), and gold were negatively co-movement, and found the dependency between both assets was high during of market downturn as the same period of debt crisis in Europe. They proved that gold could be the hedge asset for stock downturn regime that can reduce lost around 0.02–0.08%. However, most of researchers as mention in part of dependency, they applied Markov Switching and Copula model to capture dependency in order to measure risks in Value at Risk and Expected Shortfall afterward.

IV. MATERIAL AND METHODOLOGY

The assessment of the Copula with Markov Switching will consist of the standardized residuals for each variables that are obtained by ARMA-GARCH process and transform into uniform [0,1], then we will obtain starting value of dependence parameter by maximizing the Markov Switching Copula log-likelihood. Finally, the testing Bayesian will use to
estimate the posterior mean of parameter sets in the model [10]. The involved process is applied with two families of Elliptical such as Gaussian and Student-\( t \) copulas to join the marginal distribution, both can express as:

Markov Switching Gaussian copula or Normal copula is a linear correlation matrix which is symmetric function because of having equality between the upper and lower tail dependency. It does not have the tail dependence in this function. The formula can be written as follows: Let \( \Phi() \) be the standard normal cumulative distribution and \( \theta_i \) is estimated parameter from ARMA - GARCH

\[
\rho_{ii} \quad \cdots \quad \rho_{ii} \\
\vdots \quad \ddots \quad \vdots \\
\rho_{ji} \quad \cdots \quad \rho_{ij}
\]

\[f_{\alpha_0}(N) = \sum_{i=1}^{N} \frac{1}{\sqrt{R^2}} \exp \left\{ -\frac{1}{2} \gamma'\gamma - 1 \right\} \left\{ \prod_{j=1}^{i-1} \exp \left\{ -\frac{1}{2} \gamma'\gamma \right\} \right\}^{-1} \]  

Where \( \gamma_1 = \Phi^{-1}(\Phi(\eta_{ii})) = \Phi^{-1}(u_i) \)

\( u_i = F_i(\eta_{ii}; \theta_i) \)

\( \mathbf{R} \) is correlation matrix

\( \mathbf{I} \) is the identity matrix

Markov Switching Student-\( t \) copula is symmetrical tail dependence and has linear coefficient, which can capture dependency of some tail in multivariate case. The equation of student-\( t \) copula density function can express as the following formula at below:

\[
f_{\alpha_0}(N) = \sum_{i=1}^{N} \frac{1}{R} \exp \left\{ -\frac{1}{2} \gamma'\gamma - 1 \right\} \left\{ \prod_{j=1}^{i-1} \exp \left\{ -\frac{1}{2} \gamma'\gamma \right\} \right\}^{-1} \]  

Where \( \tau \) is gamma distribution and \( v \) is degree of freedom

Also, Markov Switching Copulas will be useful to investigate the different dependencies at whole time period for study the different behavior particularly variance contains the dependence structure that might be indicated by a hidden Markov chain with both regime of market upturn and downturn or low dependence and high dependence regime respectively [10] and accommodate structural breaks in variance by the consistent model. The parameter of dependence copula is \( R_{t}^{S_t} \) which is dominated by unobserved variable at time \( t \) which is \( S_t \)

The basic idea of Markov Switching are expressed as: \( S_t \) will be fulfilled by the Copula to explain the tail dependence by joint distribution of \( x_1, \ldots, x_n \) condition, \( R_{t}^{S_t} \) on \( S_t \) [8] which will be defined as

\[
(x_{1}, \ldots, x_{n})|\{S_t = i\} \sim C_{n}^p(u_1, \ldots, u_n; [\theta_1, \ldots, \theta_n]) \]

The regime of \( S_t \) is dominated by the first order of Markov chain express from the formula below of transition probabilities (P):

\[
P_{ij} = \Pr(S_{t+1} = j|S_t = i) \text{ and } \sum_{j=1}^{n} P_{ij} = 1 \text{ i,j = 1,2} \]

\( P_{ij} \) is explain probability of switching achieve from regime \( i \) to \( j \), the transition can arrange in from of matrix of \( P \), as the formula below:

\[
P = \begin{bmatrix}
P_{11} & P_{12} \\
P_{21} & 1 - P_{11}
\end{bmatrix}
\]

The basic idea of Copula are described as follows: This model will help to capture the multivariate case which consists of fat-tailed distribution to measure stochastic dependency between \( n \) random variables.

For example, given \( n \) variables are \( (x_1, \ldots, x_n) \) and the marginal distribution are \( F_1(x_1), \ldots, F_n(x_n) \) by Sklar’s Theorem explanation. The linkage between distributions of \( x_1, \ldots, x_n \) are combined with their margins by using copula function to yield the joint distribution function as below equation.

\[
H(x_1, \ldots, x_n) = C(F_1(x_1), \ldots, F_n(x_n)) = C(u_1, \ldots, u_n)
\]  

The marginal distributions of \( u_1, \ldots, u_n \) are uniform of the interval \( (0, 1) \). If \( F_t(x_1), \ldots, F_t(x_n) \) are the margins that is continuous distributions function, then
C will be the unique copula function, but if
\( F_1(x_1), \ldots, F_n(x_n) \) are the margins that is discrete distributions function C is not the unique copula function. The copular density function is given by:

\[
C(F_1(x_1), \ldots, F_n(x_n)) = \frac{h(F_1^{(-1)}(u_1), \ldots, F_n^{(-1)}(u_n))}{\prod_{i=1}^{n} f_i(F_i^{(-1)}(u_i))}
\]

(8)

Where \( h \) is the density function associated to II.

\( f_i \) is the density function associated to II.

\( c \) is the copula density

The dependence structure that relates to this function is the Pearson’s correlation which the value of parameter is in

(-1, 1) interval. Two main types to classify copula functions that are Elliptical and Archimedean. The individual classes can divide density of copula families separately. Elliptical consists of Gaussian or Normal copula and Student-t copula which are the symmetric tail dependence. And Archimedean consists of Frank copula, Clayton copula, and Joe copula which are asymmetric tail dependence. For this study will employ Elliptical copula function in quadratic form of the copula function. In this study, we aim to investigate the portfolio of ASEAN-5. Thus, we consider the five following portfolios.

1) Portfolio Thailand: SET + GOLD + OIL + WHEAT + BOND
2) Portfolio Indonesia: JKSE + GOLD + OIL + WHEAT + BOND
3) Portfolio Singapore: SGX + GOLD + OIL + WHEAT + BOND
4) Portfolio Malaysia: KLSE + GOLD + OIL + WHEAT + BOND
5) Portfolio Philippines: PSE + GOLD + OIL + WHEAT + BOND

V. DATA

This research takes monthly interest rate of Government bonds in ASEAN-5. Secondly is daily data of international stock market. The weekly data are divided for five countries stock index namely SET index, STI index, KLC index, PSE index, and PSE index. Third, weekly price of commodity splits for gold, oil, and wheat. All data are collected by data from Reuter DataStream, and Boom Berge Chiang Mai, University since 23 May, 2003 – 12 May, 2017.

RESULT OF THE STUDY

A. Model selection

![Fig.1 AIC/BIC result](image)

We compared various margins assumption and the lowest Akaike Information criterion (AIC) and Bayesian Information criterion (BIC) between 1 regime and 2 regimes. We found that the margins of Thailand, Singapore, Malaysia, and Philippines are student-t distribution at 1 Regime. There is only Indonesia is normal distribution in 2 regimes. The parameters of each are all significant as shown in Table II.

B. Model Estimation

![Table II](image)
We used ARMA-GARCH process to appropriately analyze the volatility and estimate the marginal. We selected the optimal lag and marginal distribution assumption for ARMA(p,q)-GARCH(1,1) by using normal, student-t, skew student-t conditional distributions to select the significant probabilities of each variables and found that the returns on

1) Portfolio of Thailand: SET, OIL, GOLD, WHEAT, and BOND satisfied ARMA(5,3), ARMA(5,5), ARMA(3,5), ARMA(5,5), and ARMA(6,5) with GARCH (1,1) respectively.

2) Portfolio of Singapore: STI, OIL, GOLD, WHEAT, and BOND satisfied ARMA(5,4), ARMA(5,5), ARMA(3,5), and ARMA(3,4) with GARCH (1,1) respectively.

3) Portfolio of Indonesia: JCI, OIL, GOLD, WHEAT, and BOND satisfied ARMA(0,0), ARMA(3,3), ARMA(5,5), ARMA(5,5), and ARMA(5,5) with GARCH (1,1) respectively.

4) Portfolio of Philippines: PSEI, OIL, GOLD, WHEAT, and BOND satisfied ARMA(1,1), ARMA(5,5), ARMA(5,5), ARMA(5,5), and ARMA(5,5) with GARCH (1,1) respectively.

C. Model estimated result
Fig.3 shows the solutions of multivariate between Student-t copula parameters with no regime switching. The correlation on Thailand portfolio: SET and Commodities are positive especially Stock and OIL are the highest correlation at 17%, but between SET and BOND are minus. The correlation between BOND and Commodities are positive only OIL at 8%, but the correlation with GOLD and WHEAT are negative. All commodities are positive. The correlation on Malaysia portfolio: KLCI are positive with oil at 17%, but negative with gold and wheat, bond is negative with all commodities. All commodities are positive relationships of each other.

Indonesia allows portfolio to have 2 regimes switching with parameters of the Markov Switching normal copula at Fig.1. The results at Fig.4 shows that the value of the matrix dependence parameter in regime 1 interpret to be likely higher than regime 2. Thus, we can interpret regime 1 to be the high dependence regime, while regime 2 is the low dependence regime as following [10]. The coefficient interpret regime 1 that JCI has negative dependence with Commodities and BOND, except OIL is positive, also BOND is negative with Commodities. Regime 2 shows that the coefficient between JCI and Commodities are positive, except OIL and BOND. In the other hand, BOND and OIL are positive dependency. We can use these values to construct efficient portfolio and find optimal plans for best expected returns with minimum loss which will be reported in the last section.

D. Optimal Portfolio’s weight

This part was estimated the assets allocation portfolio to monitor an optimal portfolio’s weight for each five countries. The percentages of each assets can suggest the investor to contribute their money in appropriate ratios included expectation of minimum risk with the highest return. The empirical results can explain as follows:
Fig. 1 Optimal Portfolio Thailand
Fig. 1 illustrates the efficient frontier of an optimal weight portfolio Thailand is separately for SET 18%, OIL 43%, GOLD 0%, WHEAT 38%, and BOND 0%. This portfolio will be suitable for the investors who are risk lover and want to gain high returns at 0.0071% with risk at 0.32%. OIL represents the best choice of investing when compared with STOCK, and WHEAT. In contrast GOLD and BOND are the worse choice to invest at 0%.

Fig. 2 Optimal Portfolio Singapore
Fig. 2 illustrates the efficient frontier of an optimal weight portfolio Singapore is separately for STI 1.22%, OIL 20.67%, GOLD 8.58%, WHEAT 69.52%, and BOND 0%. This portfolio will be suitable for the investors who are risk lover and want to gain high returns at 0.0021% with risk at 0.22%. WHEAT represents the best choice of investing when compared with STOCK, OIL, and GOLD. In contrast BOND is the worse choice to invest at 0%.

Fig. 3 Optimal Portfolio Malaysia
Fig. 3 illustrates the efficient frontier of an optimal weight portfolio Malaysia is separately for KLCI 4.92%, OIL 41.95%, GOLD 0%, WHEAT 9.22%, and BOND 43.91%. This portfolio will be suitable for the investors who are risk lover and want to gain high returns at 0.012% with risk at 0.37%. BOND represents the best choice of investing when compared with STOCK, OIL, and WHEAT. In contrast GOLD is the worse choice to invest at 0%.

Fig. 4 Optimal Portfolio Philippines
Fig. 4 illustrates the efficient frontier of an optimal weight portfolio Philippines is separately for PSEI 0.63%, OIL 44.63%, GOLD 0%, WHEAT 54.73%, and BOND 0%. This portfolio will be suitable for the investors who are risk lover and want to gain high returns at 0.0073% with risk at 0.329%. WHEAT represents the best choice of investing when compared with STOCK, OIL, and GOLD. In contrast BOND and GOLD are the worse choice to invest at 0%.

Fig. 5 Optimal Portfolio Indonesia
Fig. 5 illustrates the efficient frontier of an optimal weight portfolio Indonesia in market downturn, there are high dependency of each assets. Portfolio is
seperated for JCI 28.87%, OIL 17.30%, GOLD 4.84%, WHEAT 17.23%, and BOND 31.75%. This portfolio will be loss of return at -0.0049% and risk will be 4.455%. Thus, this market will not incentive investors to invest because of bad economy.

Fig.6 Optimal Portfolio Indonesia in regime 2nd
Fig.6 illustrates the efficient frontier of an optimal weight portfolio Indonesia in market upturn, there are low dependency of each assets. Portfolio is seperated for JCI 34.23%, OIL 17.19%, GOLD 12.58%, WHEAT 0%, and BOND 36%. This portfolio will be suitable for the investors who are risk lover and want to gain high returns at 0.1773% with risk at 37.85%. II. BOND represents the best choice of investing when compare with STOCK, OIL, and GOLD. In contrast WHEAT is the worse choice to invest at 0%. This will be occur during good economy happening.

I. CONCLUSION
This paper intend to offer the optimal portfolio for multi-assets allocation by using Markov Switching Copula model to solve the differential regimes issue. The results of this study allow to improve the performance of portfolio’s strategies to obtain maximum return with less risk for five countries of ASEAN 5. We need to investigate to the evaluation of dependency with regime switching is efficient for the group of five countries in ASEAN 5, or not. Thus, we selected data since 23 May, 2003 – 12 May, 2017. There are three main results. First, Thailand, Singapore, Malaysia, Philippines are indicated by one regime on conditional student-t copula distribution, but only Indonesia is allowed to have two regimes on normal Markov Switching Copula distribution, by using the lowest AIC/BIC estimation. Second, the results interpret that Indonesia has two regimes switching which regime1 is high dependency likely to be market downturn, the probability from regime1 switches to regime2 is 68.28% or around 3 weeks. Regime2 is low dependency likely to be market upturn, the probability from regime2 to regime1 is 29.41% or around one week. Finally, the optimal portfolio was estimate the maximum risks and returns for the investors by using Expected Shortfall in varying market which performs the strategies for investment.

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II. REFERENCE


