

## Cross-asset class portfolio between gold and stocks in Indonesia

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### Abstract

This study observes the effectiveness of hedging by using the gold commodity futures instrument as a hedge asset towards Indonesian stock which is represented by sectoral indices and Composite Stock Price Index (CSPI). It uses DCC-GARCH which can dynamically accommodate the correlation between gold and the stock. This study finds that gold could become a safe haven asset towards stock in Indonesia. In addition, this study reveals that gold can effectively become a hedge asset for the stocks in Indonesia and the hedged portfolio resulted in a higher risk-adjusted performance of the portfolio of investment.

### Introduction

Since the Bretton Wood System collapsed in 1968–1973, the important role of gold as a criterion of the currency value in the international monetary system is no longer in place. Nevertheless, the usage of gold by the investors remains because of its hedging and safe-haven capability towards the other assets. Other than that, gold is also the type of precious metal that universally acceptable, durable, easily authenticated, and relatively transportable compared to other assets (Worthington & Pahlavani, 2007). Gold is considered as an asset that frequently observed and provides an effective hedging ability when the inflation occurred (Dempster & Artigas, 2010).

Baur & Lucey (2010) define hedge as an asset which has negative correlation or zero correlation toward another asset when the market does not show any turmoil condition. While safe haven is defined as an asset that has negative correlation or zero correlation towards another asset when market turmoil occurs. The previous research by Capie, Mills, & Wood (2005) showed that gold could become a hedge asset against Dollar. Beckmann, Berger, & Czudaj (2014); Robiyanto, Wahyudi, & Pangestuti (2017a) also found that generally gold is a hedge asset against the other assets in a portfolio and it depends on the economic environment that had been observed. Baur & Lucey (2010) found that gold is a hedge asset of stock in the United States of America and the United Kingdom, gold is also a hedge asset for the bond in Germany. Furthermore, Baur & Lucey (2010) have concluded that gold is a safe haven asset against stock in 15 trading days after the turmoil market has occurred. Based on the previous studies, it could be inferred that gold is decent to become a hedge asset and safe haven toward the other asset for minimizing the risk of the portfolio.

Putting gold in one portfolio of stock investment is possible since the portfolio that has been composed is a cross-asset class portfolio. Greer (1997) stated that asset allocation should be using the cross-asset class portfolio to adjust the actual market condition. The cross-asset class portfolio is defined by Baur (2013) as a portfolio that has been composed of assets in different classes, for instance, fixed-income assets (bond, government bond), stock, and cash.

Enhancing numbers of assets in different asset classes into the portfolio is a part of portfolio diversification strategy. Diversification by adding numbers of a different asset class that invested can reduce the total risk of a portfolio because the diversifiable risk of the portfolio is effectively reduced. Markowitz (1952) also introduced modern portfolio theory that assumes a normal distribution of stock return and used single index model that generates a constant correlation. Utilization of a normally distributed assumption by Markowitz due to the formulation of the modern portfolio that had been composed by Markowitz using mean and variance and both can be clearly described when the stock return is normally distributed. (Damodaran, 2008).

However, the utilization of assumption that assumes a normal distribution of stock return is not in accordance with the actual condition because the stock return tends to abnormally distributed in actual condition (Robiyanto, 2017a; Robiyanto, 2017b; Robiyanto & Puryandani, 2015; Robiyanto et al., 2017b). Research conducted by Aparicio & Estrada (2001); Ogata (2012); Robiyanto, Hersugondo, & Puryandani (2015) proved that the stock return is abnormally distributed and it reinforced the criticism of modern portfolio. Other than that, the dynamic condition of the market will be better if it was followed by the utilization of dynamic portfolio that considers and adjusts the portfolio with time-varying correlations than the utilization of single index portfolio.

Some of the studies that use the dynamic portfolio to evaluate the portfolio performance and the effectiveness of hedging process are the studies that have been done by Robiyanto et al. (2017b). However, both of the studies do not use the calculation of Adjusted Sharpe Index (ASI). The calculation of ASI is useful to reduce the bias that might be appeared in the estimation of standard deviation at traditional Sharpe Index calculation (Jobson & Korkie, 1981; Robiyanto, 2018). Besides using Sharpe Index that utilizes standard deviation or total risk, this research also uses Treynor Index that utilizes beta or undiversifiable risk (Zulkafli, Ahmad, & M., 2017). The return of each index in Indonesia will be paired with gold to measure the portfolio performance that can be shown by the risk-adjusted return (Sharpe, ASI, and Treynor) calculation. This research uses not only the Composite Stock Price Index (CSPI) on the Indonesian Stock Exchange (IDX) but also nine sectoral indices. Nine sectoral indices are chosen to know the effectiveness of hedging in every sector of Indonesia capital market. The differences between each character of the indices may provide different results of the hedging effectiveness and the portfolio performance, thus making this research appealed to be done.

This research aims to examine the effectiveness of hedging by combining gold with an Indonesian stock which is represented by the CSPI or nine sectoral indices into one dynamic portfolio. Furthermore, this study aims to analyze the dynamic portfolio performance that would be shown by the risk-adjusted return by composing a hedged portfolio between gold and Indonesian stock using the DCC-GARCH method. The benefits of this research are as reference material for investors in deciding the hedging strategy on the portfolio and this research also useful for academics in providing additional information about investment knowledge and portfolio management especially on the creation of hedging strategy.

## Research Methods

Monthly closing prices of the Composite Stock Price Index (CSPI) in the Indonesian Stock Exchange (IDX) and nine Sectoral Indices which are Agriculture Index, Mining Index, Basic Industry and Chemicals Index, Miscellaneous Industry index, Consumer Goods Industry Index, Property and Real Estate Index, Infrastructure, Utilities, and Transportation Index, Finance Index, and also Trade, Services, and Investments Index are used as the data in this research. Research period between January 2011 to April 2017. This research also uses monthly closing prices of gold from January 2011 to April 2017. Data obtained from Bloomberg. The data of CSPI return and nine sectoral indices are obtained by using a formula as follows:

$$R_{Index,t} = \left[ \frac{P_{Index,t} - P_{Index,t-1}}{P_{Index,t-1}} \right] \quad (1)$$

Where,

$P_{Index,t}$  = Monthly closing prices of CSPI or nine sectoral indices at time t

$P_{Index,t-1}$  = Monthly closing prices of CSPI or nine sectoral indices at time t - 1

The data of gold return are also obtained by using a formula as follows:

$$R_{Gold,t} = \left[ \frac{P_{Gold,t} - P_{Gold,t-1}}{P_{Gold,t-1}} \right] \quad (2)$$

Where,

$P_{Gold,t}$  = Monthly closing prices of gold at time t

$P_{Gold,t-1}$  = Monthly closing prices of gold at time t - 1

This study uses DCC-GARCH as a method to create the dynamic portfolio, and the calculation has been done by using Eviews. Hence this study calculates the Hedging Effectiveness by using a formula that has been developed by Ku, Chen, and Chen (2007) as follows:

$$HE = \frac{\text{Variance (unhedged)} - \text{Variance (hedged)}}{\text{Variance (hedged)}} \quad (3)$$

Variance (hedged) shows the variance of the portfolio that consists of gold and CSPI or nine Sectoral Indices while variance (unhedged) is the variance of CSPI or 9 Sectoral Indices. The greater Hedging Effectiveness in portfolio shows that portfolio strategy which has been used is a good strategy because the magnitude of Hedging Effectiveness indicates the magnitude of risk reduction in the portfolio (Kumar 2014).

Research about the risk-adjusted return of the hedged portfolio and unhedged portfolio can be done by the calculation of Sharpe Index which has been introduced by Sharpe (1966) with the following formula:

$$\text{Risk-Adjusted Return} = \frac{\text{Average of Portfolio Return} - \text{Risk-Free Rate}}{\text{Portfolio Standard Deviation}} \quad (4)$$

The standard deviation of the portfolio can be obtained by using the following formula:

$$\text{Standard Deviation } (\sigma_i) = \sqrt{\frac{\sum [(R_{i,t} - E(R_{i-t}))]^2}{N}} \quad (5)$$

The calculation of Adjusted Sharpe Index also has been done by previous researchers like Ahmad & Ibrahim (2002); Pangestuti, Wahyudi, & Robiyanto (2017) and Zulkafli et al. (2017) by using the following formula:

$$\text{Adjusted Sharpe Index (ASI)} = \text{Sharpe Index} \times \frac{\text{Number of Observations (N)}}{\text{Number of Observations (N)} + 0.75} \quad (6)$$

The calculation of risk-adjusted return by Treynor's Index can be done by using a formula as follows:

$$\text{Treynor's Index} = \frac{\text{Average Return on Portfolio} - \text{Risk-Free Rate}}{\beta_i} \quad (7)$$

The Coefficient of  $\beta_i$  is obtained by doing a regression test of the CSPI's return or nine sectoral indices' return with the market return, and the regression model can be formulated as follows:

$$R_{i,t} = \sigma_i + \beta_i R_{m,t} + e_{i,t} \quad (8)$$

Where,

$R_{i,t}$  = average monthly return of CSPI or nine sectoral indices

$\sigma_i$  = Constant

$\beta_i$  = beta coefficient of CSPI or nine sectoral indices

$R_{m,t}$  = Daily market return of portfolio in month t

$e_{i,t}$  = Unexplained residual return of the regression in month t, noted:  $E(e_{i,t}) = 0$

Sharpe's Index, ASI, and Treynor's Index are tested by using two-sample t-test. Normality test is conducted before the hypothesis test to know whether this study needs to use Independent t-test or Mann Whitney test.

## Results and Discussion

### Unit root test

Arouri, Lahiani, & Nguyen (2014) stated that to do a test of time series data, the data should be stationary which is the Mean, and the Variance is equal all the time. Therefore, Unit Root Test has been done in this study to know whether the return of gold and return of stock are stationary or not. One of the Unit Root Test tools that are frequently used by the researchers like Kumar (2014), Sharma & Mathur (2016), Dajcman, Festic, & Kavkler (2012) is Augmented Dickey-Fuller (ADF). Hence, this study uses ADF as a tool to do Unit Root Test which can be seen in Table 1. Based on the result of the Unit Root test, the return data of gold and the return data of stock are stationary because the probability score is less than 0.05 which means the null hypothesis of unit root test that said the data are not stationary is rejected. Furthermore, DCC-GARCH can be applied because the data are stationary.

### Analysis of DCC-GARCH between Gold and CSPI

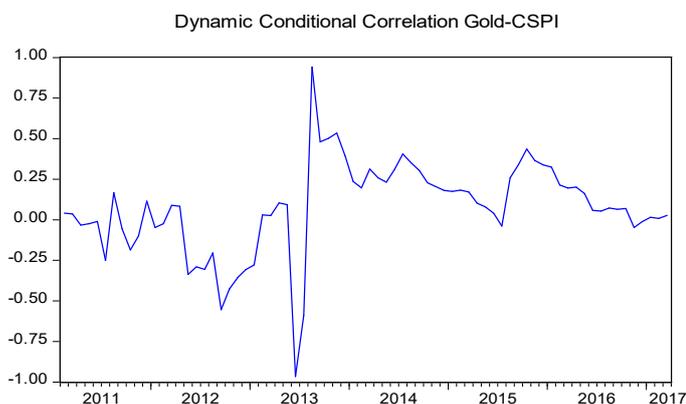
The dynamic conditional correlation (DCC) between CSPI and gold is shown in Figure 1. The graph of the dynamic conditional correlation between CSPI and gold shows that in 2011 until at the beginning of the second quarter of 2013, the dynamic correlation scores between gold and CSPI are tended to negatively correlated and tend to have zero correlation. In that period, the dynamic correlation scores between gold and CSPI are also positively correlated, but the positive correlation scores are below 0.2 which is classified as very weak correlation

by Evans (1996). In other words, gold can become a good diversifier and good hedge asset for the CSPI in 2011 until at the beginning of second quarter of 2013. In the middle of the second quarter of 2013, the dynamic correlation between gold and CSPI decreased into minus 0.996.

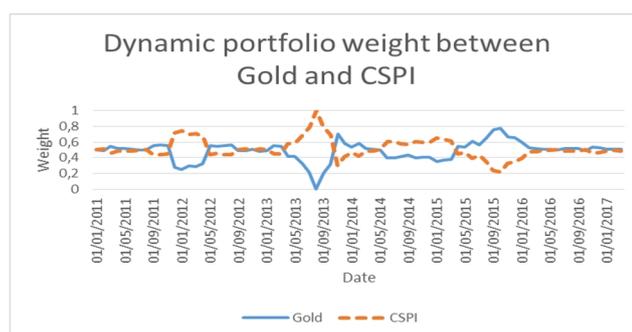
**Table 1.** Augmented Dickey-Fuller Test

Description	ADF-Statistics	Probability
Gold	-9.654	0.000
CSPI	-8.868	0.000
Agriculture	-10.521	0.000
Basic Industry and Chemical	-8.784	0.000
Consumer Goods	-7.076	0.000
Financial	-8.787	0.000
Mining	-9.796	0.000
Miscellaneous	-9.072	0.000
Property and Real Estate	-7.807	0.000
Trade, Services and Investments	-8.328	0.000
Infrastructure, Utilities, and Transportation	-9.013	0.000

Source: Bloomberg, processed.



**Figure 1.** DCC Gold-CSPI



**Figure 2.** Dynamic Portfolio Weight Gold-CSPI

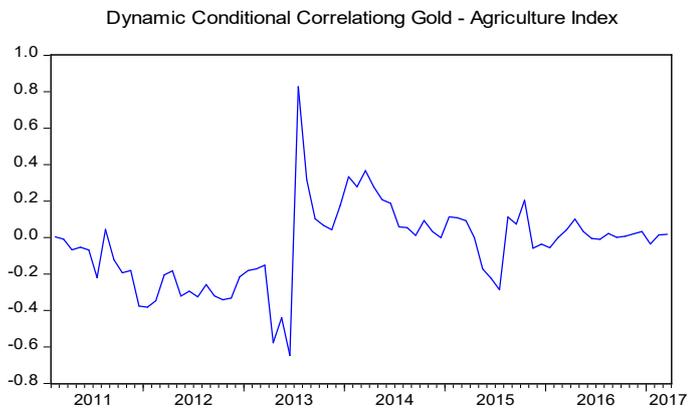
The sharp decline of the dynamic correlation score occurred when Indonesia was experiencing a minor crisis that was caused by the United State's tapering off issues and it caused the movement of investment funds from developing countries to the developed countries. Claessens & Kose (2013) explained that the shifting of external funding from one country to another shows Sudden Stop Crisis that is able to cause turmoil in the capital market. Therefore, the ability of gold to give a negative correlation in the portfolio that consists of CSPI can be classified as a safe haven. However, the negative correlation only occurred for approximately two months because in August 2013, the dynamic correlation score was soaring up into 0.941 and it is classified as a very strong correlation by Evans (1996). This evidence showed that gold could only become a safe haven asset temporary which was approximately 40 trading days and after that the gold price would follow the fall of CSPI

price that had been caused by the sudden stop crisis. This finding is consistent with the research conducted by Baur & Lucey (2010) who also found that gold can only become a safe haven asset temporary which is 15 trading days. Portfolio data processing using dynamic portfolio weight can be seen in Figure 2.

In Figure 2, it can be seen that after 40 trading days of market turmoil in 2013, investors are advised to form a 100% portfolio on CSPI investment and 0% on gold investments so the investors will not invest in two assets that have a positive correlation strong and it is on a bearish trend which will make the loss even greater. The dynamic portfolio weight has an average weight of 48.45% for gold and 51.55% for CSPI.

**Analysis of DCC-GARCH between Gold and Nine Sectoral Indices**

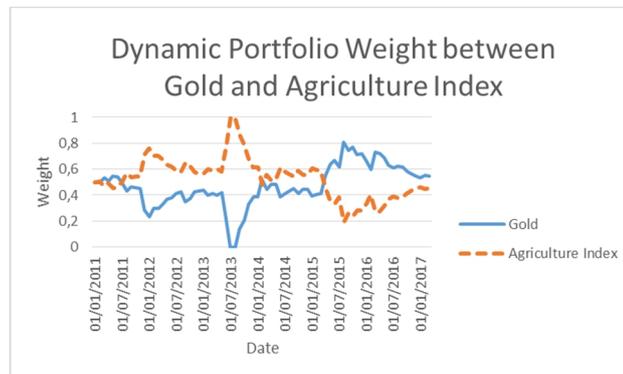
The DCC-GARCH graph between gold and the agriculture index in 2011 until at the beginning of second quarter of 2013 shows negative correlation scores and also zero correlation. However, in August 2011, the dynamic correlation scores were greater than zero (approximately 0.01 until 0.04), but according to Evans (1996) those correlation scores were classified as very weak correlation or in the other word, gold had a role as a diversifier in that period as can see in Figure 3.



**Figure 3.** DCC Gold-Agriculture Industry

In the second quarter of 2013, the correlation score between gold and agriculture index decreased into minus 0.65, but at the beginning of third quarter of 2013, the correlation score increased into 0.83 which is classified by Evans (1996) as very strong correlation. The correlation scores that were generated in the second quarter of 2013 were simultaneously occurred with the sudden stop crisis. This evidence showed that gold could become a safe haven asset for the agriculture index in 40 trading days. In 2014 the correlation scores between gold and agriculture index began to shrink in the range of -0.29 to 0.37. The correlation score was obtained by performing a hedged portfolio assessment based on the weighting shown in Figure 4.

The average of dynamic portfolio weight between gold and agriculture index in Figure 4 is 47.10% weight of gold and 52.90% weight of Agriculture Index. Just like the portfolio weight between gold and CSPI, Investors are also suggested to form a portfolio that consists of 100% stock investment and 0% gold investment after 40 trading days from the occurrence of capital market turmoil in Indonesia.



**Figure 4.** Dynamic Portfolio Weight Gold-Agriculture Industry

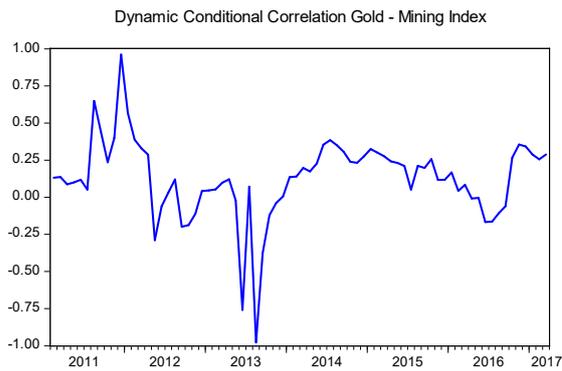


Figure 5. DCC Gold-Mining Industry

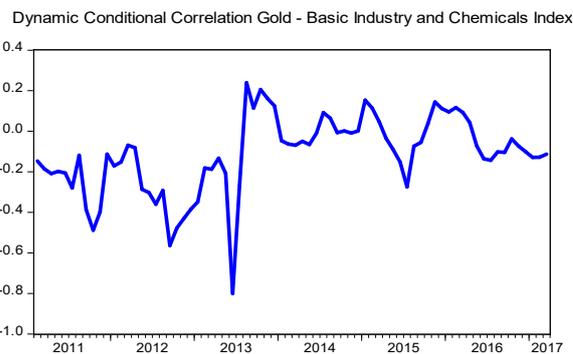


Figure 7. DCC Gold-Basic Industry

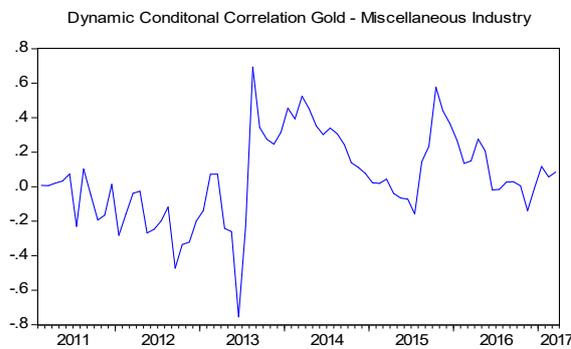


Figure 9. DCC Gold-Miscellaneous Industry

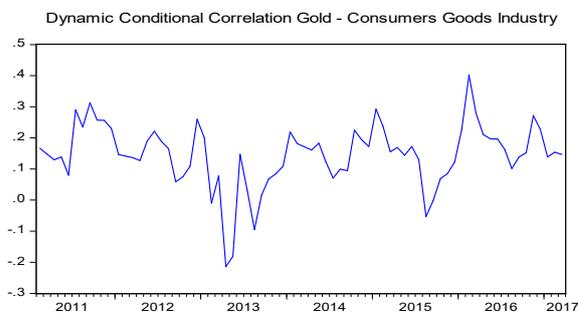


Figure 11. DCC Gold-Consumer Industry

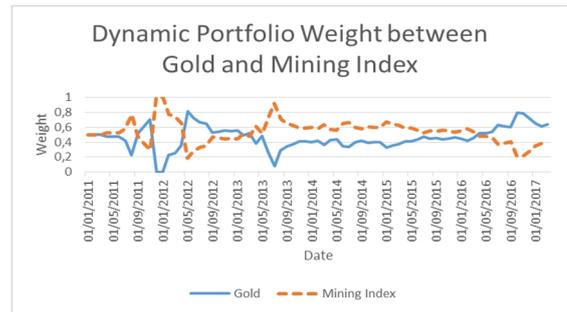


Figure 6. Dynamic Portfolio Weight Gold-Mining Industry

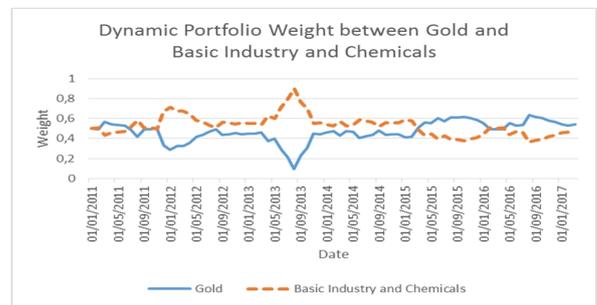


Figure 8. Dynamic Portfolio Weight Gold-Basic Industry

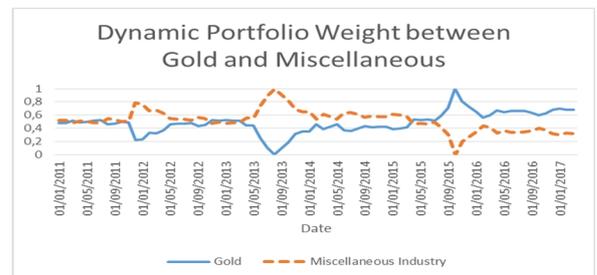


Figure 10. Dynamic Portfolio Weight Gold-Miscellaneous Industry

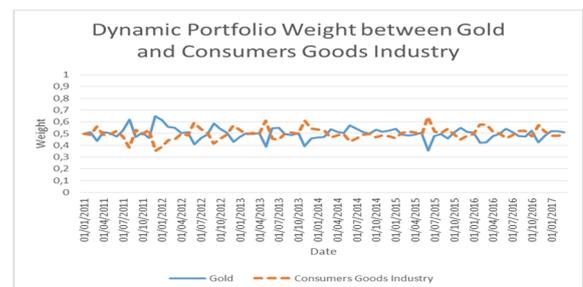


Figure 12. Dynamic Portfolio Weight Gold-Consumer Industry



Figure 13. DCC Gold-Property Industry



Figure 14. Dynamic Portfolio Weight Gold-Property Industry

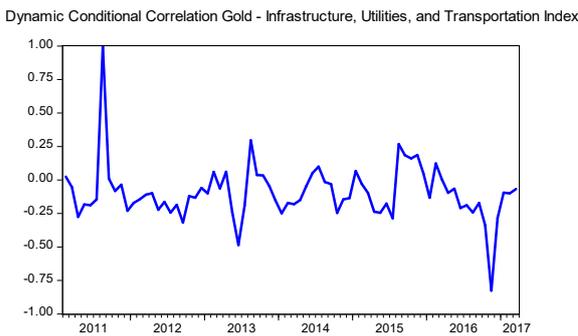


Figure 15. DCC Gold- Infrastructure Industry

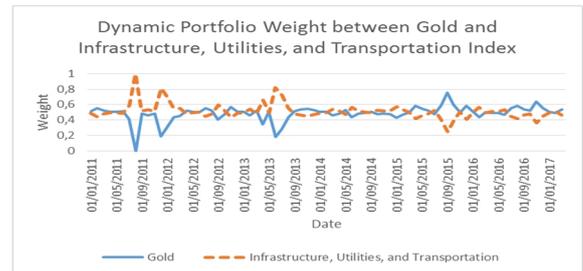


Figure 16. Dynamic Portfolio Weight Gold-Infrastructure Industry

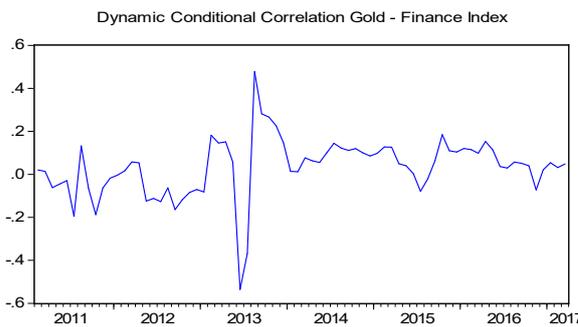


Figure 17. DCC Gold-Financial Industry

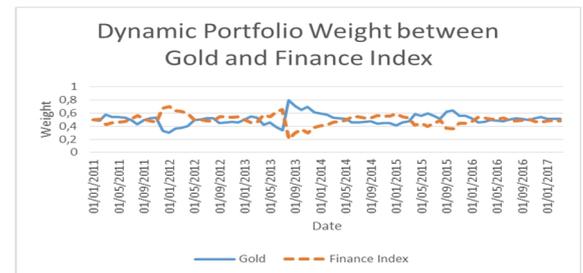


Figure 18. Dynamic Portfolio Weight Gold-Financial Industry

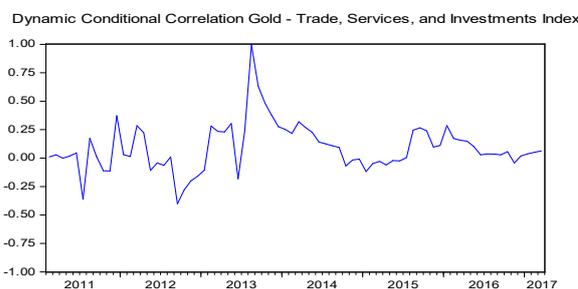


Figure 19. DCC Gold-Trade Industry

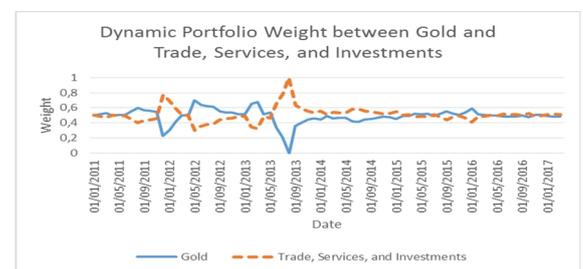


Figure 20. Dynamic Portfolio Weight Gold-Trade Industry

The next primary sector index is mining index which has the dynamic conditional correlation against the gold in Figure 5 with the average of dynamic portfolio weight in the amount of 46.18% weight of gold and 53.82% weight of mining index (Figure 6). The highest correlation score between gold and mining index was occurred in December 2011 in the amount of 0.961, while the lowest correlation score between gold and mining index occurred in August 2013 in the amount of minus 0.978. In 2013, the correlation scores between gold and mining index were also negative which mean the gold can become a safe haven asset towards mining index.

Figure 7 shows DCC-GARCH between gold and basic industry and chemicals index that classified as a secondary industry sector. The dynamic correlation scores between gold and basic industry and chemicals index were in the range of minus 0.81 to 0.24. This evidence shows that gold can become not only diversifier but also hedge asset in the research period. In the second quarter of 2013 the correlation scores between gold and basic industry and chemicals index decreased into minus 0.8, and it proves that gold can become a safe haven asset for the basic industry and chemicals index. The establishment of the portfolio between gold and basic industry and chemicals index uses dynamic portfolio weight with the average weight of 54.27% for gold and 45.73% for basic industry and chemicals index as shown in Figure 8.

The next secondary industry sector is miscellaneous industry index which has the dynamics conditional correlation as shown in Figure 9. The result of dynamic conditional correlation has been composed based on the portfolio weighting as shown in Figure 10 by the average weight of 68.2% for gold and 31.78% for miscellaneous industry index. The correlation scores between gold and miscellaneous industry index in 2011 until March 2013 fluctuated in the range of minus 0.47 to 0.1 which means gold can become both a diversifier and a hedge for the miscellaneous industry index. In the second quarter of 2013, the correlation score decreased into minus 0.75, but in June 2013 the correlation score increased into 0.69 so that the gold can be classified as safe have an asset for the miscellaneous industry index because market turmoil occurred in that period. After the sudden stop crisis in 2013 elapsed, the correlation scores between gold and miscellaneous industry index fluctuated in the range of weak correlation.

Gold can only become a diversifier for consumer goods industry index which can be seen from the dynamic correlation scores in DCC-GARCH graph (Figure 11) that shows a fluctuation of correlation score in the range of 0.01 until 0.4. However, sometimes gold become a hedge asset as shown in August 2015 because of the negative correlation (approximately minus 0.05) in that time besides gold can also become a safe haven asset for the consumer goods industry index due to the negative correlation in time of market turmoil. The establishment of the dynamic portfolio was based on the dynamic portfolio weight which can be seen in Figure 12 with the average weight of 49.96% for gold and 50.04% for consumer goods industry index.

Property and real estate index which classified as the tertiary index has dynamic correlation score as shown in Figure 13. The dynamic correlation in Figure 13 was built by the dynamic portfolio weight which can be seen in Figure 14. The average weight of the portfolio is in the amount of 56.38% for gold and 43.62% for property and real estate index.

The highest correlation score between gold and property and real estate index occurred in February 2016 in the amount of 0.3 while the lowest correlation score between gold and property and real estate index occurred in June 2013 in the amount of minus 0.89 along with the occurrence of sudden stop crisis. Based on Figure 13, the gold can be classified as a diversifier, hedge, and also safe haven asset for the property and real estate index.

The DCC-GARCH graph (Figure 15) shows a dynamic conditional correlation between gold and infrastructure, utilities, and transportation index. In August 2011, the perfect correlation (1,0) between gold and infrastructure, utilities, and transportation index occurred. However, in general, the correlation scores were in the range of minus 0.826 to 0.296 which mean the correlation was still in the good range for a diversifier and hedge asset. The negative correlation that occurred in the second quarter of 2013 shows that gold can become a safe haven asset for infrastructure, utilities, and transportation index. The dynamic portfolio was established based on the dynamic portfolio weight as shown in Figure 16 with the average weight of 48.67% for gold and 51.33% for infrastructure, utilities, and transportation index.

The next tertiary sector index is financial sector index which has the dynamic conditional correlation as shown in Figure 17. In Figure 17, it appears that the dynamic correlation between gold and financial sector index fluctuated in the range of minus 0.20 to 0.18. In the other word, gold can become both diversifier and hedge asset for financial sector index. In the second quarter of 2013, the dynamic correlation score between gold and financial sector index decreased from 0.15 to minus 0.54. The negative correlation between gold and financial sector index in time of market turmoil shows that gold can become a safe haven asset for financial sector index. The establishment of the dynamic portfolio was using the dynamic portfolio weight as shown in Figure 18. The average weight of the dynamic portfolio weight is in the amount of 50.65% for gold and 49.35% for the financial sector.

Dynamic conditional correlation between gold and trade, services, and investments index as shown in DCC-GARCH graph (Figure 19) shows that in the period of 2011 to March 2017, the correlation scores between gold and trade, services, and investments index were in the range of minus 0.402 until 0.372 which mean the gold can become a diversifier and safe haven asset for the trade, services, and investments index. In the second quarter of 2013, gold was negatively correlated (-0.183) with trade, services, and investments index for 40

trading days when the market turmoil occurred. This shows that gold can become a safe haven asset for trade, services, and investments index. The establishment of dynamic portfolio used dynamic portfolio weight as shown in Figure 20 which has the average weight in the amount of 49.03% for gold and 50.97% for trade, services, and investments index.

### Hedging effectiveness of cross asset class portfolio

Base on the calculation of hedging effectiveness, Table 2 is represent the result of hedging effectiveness has been established. The result of Hedging Effectiveness calculation in Table 2 shows that gold can give the biggest reduction of risk to the Property and Real Estate Index with a value of 66.42% and it shows that gold can become a good hedge asset for the Property and Real Estate Index by reducing 66.42% of investment risk. The magnitude of Hedging Effectiveness value between gold and the Property and Real Estate Index shows that the risk of the Property and Real Estate Index tend to be high in the research period, and it is shown at the variance of the Property and Real Estate in the amount of 0.005 which has been reduced by the hedging process into 0.002.

**Table 2.** Gold Hedging Effectiveness

Description	Hedging Effectiveness
CSPI	25.30%
Agriculture	59.36%
Basic Industry and Chemical	57.57%
Consumer Goods	22.77%
Financial	52.07%
Mining	46.70%
Miscellaneous	49.87%
Property and Real Estate	66.42%
Trade, Services and Investments	40.47%
Infrastructure, Utilities, and Transportation	48.39%
Average	46.89%
Minimum	22.77%
Maximum	66.42%

The reduction of risk has occurred because of the negative correlation between gold and the Property and Real Estate index at the time of research period so that the total risk was reduced as a result of mutually negating price movement. The gold can also give a big reduction of risk to the Agriculture index with the Hedging Effectiveness value of 59.36%. It means that gold can reduce the total risk of hedge portfolio that consists of gold and Agriculture index in the amount of 59.36%. The smallest Hedging Effectiveness value is shown by the portfolio combination of gold and Consumer Goods Industry Index with the Hedging Effectiveness value of 22.77%. However, all of the Hedging Effectiveness scores is greater than zero which mean that gold can become the hedged asset for stock in Indonesia and this finding supports the study that has been done by Kumar (2014); Robiyanto et al. (2017b).

### Risk-Adjusted Return of Sharpe Index, Adjusted Sharpe Index, and Treynor's Index

Risk-adjusted return that has been obtained by the calculation of Treynor, ASI, and Sharpe formula, can be seen in Table 3. Base on the calculation of risk-adjusted return by using three performance indicators which are Sharpe Index, Adjusted Sharpe Index, Treynor's Index, it can be inferred that the risk-adjusted return of hedged portfolio consisted of gold and Agriculture Index, gold and Mining Index, gold and Basic Industry and Chemicals Index, and also gold and Property and Real Estate Index are greater than the risk-adjusted return of unhedged portfolio. It means that gold can improve the risk-adjusted performance of those four sectoral indices. Furthermore, this study establishes a hypothesis for the overall risk-adjusted return testing by using two-sample t-test.

The null hypothesis is "the risk-adjusted return of the hedged portfolio is less than the risk-adjusted return of unhedged portfolio" while the alternative hypothesis is "the risk-adjusted return of the hedged portfolio is greater than the risk-adjusted return of the unhedged portfolio." This alternative hypothesis is the tailed right side (Levine, Krehbiel, & Berenson, 2006). After the hypothesis has been established, the normality

test should be done to know whether this study needs to use Independent t-test or Mann Whitney test. The output of the normality test can be seen in Table 4.

**Table 3.** Risk-Adjusted Return of Sharpe Index, Adjusted Sharpe Index, and Treynor's Index

Description	Unhedged Portfolio			Gold Hedged Portfolio		
	Sharpe	ASI	Treynor	Sharpe	ASI	Treynor
CSPI	0.051	0.050	0.002	-0.008	-0.008	-0.000
Agriculture	-0.069	-0.068	-0.006	-0.068	-0.067	-0.008
Basic Industry and Chemical	0.068	0.067	0.003	0.017	0.017	0.000
Consumer Goods	0.177	0.175	0.012	0.124	0.122	0.017
Financial	0.108	0.107	0.005	0.036	0.035	0.002
Mining	-0.189	-0.187	-0.015	-0.186	0.184	-0.018
Miscellaneous	0.058	0.057	0.003	-0.019	-0.018	-0.001
Property and Real Estate	0.153	0.151	0.008	0.121	0.119	0.008
Trade, Services and Investments	0.095	0.094	0.005	0.032	0.032	0.002
Infrastructure, Utilities, and Transportation	0.009	0.009	0.000	-0.044	-0.044	-0.004

**Table 4.** The Result of Normality Test By Using Kolmogorov Smirnov

Description	Sig.
Unhedged Sharpe Index	0.1920
Unhedged Adjusted Sharpe Index	0.1920
Unhedged Treynor's Index	0.0950
Hedged Sharpe Index	0.2000
Hedged Adjusted Sharpe Index	0.2000

Base on the result of normality test, the Sharpe Index, Adjusted Sharpe Index, Treynor's Index is normally distributed because all of the P-Value of the Indices is greater than 0.05 and it means that this study will use Independent t-test. The Independent t-test requires levene test as the procedure to know whether the data is equal variance assumed or equal variance not assumed. The output of Levene test is shown in Table 5

**Table 5.** The Result of Levene Test

Description	Sig.
Sharpe Index	0.687
Adjusted Sharpe Index	0.687
Treynor's Index	0.710

The output of Levene test shows that the Sharpe Index, Adjusted Sharpe Index, and Treynor's Index is classified as equal variance assumed because all of the P-Value of the Indices is greater than 0.05. Hence the P-Value that will be used is the P-Value that classified equal variance assumed which can be seen in Table 6.

**Table 6.** The Result of Independent t-test

Description	Sig.
Sharpe Index	0.161
Adjusted Sharpe Index	0.161
Treynor's Index	0.326

The result of independent t-test showed that the three indices which are Sharpe Index, Adjusted Index, Treynor's index of all risk-adjusted return have P-Value that less than 0.05. It means that generally the risk-adjusted return of the hedged portfolio is less than the risk-adjusted return of the unhedged portfolio. This result shows that in general, composing a portfolio which consists of gold and Indonesian stock, can make the risk of the portfolio reduced but will not increase the risk-adjusted performance. This result is supporting the research conducted by Robiyanto et al. (2017b) who also found that gold can not improve the risk-adjusted performance of a portfolio which consists of Composite Stock Price Index and gold. However, the hedged portfolio consisted

of gold and Agriculture Index, gold and Mining Index, gold and Basic Industry and Chemicals Index, and also gold and Property and Real Estate Index have better risk-adjusted performance than the unhedged portfolio. This finding is consistent with the research conducted by Kumar (2014) and Arouri et al. (2014) who also found that hedging process will improve the risk-adjusted performance of a portfolio.

## Conclusion

This research concluded that gold is negatively correlated with stocks in Indonesia which are represented by Composite Stock Price Index and nine sectoral indices. The existence of a negative correlation between those two assets showed that gold could have a negative correlation with stock in Indonesia. Even, gold can become a safe haven asset for the CSPI and nine sectoral indices because gold is negatively correlated with stock in time of turmoil market that occurred in developing countries including Indonesia.

This study shows that gold can effectively become hedge assets for the Indonesian stocks by producing the score of hedging effectiveness that greater than zero. After comparing the risk-adjusted return between unhedged portfolio and hedged portfolio which has been compiled by dynamic portfolio, it is generally known that hedge and safe haven could not increase the risk-adjusted performance or in the other word, gold could not make the risk-adjusted return of hedged portfolio greater than an unhedged portfolio. However, the establishment of portfolio by combining the gold with Agriculture Index, Mining Index, Consumer Goods Industry Index, or Property and Real Estate Index showed a result that risk-adjusted return of hedged portfolio is greater than the risk-adjusted return of unhedged portfolio or in the other word the risk-adjusted performance of hedged portfolio is better than the risk-adjusted return of unhedged portfolio and these findings support the findings that have been found by Kumar (2014); Arouri et al. (2014); and Robiyanto et al. (2017b).

The focus of this research is on the establishment of a portfolio that contains only two assets which is gold and CSPI or each of nine sectoral indices in a portfolio while a portfolio usually consists of more than two assets. This limitation appears because this research used bivariate analysis as an analysis tool which is only can measure the correlation score of a portfolio that consists of two. Therefore, future research that observes a hedging strategy between gold and Indonesian Stock by using multivariate analysis is needed.

Investment manager and investors need to dynamically establish a combination of the portfolio between gold and stocks that classified into Agriculture Index, Mining Index, Consumer Goods Industry Index, or Property and Real Estate Index. Investment manager and investors also need to use gold as a hedged asset in their portfolio that consists of stock in Indonesia. Investment manager and investors are recommended to use the gold futures contract position to reduce the transaction cost and maximize the portfolio returns.

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