

1-30-2018

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Recommended Citation

Robiyanto, Robiyanto (2018) "DCC-GARCH Application in Formulating Dynamic Portfolio between Stocks in the Indonesia Stock Exchange with Gold," *The Indonesian Capital Market Review*. Vol. 10 : No. 1 , Article 3.

DOI: 10.21002/icmr.v10i1.10821

Available at: <https://scholarhub.ui.ac.id/icmr/vol10/iss1/3>

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INDONESIAN CAPITAL MARKET REVIEW

DCC-GARCH Application in Formulating Dynamic Portfolio between Stocks in the Indonesia Stock Exchange with Gold

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(Received: August 2017/ Revised: January 2018 / Accepted: January 2018 / Available Online: January 2018)

This study tries to form a portfolio by using a method which may accommodate the dynamic of assets correlation and the abnormality of stock return distribution namely DCC-GARCH. The objective of this study is to combine individual stocks with gold, so retail investor can also apply this method. This study using data from January 2009 –December 2017 period. Samples in this study were nine stocks. The results of this study showed that there were two stocks with higher Sharpe Ratio if combined with gold through dynamic portfolio formation (hedged portfolio) namely BBKA-Gold and SMCB-Gold than unhedged portfolio. And there are three stocks with higher Treynor Ratio if combined with gold through dynamic portfolio formation (hedged portfolio) namely BBKA-Gold, SMCB-Gold and UNTR-Gold than unhedged portfolio. This finding proves that the DCC-GARCH application can improve the risk-adjusted return of these stocks when combined with gold.

Keywords: DCC-GARCH, Hedging Effectiveness, Dynamic Portfolio, Optimal Hedge Ratio, Sharpe Ratio

JEL classification: G10; G11; G15

Introduction

Investment management is closely related to portfolio formation. Portfolio formation aims to create integrated balance to give protection and opportunity for investors. In line with it, Greer (1997) stated that strategic assets allocation is a series of pivotal decisions which should be made by a portfolio manager. Therefore, investors need to formulate integrated portfolio which meets the needs. The main theory that is often used in the formation of a portfolio is Modern Portfolio Theory.

Modern Portfolio Theory was initially introduced by Harry M. Markowitz (1952); Henry M. Markowitz (1959). Unfortunately, the the-

ory is not without critiques. The theory based on the assumption that stock return data is normally distributed. This assumption is a part that is mostly criticized by other academicians (e.g., Canedo and Cruz (2013); Chion, Veliz, and Carlos (2008)). Several research done by Canedo and Cruz (2013); Chion et al. (2008) showed that stock return tends to not normally distributed. The next critique is that a portfolio should employ dynamic approach due to the rapid changing of stock market condition across time. However, Modern Portfolio Theory introduced by Harry M. Markowitz (1952); Henry M. Markowitz (1959) tends to apply constant/static approach. The similar thing also happens for the portfolio formation by employing Single

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Index Model method. Dynamic portfolio is assumed to be able to result in better performance.

Meanwhile, since the global financial crisis in 2008, gold is viewed as an instrument that would be able to become hedge for stock market investors (Baur and Lucey (2010); Baur and McDermott (2009); Ciner, Gurdgiev, and Lucey (2012); Robiyanto, Wahyudi, and Pangestuti (2017a, 2017b)). Some research also prove that including gold in equity portfolio can improve portfolio performance. Ratner (2010) found that including gold in equity portfolio could improve portfolio performance significantly. This finding also supported by Robiyanto et al. (2017b). Even though, gold tends to underperform stock as a stand-alone investment instrument (Hoang, Lean, & Wong, 2015).

The inclusion of other asset class (i.e., gold) in portfolio formulation are rare in Indonesian setting, especially by using dynamic method. Most of research in Indonesia tend to use old-fashioned, static and traditional portfolio formulation such as Single Index Model and Markowitz (i.e., Anggraini (2013); Hamdani, Murhadi, and Sutejo (2015); Kewal (2014); Maryani (2015); Septyanto and Kertopati (2014)). While some researcher claim that the portfolio formulation must use a dynamic approach and methods that can accommodate data that is not normally distributed (Canedo & Cruz, 2013; Chion et al., 2008; Ogata, 2012).

Research which use the dynamic portfolio formulation approach have been conducted in developed countries and several other developing countries. In Indonesia, (i.e., Robiyanto et al. (2017a, 2017b) which use JCI to represent the Indonesia Stock Exchange), research in this area have not been conducted by using individual stocks. The usage of individual stocks as part of portfolio is important because it can applied directly by an individual investor. Therefore, in this research, gold is combined with stocks in Indonesia Stock Exchange in formulating portfolio. DCC-GARCH technique introduced by Engle (2002) used to formulate the dynamic portfolio. This method also been used by D. Kumar (2014) in India; Arouri, Lahiani, and Nguyen (2015) in China; Robiyanto et al. (2017b) in Indonesian and Malaysian capital

markets. This method also been used by Filis, Degiannakis, and Floros (2011) in crude oil market. DCC-GARCH could provide the dynamic correlation instead of static correlation, and can accommodate data that is not normally distributed.

To assess the stock combination effectiveness with gold into dynamic portfolio (hedged portfolio), hedging effectiveness comparison is done and different test for risk-adjusted return from hedged portfolio and unhedged portfolio. This study is expected to be a reference for the establishment of investment portfolio based on dynamic approach for institutional or retail stock investors in Indonesia Stock Exchange by using other asset class like gold. The retail investor tends to buy individual stocks, so they need another instrument to hedge, or diversify their portfolios. Since retail investor have fund limitation, so they must use an instrument that is affordable for them.

Literature Review

Modern Portfolio Theory and Modern Hedge Theory

Hedge theory is introduced by Keynes (1930) and Hicks (1939) based on the Hedging Pressure Hypothesis which stated that risk premium acquired by speculators, a reward from the availability to cover the price risk to be transferred by hedgers. This theory was then known with Tradition Hedge Theory. Through its development, Traditional Hedge Theory was argued Working (1953). Working (1953) stated that hedging action is an instrument in maximizing expected return.

Modern Portfolio Theory introduced by Harry M. Markowitz (1952); Henry M. Markowitz (1959) accommodates hedging action for certain portfolio by involving investment on assets in spot and futures markets. Assets utilization from spot and futures markets in formulating an effective portfolio is an important means to achieve minimum risk or maximize profit (Yingjing & Juanjuan, 2005). Alghalith (2010) also supports this statement by explaining that, historically, the attempts to achieve minimum

profit variances are the main goal of the hedgers.

Dynamic Conditional Correlation Application of Dynamic Portfolio

Engle (2002) explained that correlation is a crucial input for finance management. Asset allocation and risk estimation fully depend on correlation. Optimal portfolio formulation with a series of limitations requires return covariance matrix estimation. Similarly, estimation for standard deviation from portfolio requires covariance matrix from all available assets in portfolio. These functions follow estimation and prediction from giant covariance matrix with various assets (Robiyanto, 2017a).

Several actions in conducting correlation estimation among finance variables that can be depended have become triggers for various researches done by many academicians and practitioners in capital market. Simple method utilization of historical correlation and exponential smoothing) have been carried out by many researchers. Meanwhile, method utilization has higher sophistication level either GARCH or stochastic volatility have also been review by many on econometrical literature and applied by many expertise practitioners. One of them is Engle (2002) who has formulated Dynamic Conditional Correlation (DCC) estimator for it has flexibility within univariate GARCH.

Previous Studies About Dynamic Stock and Gold Portfolio Formulation By Using DCC-GARCH

Most previous studies about dynamic stock and gold portfolio formulation were done in emerging market setting, i.e. Arouri et al. (2015); D. Kumar (2014); Robiyanto et al. (2017b). Arouri et al. (2015) researched the potential use of gold as a hedge for the portfolio of stocks in the Chinese stock market. Variables used in this research is gold return and stock return. The data used from the period March 2, 2004, to March 31, 2011. The analysis is done by using various approaches DCC-GARCH. The results of this study indicate that gold can

be a good diversification tool for the portfolio and able to become a hedge for the stocks in the Chinese stock market.

D. Kumar (2014) used a relatively similar approach to Arouri et al. (2015) by establishing a hedging portfolio of sectors in the capital market in India. The data used is the period January 7, 2004, to June 30, 2012. The result of this research is that gold can be a good diversification tool for the portfolio and able to become a hedge for the shares of sectors in the Indian capital market. Both Arouri et al. (2015) and D. Kumar (2014) use DCC-GARCH in the formation of their portfolios and conclude that portfolios involving gold as a hedging instrument can result in better performance than a portfolio without a hedge.

Robiyanto et al. (2017b) undertook the establishment of a dynamic portfolio between the Indonesian and Malaysian stock markets with gold. Portfolio formation method used is to use DCC-GARCH. Robiyanto et al. (2017b) proves that the dynamic portfolio between the stock market and gold can result in better risk-adjusted return. This supports Artigas, Ong, Palmberg, Street, and Grubb (2010); Conover, Jensen, Johnson, and Mercer (2010) that including gold in stock portfolio will enhance its performance.

Hypothesis Formulation

Henry M. Markowitz (1959) stated that asset allocation gives effects on portfolio composition decisions. When portfolio managers employs active investment approach, then the allocation process will allow them to improve their across time value (Pangestuti, Wahyudi, & Robiyanto, 2017). However, when the portfolio managers apply passive approach, then the asset allocation process is purposed to eliminate portfolio volatility (Robiyanto, 2017b, 2018). In this research, the portfolio was in the form of dynamic portfolio. Thus, it is expected that the return adjusted to risk (risk-adjusted return) of hedge portfolio will be much better when compared to return adjusted to risk (risk-adjusted return) of unhedged portfolio.

DCC utilization can be developed in port-

folio diversification and hedging effectiveness. There have been some researchers who have implemented DCC model in formulating portfolio with hedging instrument like Arouri et al. (2015); B. P. Kumar and Supriya (2014); and Robiyanto et al. (2017b). They found that hedged portfolio with gold formulated with DCC can produce better risk-adjusted return. Those explanations have led to the following hypothesis:

H1: Hedged portfolio has better high risk-adjusted return compared to unhedged portfolio

Research Methods

Samples and Research Data

The data for this study are listed stocks in Indonesia Stock Exchange and the gold price in international market. While, the samples were stocks listed in Indonesia Stock Exchange gathered using purposive sampling with the following criteria: first, actively traded stocks, as reflected from the stock entrance during 2009 – 2017 period respectively into the LQ45 Index calculation, and second, never done any corporate action that cause nominal changes on stock price like stock split and reverse stock split.

16 stocks have met the first criteria, but 7 of them had stock split that finally there were only nine stock met the first and second criteria, they are: AALI, BBKA, BBNI, BDMN, INCO, INDF, SMCB, UNTR, and UNVR.

Stock price data for monthly closing during January 2009 – December 2017 period for those 9 stocks used as samples were acquired from the official site of the Indonesia Stock Exchange (www.idx.co.id), while the monthly closing data for gold price in international market during January 2009 – December 2017 were retrieved from www.kitco.com (according to Picard (2015); Robiyanto et al. (2017b), data from Kitco been extensively used in many research and publication, and recognized as reliable data source). BI rate (for period before August 2016) and the BI 7-Day Repo Rate which replacing BI rate (for period after August 2016) used as risk-free-rate proxy in this study. BI rate

and the BI 7-Day Repo Rate obtains from Bank Indonesia's official website. Monthly data used for data availability reason.

This study use gold price in international market because gold future trading in Indonesia was based on gold spot price. This is differ from other commodity futures markets which tend to use the futures price as its underlying price, hard commodity futures trading in Indonesia uses spot price as its underlying price. Indonesian futures trading uses two currency types; they are floating rate (follows the exchange market rate/investors using US\$ in their futures trading) and fixed rate (investors use Rupiah in their futures trading by assuming US\$ 1 = Rp 10,000) (Robiyanto et al., 2017b). Mini futures trading also available in Indonesia, investor can trade in decimal lot number (0.01 – 0.9). So, using gold international spot prices are applicable in Indonesian setting.

Technique of Analysis

This research employed Dynamic Conditional Correlation – Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model which was introduced by Engle (2002). DCC-GARCH is the development of GARCH model which was initially introduced by Bollerslev (1986). DCC-GARCH model assumes conditional correlation matrix changes across time and also apply for data which is not normally distributed (Robiyanto et al., 2017b). DCC-GARCH calculation was done by using Eviews Program. Meanwhile, hedging effectiveness (HE) was estimated by applying a formula established by Ku, Chen, and Chen (2007) as follows:

$$HE = \frac{Variance_{unhedged} - Variance_{hedged}}{Variance_{unhedged}} \quad (1)$$

Optimal hedge ratio by using the following formula :

$$\beta_t^{gs} = \frac{h_t^{sg}}{h_t^g} \quad (2)$$

where β_t^{gs} is optimal hedge ratio.

Table 1. Descriptive Statistics of Individual Stocks Return

No.	Name	N	Minimum (%)	Maximum (%)	Mean (%)	Dev. Std.
1.	AALI	108	-21.066	27.009	0.693	0.094
2.	BBCA	108	-15.384	31.914	2.015	0.069
3.	BBNI	108	-22.909	73.611	3.055	0.112
4.	BDMN	108	-26.612	38.308	1.293	0.105
5.	INCO	108	-52.611	31.496	1.850	0.101
6.	INDF	108	-27.675	53.932	1.449	0.151
7.	SMCB	108	-17.213	39.062	2.331	0.089
8.	UNTR	108	-28.571	40.740	1.222	0.118
9.	UNVR	108	-22.222	42.857	0.827	0.108

Source: Secondary data, processed.

Table 1. Summary of DCC Between Stocks and Gold

	Maximum	Minimum	Average
AALI-GOLD	0.291	-0.265	-0.033
BBCA-GOLD	0.882	-0.320	0.129
BBNI-GOLD	0.987	-0.270	0.202
BDMN-GOLD	0.471	-0.276	0.073
INCO-GOLD	0.576	-0.973	0.087
INDF-GOLD	0.533	0.196	0.374
SMCB-GOLD	0.460	-0.541	0.025
UNTR-GOLD	0.537	-0.858	0.035
UNVR-GOLD	0.576	-0.197	0.253

Source: Secondary data, processed.

Risk-adjusted return of portfolio performance formulated was calculated by employing the following Sharpe Ratio (RVOL) developed by Sharpe (1966) and Treynor Ratio (RVOL) developed by Treynor (1965) as follows:

$$\text{Reward to Variability Ratio (RVOL)} = \frac{\text{Average of Portfolio Return} - \text{Risk-Free Rate}}{\text{Portfolio's Standard Deviation}} \quad (3)$$

$$\text{Reward to Variability Ratio (RVOL)} = \frac{\text{Average of Portfolio Return} - \text{Risk-Free Rate}}{\text{Portfolio's Beta}} \quad (4)$$

Difference Test between risk-adjusted return measured with Sharpe Ratio and Treynor Ratio for hedged portfolio and unhedged portfolio was done by applying 2 (two) averages difference test (T-Test)

Results and Discussions

Descriptive Statistics Analysis

The descriptive statistics of individual stocks return used as this research samples can be observed in Table 1. The highest average stock return during the research period belonged to BBNI stock with the average return of 3.055%, while the lowest average return went to AALI stock with 0.693%. INDF is a stock with the

highest risk level with 0.152 of standard deviation value, while BBNI is a stock with the lowest risk level with 0.069 of standard deviation value.

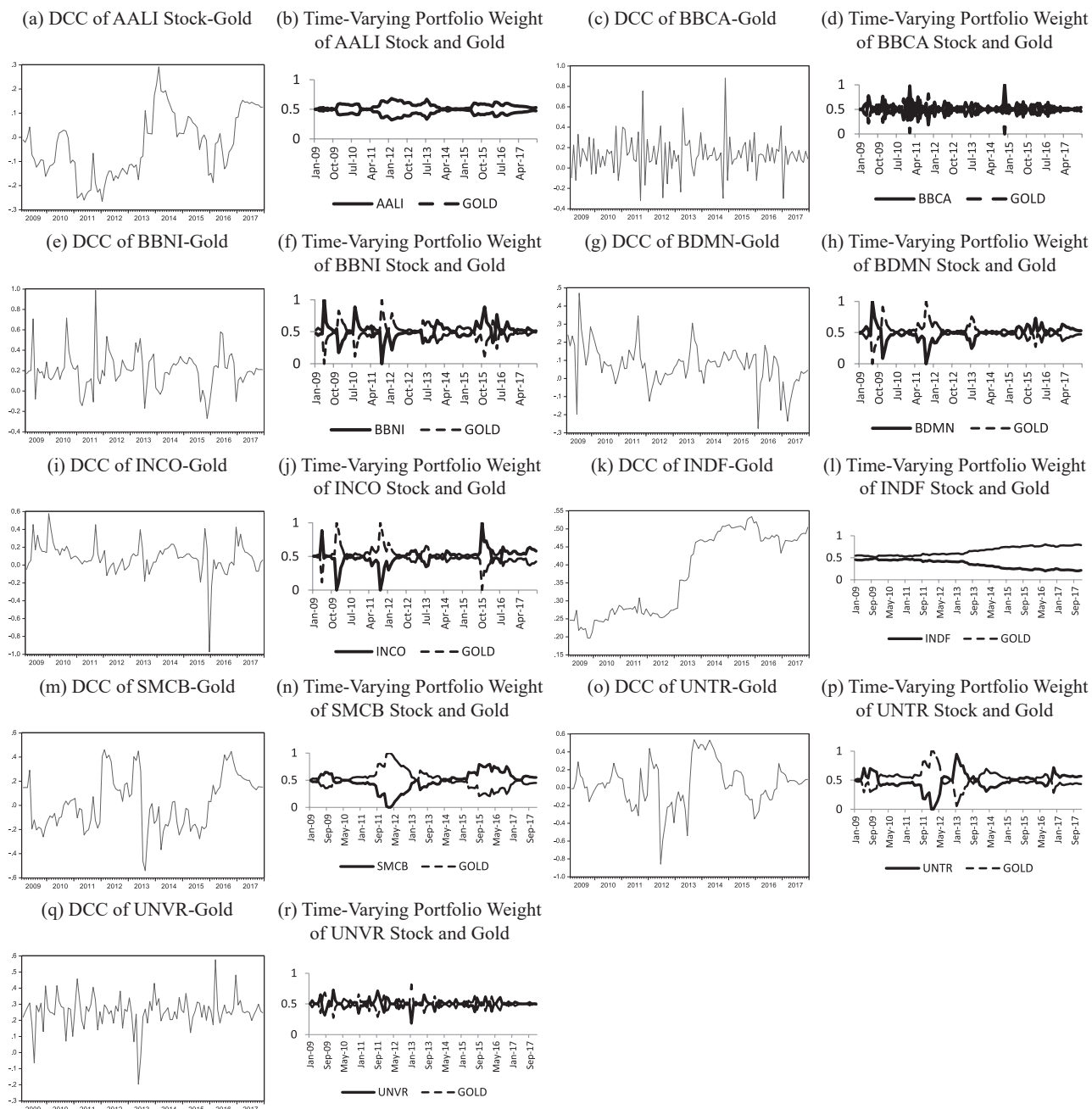
DCC-GARCH Analysis and Weight Ratio Portfolio

The calculation result of DCC-GARCH for each stock with gold respectively during the research period can be seen through Table 1 and Figure 1.

Overall, the average of DCC between stocks and gold are low. So, the portfolio formulation between stocks and gold are suitable. The DCC are ranging from -0.858 to 0.987. According to Harry M. Markowitz (1952), when the return of assets does not correlate, then diversification can eliminate risk. The highest average of DCC is 0.374, found in INDF-GOLD, while the lowest is -0.033, found in AALI-GOLD.

Figure 1 indicated that DCC for stocks and gold during the research period tends to be fluctuating and varying across the time. This shows that the usage of constant correlation coefficient in portfolio formulation is not appropriate. On the other hand, the portfolio weight calculation

Figure 1. DCC Between Stocks-Gold and Time-Varying Portfolio Weight



result done by employing DCC-GARCH also can be seen in Figure 1. The portfolio's weights are changing across time follows the changing in correlation. This finding consistent with research done by Arouri et al. (2015); Robiyanto et al. (2017b).

Optimal Hedge Ratio, Hedging Effectiveness, and Sharpe Ratio of Individual Stock with Gold Portfolio

The calculation results for optimal hedge ratio, hedging effectiveness, and Sharpe Ratio for

individual stock with gold portfolio have been summarized in Table 2 and explained in the following part.

The lowest optimal hedge ratio value goes to AALI-Gold portfolio with -4.615% of optimal hedge ratio, while, the highest one goes to INDF-Gold portfolio with 45.930%. This means that an investor who hold AALI stock must also buy Gold to hedge he/her portfolio. The comparison is buy Rp1 in AALI stock must also accompanied with buy Rp0.046 in Gold (also apply in future contract form, both mini or regular contract). While an investor who hold

Table 2. Optimal Hedge Ratio, Hedging Effectiveness and Sharpe Ratio for Individual Stocks with Gold

Portfolio	Optimal Hedge Ratio (%)	Hedging Effectiveness (%)	Average Return (%)	Standard Deviation	Sharpe Ratio	Treynor Ratio
AALI	-	-	0.693	0.096	0.015	0.003
BBCA	-	-	2.015	0.070	0.015	0.004
BBNI	-	-	3.055	0.113	0.222	0.014
BDMN	-	-	1.293	0.101	0.074	0.007
INCO	-	-	1.449	0.152	0.059	0.007
INDF	-	-	2.331	0.090	0.198	0.014
SMCB	-	-	0.827	0.111	0.025	0.002
UNTR	-	-	2.348	0.093	0.193	0.015
UNVR	-	-	2.078	0.706	0.217	0.004
Gold	-	-	0.048	0.049	-0.010	-0.003
AALI – Gold	-4.615	64.488	0.629	0.057	0.015	0.002
BBCA – Gold	12.613	60.257	1.456	0.044	0.205	0.016
BBNI – Gold	21.569	55.918	1.156	0.075	0.081	0.006
BDMN – Gold	8.884	59.843	0.732	0.064	0.029	0.002
INCO – Gold	11.062	65.210	0.945	0.090	0.044	0.005
INDF – Gold	45.930	39.937	1.584	0.069	0.149	0.012
SMCB – Gold	4.881	63.776	0.769	0.067	0.034	0.002
UNTR – Gold	6.489	59.809	1.473	0.059	0.157	0.013
UNVR – Gold	25.336	53.080	1.297	0.048	0.156	0.026
Average	14.683	58.035			0.096*	0.009**

Source: Secondary data, processed.

Note :

* Average of Sharpe Ratio hedged portfolio

** Average of Treynor Ratio hedged portfolio

INDF stock must also sell Gold to hedge he/her portfolio. The comparison is buy Rp1 in INDF stock must also accompanied with sell Rp0.459 in Gold (only apply in future contract form, both mini or regular contract). Overall, the average value of optimal hedge ratio for hedged stocks with gold instrument is 14.683%.

Hedging Effectiveness

From Table 2, it can be seen that the average value of hedging effectiveness for individual stocks hedged with gold is 58.035. The lowest hedging effectiveness value goes to UNVR-Gold portfolio with hedging effectiveness of 53.080%, which means adding Gold into portfolio that consist of UNVR can reduce 53.080% UNVR risk. While, the highest one found in INCO-Gold portfolio with 65.210%, which means adding Gold into portfolio that consist of INCO can reduce 65.210% INCO risk. All the individual stocks hedged with gold can produce bigger than 0 of hedging effectiveness value, so this means that gold could reduce the portfolio risk's variance around 53.080% to 65.210

%. Overall, these findings support the research findings from Arouri et al. (2015); D. Kumar (2014); Gencer and Musoglu (2014); Robiyanto et al. (2017b).

Sharpe Ratio's Mean Difference Test Result

Based on the average two difference test result for Sharpe Ratio of individual stocks dynamic portfolio hedged with gold (hedged portfolio) and unhedged portfolio of individual stocks as shown in Table 3, the calculation T value was acquired at 0.555 smaller than the table T value with significance level at 10% as big as 1.65. Thus, it can be concluded that the significant different between Sharpe Ratio of individual stocks dynamic portfolio hedged with gold (hedged portfolio) and unhedged portfolio of individual stocks is unavailable.

Sharpe Ratio average value of individual stocks dynamic portfolio hedged with gold (hedged portfolio) is at 0.096, smaller than the Sharpe Ratio average value of the unhedged portfolio at 0.113 which means there is a difference of average value at 0.016. It indicates that

Table 3. Test Results for Individual Stocks Sharpe Ratio

No.	Description	Mean Difference	T	Significance	Conclusion
1.	Sharpe Unhedged – Hedged By Gold	0.016	0.555	0.594	No Difference
2.	Treynor Unhedged – Hedged By Gold	-0.001	-0.496	0.633	No Difference

Source: Secondary data, processed.

the performance (risk-adjusted return) of stocks dynamic portfolio hedged with gold (hedged portfolio) measured with Sharpe Ratio is statistically relatively the same with the performance (risk-adjusted return) of unhedged portfolio. The same result also apply for Treynor Ratio. Based on the average two difference test result for Treynor Ratio of individual stocks dynamic portfolio hedged with gold (hedged portfolio) and unhedged portfolio of individual stocks, the calculation T value was acquired at 0.496 smaller than the table T value with significance level at 10% as big as 1.65. Thus, it can be concluded that the significant different between Treynor Ratio of individual stocks dynamic portfolio hedged with gold (hedged portfolio) and unhedged portfolio of individual stocks is unavailable.

Treynor Ratio average value of individual stocks dynamic portfolio hedged with gold (hedged portfolio) is at 0.009, higher than the Treynor Ratio average value of the unhedged portfolio at 0.007 which means there is a difference of average value at 0.001. It indicates that the performance (risk-adjusted return) of stocks dynamic portfolio hedged with gold (hedged portfolio) measured with Treynor Ratio although tends to be higher for hedged portfolio (which is indicates that Gold could reduce the volatility of portfolio), is statistically relatively the same with the performance (risk-adjusted return) of unhedged portfolio.

This study also find that Gold can improve BBCA and SMCB performance. Portfolio BBCA-Gold and SMCB-Gold have better performance (in term of Treynor Ratio and Sharpe Ratio) than BBCA and SMCB stand-alone (unhedged). While Gold can improve UNTR performance if measured by Treynor Ratio. Portfolio UNTR-Gold have better Treynor Ratio than UNTR alone. Gold can improve BBCA, SMCB and UNTR risk-adjusted performance because including gold into a portfolio can reduce portfolio's risk. This finding support Artigas et al.

(2010) and Conover et al. (2010)'s empirical results that including gold in stock portfolio will enhance its performance.

Conclusions, Limitations, and Implications

Conclusions

This research concluded that the average risk-adjusted return measured with Sharpe Ratio and Treynor Ratio from unhedged portfolio is indeed statistically not different with the average risk-adjusted return of hedged portfolio (individual stocks). However, individually, there are two stocks when hedged with gold will have better Sharpe Ratio and Treynor value than the unhedged ones, they are BBCA-Gold and SMCB-Gold. While UNTR-Gold has better Treynor Ratio that the UNTR alone. It indicates that the DCC-GARCH application can improve the risk-adjusted return of these stocks when combined with gold.

Limitations

This research still focuses on the use of stocks and gold as the instruments of portfolio formulation. There are still plenty of instruments from different asset classes that can be studied and included into portfolio like hard commodity such as precious metals and soft commodity such as oil and agricultural products that are traded in the commodity market. Future research which are going to employ the same technique need to consider those other investment instruments in formulating the dynamic portfolio.

Implications

Investment managers and individual investors who are investing in the Indonesia Stock Exchange need to employ gold instrument as

hedge for BBKA, SMCB and UNTR stocks. Investment managers also need to balance their investment proportions dynamically for both stock and gold instruments. It is unnecessary for investment managers and investors to buy in physical form, but may take positions in gold futures contract with not great amount of fund

for the existence of lever factor on futures contract. Also, the transaction cost will be cheaper and by the portfolio dynamism formulated in considering the investment policies done that will be active in selling and purchasing positions.

References

- Alghalith, M. (2010). A New Theory of Hedging. *Journal of Derivatives & Hedge Funds*, 16(2), 83-84. doi: <https://doi.org/10.1057/jdhf.2010.6>
- Anggraini, R. (2013). Analisis Pembentukan Portofolio Optimal Menggunakan Model Indeks Tunggal Untuk Pengambilan Keputusan Investasi. *Jurnal Ilmu & Riset Akuntansi*, 2(6), 1-24.
- Arouri, M. E. H., Lahiani, A., & Nguyen, D. K. (2015). World Gold Prices and Stock Return in China: Insights for Hedging and Diversification Strategies. *Economic Modelling*, 44, 273–282. doi: 10.1016/j.econmod.2014.10.030
- Artigas, J. C., Ong, E., Palmberg, J., Street, L., & Grubb, M. (2010). Gold: Hedging Against Tail Risk: World Gold Council.
- Baur, D. G., & Lucey, B. M. (2010). Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold. *The Financial Review*, 45, 217-229. doi: 10.1111/j.1540-6288.2010.00244.x
- Baur, D. G., & McDermott, T. K. (2009). Is Gold a Safe Haven?: International Evidence. *Institute for International Integration Studies (IIS) Discussion Paper*(310).
- Bollerslev, T. (1986). Generalized autoregressive conditional heteroscedasticity. *Journal of Econometrics*, 31, 307-327. doi: [https://doi.org/10.1016/0304-4076\(86\)90063-1](https://doi.org/10.1016/0304-4076(86)90063-1)
- Canedo, M. A., & Cruz, E. D. (2013). *The Philippine Stock Returns and The Levy Distribution*. Paper presented at the 12th National Convention on Statistics (NCS), EDSA Shangri-La Hotel, Mandaluyong City.
- Chion, S. J., Veliz, C., & Carlos, N. (2008). On the Normality of Stock Return Distributions: Latin American Markets 2000-2007. *Journal of CENTRUM Cathedra*, 1(2), 90-108. doi: <http://dx.doi.org/10.7835/jccberj-2008-0015>
- Ciner, C., Gurdgiev, C., & Lucey, B. M. (2012). Hedges and Safe Havens – An Examination of Stocks, Bonds, Oil, Gold and the Dollar. *Working Paper*.
- Conover, C. M., Jensen, G. R., Johnson, R. R., & Mercer, J. M. (2010). Is Now the Time to Add Commodities to Your Portfolio? *Journal of Investing*, 4(10-19).
- Engle, R. F. (2002). Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics*, 20(3), 339-350. doi: <http://dx.doi.org/10.1198/073500102288618487>
- Filis, G., Degiannakis, S., & Floros, C. (2011). Dynamic Correlation between Stock Market and Oil Prices: The Case of Oil-Importing and Oil-Exporting Countries. *International Review of Financial Analysis*, 20(3), 152-164. doi: doi:10.1016/j.irfa.2011.02.014
- Gencer, H. G., & Musoglu, Z. (2014). Volatility Transmission and Spillovers among Gold, Bonds and Stocks: An Empirical Evidence from Turkey. *International Journal of Economics and Financial Issues*, 4(4), 705-713.
- Greer, R. J. (1997). What is an Asset Class, Anyway? *Journal of Portfolio Management*, 23(2), 86-91. doi: 10.3905/jpm.23.2.86
- Hamdani, A. S., Murhadi, W. R., & Sutejo, B. S. (2015). Pembentukan Portofolio Optimal Pada Indeks KOMPAS100 Periode 2013-2014. *Calyptra: Jurnal Ilmiah Mahasiswa Universitas Surabaya*, 4(2), 1-13.
- Hicks, J. (1939). *Value and Capital*: Oxford University Press.

- Hoang, T.-H.-V., Lean, H. H., & Wong, W.-K. (2015). Is Gold Good for Portfolio Diversification? A Stochastic Dominance Analysis of the Paris Stock Exchange. *International Review of Financial Analysis*. doi: <https://doi.org/10.1016/j.irfa.2014.11.020>
- Kewal, S. S. (2014). Pembentukan Portofolio Optimal Saham-Saham Pada Periode Bullish di Bursa Efek Indonesia. *Jurnal Economica*, 9(1), 81-91.
- Keynes, J. M. (1930). *Treatise on Money* London Macmillan.
- Ku, Y.-H. H., Chen, H.-C., & Chen, K.-H. (2007). On the Application of the Dynamic Conditional Correlation Model in Estimating Optimal Time-varying Hedge Ratios. *Applied Economics Letters*, 14(7), 503-509. doi: 10.1080/13504850500447331
- Kumar, B. P., & Supriya, M. V. (2014). Evidence on Hedging Effectiveness in Indian Derivatives Market. *Asia-Pacific Financial Markets*, 21(2), 121-131. doi: 10.1007/s10690-014-9179-6
- Kumar, D. (2014). Return and Volatility Transmission Between Gold and Stock Sectors: Application of Portfolio Management and Hedging Effectiveness. *IIMB Management Review*, 26(1), 5-16. doi: 10.1016/j.iimb.2013.12.002
- Markowitz, H. M. (1952). Portfolio Selection. *Journal of Finance*, 7(1), 77-91. doi: <http://dx.doi.org/10.1111/j.1540-6261.1952.tb01525.x>
- Markowitz, H. M. (1959). *Portfolio Selection: Efficient Diversification of Investments*. New York: John Wiley & Sons, Inc.
- Maryani, E. (2015). Analisis Pembentukan Portofolio Saham Optimal Menggunakan Model Indeks Tunggal dan Model Markowitz (Studi Kasus Pada Saham BUMN Yang Terdaftar di Bursa Efek Indonesia). *JOM FEKON*, 2(2).
- Ogata, H. (2012). Optimal Portfolio Estimation for Dependent Financial Returns with Generalized Empirical Likelihood. *Advances in Decision Sciences*, 2012, 1-8. doi: <http://dx.doi.org/10.1155/2012/973173>
- Pangestuti, I. R. D., Wahyudi, S., & Robiyanto, R. (2017). Performance Evaluation of Equity Mutual Funds in Indonesia Period of 2012-2014. *Jurnal Keuangan dan Perbankan* 21(4), 527-542.
- Picard, J. (2015). *Essays in High-Frequency Trading*. Dissertation, Michigan State University, Michigan.
- Ratner, M. (2010). Diversification Benefits of Alternative Asset Investment Using GARCH Dynamic Conditional Correlation Analysis. *Working Paper*.
- Robiyanto, R. (2017a). The Analysis of Capital Market Integration in ASEAN Region by Using the OGARCH Approach. *Jurnal Keuangan dan Perbankan* 21(2), 169-175.
- Robiyanto, R. (2017b). Performance evaluation and risk aversion rate for several stock indices in Indonesia Stock Exchange. *Jurnal Manajemen dan Kewirausahaan*, 19(1), 60-64. doi: 10.9744/jmk.19.1.60-64
- Robiyanto, R. (2018). Performance Evaluation of Stock Price Indexes in the Indonesia Stock Exchange. *International Research Journal of Business Studies*, 10(3), 173-182. doi: <https://doi.org/10.21632/irjbs.10.3.173-182>
- Robiyanto, R., Wahyudi, S., & Pangestuti, I. R. D. (2017a). Testing Commodities as Safe Haven and Hedging Instrument on ASEAN's Five Stock Markets *Jurnal Ekonomi Kuantitatif Terapan*, 10(2), 231-238. doi: <https://doi.org/10.24843/JEKT.2017.v10.i02.p11>
- Robiyanto, R., Wahyudi, S., & Pangestuti, I. R. D. (2017b). The volatility-variability hypotheses testing and hedging effectiveness of precious metals for the Indonesian and Malaysian capital markets. *Gadjah Mada International Journal of Business*, 19(2), 167-192. doi: 10.22146/gamaijb.26260
- Septyanto, D., & Kertopati, B. (2014). Analisa Pembentukan Portofolio Dengan Menggunakan Model Markowitz dan Single Index Model Pada Saham Yang Masuk dalam Indeks LQ45 di Bursa Efek Indonesia Tahun 2009-2013. *Finance and Banking Journal*, 16(2), 140-156.
- Sharpe, W. F. (1966). Mutual Fund Performance. *Journal of Business*, 39(1), 119-138. doi: <http://dx.doi.org/10.1086/294846>
- Treynor, J. L. (1965). How to Rate Management of Investment Funds. *Harvard Busi-*

ness Review, 43(1), 63-75.

Working, H. (1953). Futures Trading and Hedging. *American Economic Review*, 43, 314-343. doi: <http://www.jstor.org/sta->

ble/1811346

Yingjing, Z., & Juanjuan, L. (2005). The Researches on Hedging of Small and Medium-sized Enterprises. *Working Paper*.