JASF | **Journal of Accounting and Strategic Finance**
Vol.5 No.1 June 2022, pp. 1-21.

ISSN 2614-6649 (online)
http://jasf.upnjatim.ac.id

Revisit the Dynamic Portfolio Formation between Gold and Stocks in Indonesia in the Period Before and During the COVID-19 Pandemic

Ashalia Fitri Yuliana, Robiyanto Robiyanto[1]

Department of Management, Faculty of Economic and Business, Satya Wacana Christian University, Jalan Diponegoro 52-60 Salatiga, Jawa Tengah 50711, Indonesia

DOI: https://doi.org/10.33005/jasf.v5i1.161

***Received**: January 21, 2021. **Revised:** February 15, 2021. **Accepted:** July 27,2021*

Abstract

This research aims to review the formation of the dynamic portfolio of individual stocks and gold using the DCC-GARCH and ADCC-GARCH analysis techniques in the periods before and during the COVID-19 pandemic. This is done so that individual investors and investment managers will be able to apply this method. This research uses data from the period of October 2019 - September 2020 with a research sample of nine stocks that are included in the IDX-30. The results showed that the DCC-GARCH analysis technique before the COVID-19 pandemic and the performance of the dynamic portfolios that were unhedged and hedged had no difference. This is due to the conditions in the period before the COVID-19 pandemic which still tended to be stable, thus, no safe-haven asset is needed. Meanwhile, in the period during the COVID-19 pandemic, using the DCC-GARCH analysis technique, there were differences because conditions have started to fluctuate in uncertainty which resulted in the need for safe-haven assets. On the other hand, using the ADCC-GARCH analysis technique on the periods before and during the COVID-19 pandemic, the performance of the dynamic portfolios that were unhedged and hedged showed a difference. Because the ADCC-GARCH technique is able to see asymmetric volatility for the future, adding gold to a portfolio can reduce risk when there is uncertainty. This research also found that the ADCC-GARCH technique had better performance than the DCC-GARCH technique.

Keywords: *DCC-GARCH, ADCC-GARCH, Dynamics Portfolio, Hedging Effectiveness, Optimal Hedge Ratio.*

How to cite (APA 7th style)
Yuliana, A. F. & Robiyanto, R. (2022). Revisit the Dynamic Portfolio Formation between Gold and Stocks in Indonesia in the Period Before and During the COVID-19 Pandemic. *Journal of Accounting and Strategic Finance*, *5* (1), 1-21.

[1] Robiyanto Robiyanto
E-mail: *robiyanto.robiyanto@uksw.edu*

INTRODUCTION

A long-term investment is intended to generate returns at the high return level expected by investors. To maximize profits in investing, an investor may allocate it into strategic assets by determining the type of investment that is feasible and forming a portfolio that has better performance (Markowitz, 1952). The formation of a portfolio aims to create balance, provide protection and opportunities for investors. Therefore, the formation of a portfolio is very important for investors.

Modern portfolio theory is a basic theory of portfolio formation with the basic assumption of normally distributed stock return and tends to use a constant approach (Markowitz, 1959). The assumption that the data is normally distributed tends to be inconsistent with the research conducted by Chion et al. (2008); Canedo & Cruz (2013). In addition, several studies in Indonesia tend to use constant portfolios and the Single Index Model method, as done by Hamdani et al. (2015); Defri & Moch. Dzulkirom (2017); Oktaviani & Wijayanto (2016) and Kewal (2013).

However, portfolio formation still rarely uses a dynamic approach due to rapid changes from time to time (Robiyanto, 2018a). According to the research done by Chion et al. (2008), dynamic portfolio formation is a method that can handle data not normally distributed and is considered to have better performance. In addition, research on portfolio formation in Indonesia also tends to use only one asset class even though the types of the stock index used vary. Meanwhile, in the formation of a dynamic portfolio, different asset class instruments such as gold can be used.

Gold is an asset class instrument that has a negative correlation when financial markets are volatile Baur & Lucey (2010); Robiyanto (2018b). Thus, gold and stocks have different characteristics during volatile financial market conditions such as during the COVID-19 pandemic. This is proven by the significant increase in the gold prices which reached US$ 1,806 per ounce troy (Kontan, 2020). However, the Indonesian capital market experienced a decline and uncertainty with the composite stock price index corrected as much as 63.06% to IDR 3,989 (Katadata, 2020). The decline in stock prices was due to the fact that many investors gave up their financial assets and moved into assets with lower risk and safety, such as gold. However, gold tends to underperform as an investment asset when it stands alone (Hoang et al. 2015). Therefore, gold can be included in the formation of a dynamic portfolio which is still rarely studied in Indonesia. In addition, portfolios using asset classes with different values can produce better returns (Raza et al. 2019).

Research on the formation of dynamic portfolios has been carried out by various developed and developing countries. In Indonesia, Robiyanto (2017) uses the composite stock price index to represent the Indonesia Stock Exchange. In addition, research on dynamic portfolio formation using different asset classes was also conducted by Robiyanto et al. (2019a) combining stock and fixed income instruments. Research on dynamic portfolio formation by

combining cryptocurrency with stocks in Indonesia was also carried out by (Pamilangan & Robiyanto, 2019b). Furthermore, Robiyanto (2018a) researched portfolio formation by combining gold and individual stocks in Indonesia.

Several studies on dynamic portfolio formation in Indonesia only used the LQ45 index as a proxy for stocks and not all of them used individual stocks. Meanwhile, the use of individual stocks in portfolios is needed by investors to protect asset values and directly diversify portfolios. In addition, the DCC-GARCH analysis technique is also still used.

According to the research by Cappiello et al. (2006), the DCC-GARCH analysis technique has a limitation in which the conditional correlation does not take into account the dynamics of the asymmetric effect. Thus, in considering the impact of past shocks on volatility and future conditional correlation, it is still not possible to distinguish the effects of positive and negative shocks. Therefore, the DCC-GARCH analysis technique needs to be extended with the ADCC-GARCH analysis technique. This is because the ADCC-GARCH analysis technique studies the current volatility behavior due to the asymmetric effect in the conditional correlation between a series of positive or negative returns for the future and can also solve the problem of heteroscedasticity and is better used to measure the correlation with different asset classes. In addition, the ADCC-GARCH analysis technique method can measure conditional correlations over varying times, and build conditional correlations one step ahead of aftershocks and optimal hedging ratios (Raza et al. 2018). In Indonesia, research using the ADCC-GARCH analysis technique is also rarely carried out.

In addition, this study aims to use the IDX30 index as a proxy for individual stocks in Indonesia. The IDX30 Index is an index that measures the price performance of 30 stocks that have high capitalization and the highest market liquidity from the LQ45 index. So that the IDX30 index contains stocks from LQ45 which are conical on stocks with high liquidity. The IDX30 index is updated using the free float ratio every February and July (BEI, 2020).

Therefore, this research aims to review the formation of the dynamic portfolio of gold as an asset class which is different from stocks in Indonesia included in IDX30 as a proxy for individual stocks. This is to discover whether the dynamic portfolio formed between gold and individual stocks has a better performance than dynamic portfolios formed by individual stocks alone. The analytical techniques used are DCC-GARCH and ADCC-GARCH and stock data before the COVID-19 pandemic as well as during the COVID-19 pandemic. This research is expected to be able to add to the literature on the formation of a dynamic portfolio of gold and individual stocks in Indonesia using the ADCC-GARCH analysis technique. It can also be a consideration for individual investors and investment managers informing dynamic portfolios to diversify and hedge in order to invest using the right, affordable and better performance instruments.

The formulation of dynamic portfolios of stocks and gold has been researched in developing markets to look at the potential use of gold as a hedge for stock portfolios, one of which is in the Chinese stock market which has found that gold can be a good diversification tool for portfolios and can be a hedge for stocks (Arouri et al. 2015). Research on dynamic portfolios between the stock market and gold produces risk-adjusted returns and will improve its

performance using the DCC-GARCH analysis technique (Robiyanto et al. 2017). Robiyanto (2018a) also found that two stocks with the Sharpe ratio and three stocks with the Treynor ratio have a higher correlation when combined with gold through the formation of dynamic portfolios and portfolios with hedging.

In addition, with the ADCC-GARCH analysis technique, gold can be an effective hedge for the real estate sector stocks in the short and long term in the United States, while the importance of volatility in various scales and asymmetries shows that negative shocks tend to increase conditional volatility (variance) more than positive shocks (Raza et al. 2018). El Abed & Zardoub (2019) found that gold and financial markets show asymmetry in conditional variance with the application of a flexible modeling framework. Thus, investors and portfolio managers who enter gold and stocks into their portfolios can control risks when there is turmoil in the financial market and take advantage of diversification opportunities. In addition, gold and the information technology stock index can be a hedge, a strong portfolio diversification tool while gold can also predict the future returns of the durable goods and consumer goods index (Trabelsi et al. 2020).

Investors and investment managers in allocating portfolio assets must make decisions that have an affects on the portfolio composition using two approaches, namely the active and passive approaches. The active approach aims to increase the value over time while the passive approach aims to eliminate portfolio volatility (Robiyanto, 2020). The formation of a dynamic portfolio is expected to have a risk-adjusted return from a hedged portfolio that has a better performance when compared to the risk-adjusted return of an unhedged portfolio. Because this research carries out the formation of a portfolio using the DCC-GARCH and ADCC-GARCH analysis technique, the hypothesis formulation is as follows:

H1: Portfolios formed between gold and IDX30 individual stocks performs better than those formed by IDX30 individual stocks

H1a: Portfolios formed by the DCC-GARCH analysis technique between gold and IDX30 individual stocks performs better than those formed by IDX30 individual stocks

H1b: Portfolios formed by the ADCC-GARCH analysis technique between gold and IDX30 individual stocks performs better than those formed by IDX30 individual stocks

The ADCC-GARCH analysis technique is considered to be able to measure the most effective hedging than the DCC-GARCH because it can distinguish the presence of asymmetric effects. The ADCC-GARCH analysis technique studies current volatility and then distinguishes the effects of positive and negative shocks in the future which allows investors to consider risks to hedge their assets (Jin et al. 2020). In addition, Cui & Feng (2020) found that the ADCC-GARCH is the best method in single hedging and time-varying conditional correlation and also provides evidence of continuous changes in correlation across periods. The ADCC-GARCH method allows asymmetric effects in conditional variants and conditional correlations to increase

over time as well as lower diversification during volatile conditions (Gjika & Horváth, 2013). Raza et al. (2019) show that the ADCC-GARCH analysis technique with alternative gold assets can provide a better diversification effect and return. Thus, this research also aims to compare the performance formed between the DCC-GARCH and ADCC-GARCH analysis techniques, because the ADCC-GARCH analysis technique is considered better. Therefore, the formulation of the hypothesis is as follows:

H2: Portfolios formed using the ADCC-GARCH analysis technique have better performance than portfolios formed using the DCC-GARCH analysis technique

RESEARCH METHOD

This research uses a quantitative approach using secondary data that has been published by reliable sources. The data used in this research is the daily closing price of gold futures in grams obtained from icdx.co.id and the daily closing price of stocks included in the IDX30 stock index sourced from yahoo finance in the period of October 2019 - September 2020. The samples are the stocks included in the IDX30 which were collected using purposive sampling with the following criteria:

Table 1. Sample Selection Based on Criteria

No.	Criteria	Number of Company
1.	Companies included in the IDX30 index in the period of October 2019 - September 2020	40
2.	Companies that are inconsistent included in the IDX30 index in the period of October 2019 – September 2020	(19)
3.	Companies with a market capitalization of less than IDR 100.000.000.000.000,-	(11)
4.	Companies that did stock split or reverse stock split in years 2019 - 2020	(1)
	The final amount of sample	9

Based on the sample selection above, 9 companies that meet the criteria are obtained, namely: ASII, BBCA, BBNI, BBRI, BMRI, GGRM, HMSP, ICBP, and TLKM. In addition, the operational definition of the variables in this research uses the calculation of the return of each variable which is formulated in Table 2.

This research uses time series data which is divided into daily, weekly, monthly and annual data (Robiyanto et al. 2017) causing time changes that are so fast from time to time and not normally distributed data. To overcome this, this research uses DCC-GARCH and ADCC-GARCH techniques with Eviews 9 software. Dynamic correlation coefficients in the DCC-GARCH and ADCC-GARCH approaches are used as a substitute for static correlation in

portfolio formation because this technique can accommodate data that is not normally distributed and changes in conditional correlation over time.

Table 2. The Operational Definition of a Variable

Variable	Measurement
Gold return	Return $Gold_t$ = (P $Gold_t$ – P $Gold_{t-1}$) / P $Gold_{t-1}$
The stock return included in the index IDX-30	Return $Stock_t$ = (P $Stock_t$ – P $Stock_{t-1}$) / P $Stock_{t-1}$

In addition, the Asymmetric Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity (ADCC-GARCH) technique allows the leverage effect to study current volatility and estimate the effects of positive or negative shocks in the future that cannot be analyzed by DCC-GARCH, overcoming the problem of heteroscedasticity and captures potential asymmetric effects. The period in this study was divided from before and during the COVID-19 pandemic. Thus, to include the impact of the leverage effect, the following formula is used:

$$Q_{t=}\left(S^{O}-A'S^{O}A-B'S^{O}B-G'NG\right)+A'\varepsilon_{t-1}\,\varepsilon'_{t-1}+A+\,B'Q_{t-1}\,B+G'n_{t-1}n'_{t-1} \quad \text{.....(1)}$$

Where A, B, and G are diagonal parameter matrices and $n_t = \mathrm{I}[\varepsilon_t < 0]ozt$ (o is a variable indicator).

Meanwhile, to assess the hedging effectiveness of the established portfolio and minimize risk, the hedging effectiveness developed by Ku, Chen & Chen (2007) is formulated as follows:

$$HE = \frac{Variances_{unhedged}-Variances_{hedged}}{Variances_{unhedged}} \quad \text{.....(2)}$$

The optimal hedge ratio is formulated as follows:

$$\beta_t^{gs} = \frac{h_t^{sg}}{h_t^{g}} \quad \text{.....(3)}$$

On the other hand, in calculating portfolio performance with Risk-Adjusted Return, the Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio, and Omega ratio are used. The Sharpe ratio is formulated as follows:

$$Sharpe\ ratio = \frac{Average\ Portfolio\ Return}{Standart\ Deviation\ \ Portfolio} \quad \text{.....(4)}$$

Sortino ratio is formulated as follows:

$$SoM = \frac{R_i - RFR_t}{\delta} \quad \text{.....(5)}$$

where δ is downside deviation from the stock market index return in a certain period which is calculated by the following formula:

$$\delta = \frac{\sqrt{\sum(minRp-MAR,0)^2}}{N-1} \quad \text{.....(6)}$$

Jensen ratio is formulated as follows:

$$Jensen\ Alpha = \Delta R - \beta \Delta M \quad \text{.....(7)}$$

where, ΔR = excess return and ΔM = market excess return

Treynor ratio is formulated as follows:

$$Treynor\ ratio = \frac{Average\ of\ Portfolio\ Return - Risk\ Free\ Rate}{Portfolio\ Beta} \quad \text{.....(8)}$$

Omega ratio is formulated as follows:

$$Omega\ Ratio = \frac{\int_t^{\infty}(1-F(x))dx}{\int_{-\infty}^{t} F(x)dx} \quad \text{.....(9)}$$

where, F(x) = cumulative probability distribution

$\int_t^{\infty}(1-F(x))dx$ = probability of return above the given limit

$\int_{-\infty}^{t} F(x)dx$ = probability of return below the given limit

Difference test between risk-adjusted return with Sharpe ratio, Sortino ratio, Jensen Ratio, Treynor ratio, and omega ratio for portfolios that are unhedged and hedged, as well as the comparison of DCC-GARCH and ADCC-GARCH analysis techniques are done with the T-test.

RESULTS AND DISCUSSION

Result

Descriptive Statistic Analysis

Descriptive statistics calculations show that the highest average individual stock return before the COVID-19 pandemic was owned by BMRI stocks of 0.1681% and the lowest average of -0.1248% was owned by HMSP. Meanwhile, during the COVID-19 pandemic, the highest average return on individual stocks was owned by ICBP stocks of -0.0296%, and the lowest average of -0.3322% was owned by BBNI stocks. Descriptive statistics of individual stock returns used in this research sample can be seen in Table 3.

Analysis using DCC-GARCH and ADCC-GARCH

The results of the calculation of individual stocks with gold for the period before and during the COVID-19 pandemic using the DCC and ADCC techniques can be seen in Table 4.

The DCC-GARCH analysis technique before the COVID-19 pandemic ranged from -0.9991 to 0.9879 where the highest average of 0.2071 was found in ICBP-Gold and the lowest average was found in BMRI-Gold of -0.1951. In addition, the DCC-GARCH analysis technique during the COVID-19 pandemic ranged from -0.6046 to 0.8115 where the highest average was found in HMSP-Gold of 0.0359 and the lowest average of -0.2656 was found in BBRI-Gold.

Meanwhile, the ADCC-GARCH analysis technique before the COVID-19 pandemic ranged from -0.1558 to 0.2397 where the highest average of 0.2269 was found in ICBP-Gold and the lowest average was found in ASII-Gold of -0.1513. During the COVID-19 pandemic, it than

ranged from -0.2073 to 0.0300 where the highest average was found in ICBP-Gold of 0.0179 and the lowest average of -0.1998 was found in BBRI-Gold.

Table 3. Descriptive Statistics of Individual Stock Return Before and During The COVID-19 Pandemic

BEFORE THE COVID-19 PANDEMIC						
No	**Name**	**N**	**Minimum (%)**	**Maximum (%)**	**Mean (%)**	**Dev. Std**
1.	ASII	62	-2.3077	4.5802	0.0772	0.0156
2.	BBCA	62	-2.2946	3.9231	0.1600	0.0093
3.	BBNI	62	-4.8110	4.6358	0.1034	0.0166
4.	BBRI	62	-3.8462	3.8071	0.0970	0.0170
5.	BMRI	62	-5.4348	4.7273	0.1681	0.0167
6.	GGRM	62	-5.6540	6.9084	0.0377	0.0214
7.	HMSP	62	-4.8458	5.3398	-0.1248	0.0211
8.	ICBP	62	-4.5833	4.3981	-0.1013	0.0145
9.	TLKM	62	-4.4496	3.0769	-0.1221	0.0145
DURING THE COVID-19 PANDEMIC						
No	**Name**	**N**	**Minimum (%)**	**Maximum (%)**	**Mean (%)**	**Dev. Std**
1.	ASII	149	-11.4537	12.7072	-0.2161	0.0342
2.	BBCA	149	-7.9137	17.3333	-0.0974	0.0288
3.	BBNI	149	-11.7188	13.6076	-0.3322	0.0366
4.	BBRI	149	-8.8805	20.4918	-0.1717	0.0402
5.	BMRI	149	-12.9921	15.8031	-0.2094	0.0370
6.	GGRM	149	-10.9659	19.9848	-0.1233	0.0359
7.	HMSP	149	-9.3548	16.4502	-0.2023	0.0357
8.	ICBP	149	-6.9832	14.4578	-0.0296	0.0274
9.	TLKM	149	-6.9620	13.7405	-0.2121	0.0282

Source: Secondary data, processed

Optimal Hedge Ratio, Hedging Effectiveness for Individual Stocks with Gold Before and During The COVID-19 Pandemic

The results Optimal Hedge Ratio, Hedging Effectiveness for Individual Stocks with Gold Before and During The COVID-19 Pandemic can be seen in Table 5.

Table 4. Summary of DCC and ADCC Between Individual Stocks and Gold Before and During The COVID-19 Pandemic

BEFORE PANDEMIC COVID-19						
Portfolio	**DCC-GARCH**			**ADCC-GARCH**		
	Minimum	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
ASII – Gold	-0.5476	0.9879	0.0686	-0.1558	-0.1455	-0.1513
BBCA – Gold	-0.8588	0.1071	-0.1286	-0.0327	-0.0227	-0.0292
BBNI – Gold	-0.8814	0.7241	-0.0829	-0.0361	-0.0241	-0.0302
BBRI – Gold	-0.1872	0.5845	0.1541	0.0236	0.0371	0.0314
BMRI – Gold	-0.3639	-0.1156	-0.1951	-0.0235	-0.0151	-0.0183
GGRM – Gold	-0.9375	0.3169	0.0323	0.0777	0.0936	0.0839
HMSP– Gold	-0.9991	0.5079	0.0285	-0.0001	0.0097	0.0045
ICBP – Gold	-0.8267	0.7106	0.2071	0.2189	0.2397	0.2269
TLKM -Gold	-0.2585	0.1482	-0.0599	-0.0558	-0.0412	-0.0505
DURING PANDEMIC COVID-19						
Portfolio	**DCC-GARCH**			**ADCC-GARCH**		
	Minimum	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
ASII – Gold	-0.2898	0.0436	-0.1307	-0.1262	-0.1038	-0.1189
BBCA – Gold	-0.4176	0.8115	-0.1464	-0.1755	-0.1595	-0.1685
BBNI – Gold	-0.5714	0.2435	-0.1936	-0.1893	-0.1685	-0.1795
BBRI – Gold	-0.5002	0.5359	-0.2656	-0.2073	-0.1891	-0.1998
BMRI – Gold	-0.2986	0.0099	-0.1209	-0.1350	-0.1170	-0.1291
GGRM – Gold	-0.2755	0.4915	0.0012	-0.1187	-0.0989	-0.1116
HMSP– Gold	-0.2583	0.7442	0.0359	-0.0828	-0.0493	-0.0749
ICBP – Gold	-0.5066	0.5335	0.0159	0.0073	0.0300	0.0179
TLKM -Gold	-0.6046	0.2489	-0.1363	-0.1308	-0.1076	-0.1201

Source: Secondary data, processed

The Performance of Individual Stocks with Gold Before and During The COVID-19 Pandemic

The results of the Performance for Individual Stocks with Gold Before and During The COVID-19 Pandemic can be seen in Table 6.

Table 5. Optimal Hedge Ratio, Hedging Effectiveness for Individual Stocks with Gold Before and During Pandemic COVID-19

BEFORE PANDEMIC COVID-19								
Portfolio	DCC-GARCH				ADCC-GARCH			
	Optimal Hedge Ratio (%)	Hedging Effectiveness (%)	Average Return (%)	standard Deviation	Optimal Hedge Ratio (%)	Hedging Effectiveness (%)	Average Return (%)	standard Deviation
ASII	-	-	0.0772	0.0155	-	-	0.1031	0.0156
BBCA	-	-	0.1600	0.0093	-	-	0.1707	0.0093
BBNI	-	-	0.1034	0.0166	-	-	0.1383	0.0166
BBRI	-	-	0.0970	0.0170	-	-	0.1417	0.0168
BMRI	-	-	0.1681	0.0167	-	-	0.1885	0.0168
GGRM	-	-	0.0377	0.0214	-	-	0.0454	0.0215
HMSP	-	-	-0.1248	0.0211	-	-	-0.1268	0.0212
ICBP	-	-	-0.1013	0.0145	-	-	-0.0995	0.0147
TLKM	-	-	-0.1221	0.0145	-	-	-0.1012	0.0145
Gold	-	-	0.0204	0.0069	-	-	-0.0179	0.0070
ASII-Gold	16.3715	84.8319	0.0282	0.0060	-14.6619	69.9500	0.0775	0.0085
BBCA-Gold	-93.3817	62.4815	0.0718	0.0057	-2.9921	63.3247	0.0965	0.0056
BBNI-Gold	-7.8499	69.5005	0.0755	0.0092	-3.3860	72.1748	0.1210	0.0087
BBRI-Gold	15.8835	71.7134	0.0642	0.0090	3.1018	70.4159	0.1317	0.0091
BMRI-Gold	-19.5453	75.2828	0.0962	0.0083	-2.8296	76.5009	0.1591	0.0081
GGRM-Gold	2.7340	69.2779	0.0637	0.0118	8.8542	72.3839	0.0520	0.0113
HMSP-Gold	0.6622	68.9928	-0.0300	0.0117	0.6737	67.6055	-0.0333	0.0121
ICBP-Gold	20.5345	55.9731	-0.0628	0.0096	22.9518	64.3671	-0.0483	0.0087
TLKM-Gold	-5.7708	69.3847	-0.0634	0.0080	-5.3243	69.9013	-0.0302	0.0080
Average	-7.8180	69.7154			0.7097	69.6249		
DURING PANDEMIC COVID-19								
Portfolio	DCC-GARCH				ADCC-GARCH			
	Optimal Hedge Ratio (%)	Hedging Effectiveness (%)	Average Return (%)	Standard Deviation	Optimal Hedge Ratio (%)	Hedging Effectiveness (%)	Average Return (%)	standard Deviation
ASII	-	-	-0.2161	0.0342	-	-	-0.2127	0.0343
BBCA	-	-	-0.0974	0.0288	-	-	-0.0986	0.0289
BBNI	-	-	-0.3322	0.0366	-	-	-0.3280	0.0367
BBRI	-	-	-0.1717	0.0402	-	-	-0.1744	0.0404
BMRI	-	-	-0.2094	0.0370	-	-	-0.2174	0.0371
GGRM	-	-	-0.1233	0.0359	-	-	-0.1286	0.0360
HMSP	-	-	-0.2023	0.0357	-	-	-0.2005	0.0358
ICBP	-	-	-0.0296	0.0274	-	-	-0.0298	0.0275
TLKM	-	-	-0.2121	0.0282	-	-	-0.2033	0.0283
Gold	-	-	0.1979	0.0144	-	-	0.1880	0.0144
ASII-Gold	-13.0899	74.3926	-0.0178	0.0173	-12.3499	74.7219	-0.0053	0.0172
BBCA-Gold	-13.4648	72.2569	0.0692	0.0152	-18.2645	75.6736	0.0543	0.0142
BBNI-Gold	-24.2931	82.6729	-0.0892	0.0152	-18.2997	74.8263	-0.0619	0.0184
BBRI-Gold	-32.1622	81.2364	0.0247	0.0174	-21.2416	77.3735	0.0155	0.0192
BMRI-Gold	-12.1123	73.4757	-0.0085	0.0190	-13.2823	74.3876	-0.0058	0.0188
GGRM-Gold	-0.0854	70.2674	0.0238	0.0196	-11.5456	73.1828	0.0297	0.0187
HMSP-Gold	5.7211	76.1895	-0.1067	0.0174	-7.6826	71.9014	-0.0107	0.0190
ICBP-Gold	2.2919	69.3255	0.0073	0.0152	1.5763	70.3049	0.0769	0.0150
TLKM-Gold	-13.5465	74.8421	-0.0032	0.0141	-12.4722	74.1438	-0.0074	0.0144
Average	-11.1935	74.9621			-12.6180	74.0573		

Source: Secondary data, processed

Table 6. The Performance of Individual Stocks with Gold Before and During the COVID-19 Pandemic

BEFORE THE COVID-19 PANDEMIC										
	DCC-GARCH					ADCC-GARCH				
Portfolio	Sharpe ratio	Sortino ratio	Jensen ratio	Treynor ratio	Omega ratio	Sharpe ratio	Sortino ratio	Jensen ratio	Treynor ratio	Omega ratio
ASII	0.0406	0.0860	0.0004	0.0004	1.1103	0.0573	0.1219	0.0004	0.0006	1.1598
BBCA	0.1575	0.3191	0.0014	0.0023	1.5991	0.1684	0.3407	0.0014	0.0025	1.6548
BBNI	0.0538	0.0933	0.0007	0.0005	1.1558	0.0751	0.1310	0.0007	0.0008	1.2257
BBRI	0.0489	0.0819	0.0006	0.0005	1.1376	0.0763	0.1294	0.0008	0.0008	1.2241
BMRI	0.0923	0.1571	0.0013	0.0009	1.2767	0.1041	0.1768	0.0012	0.0010	1.3183
GGRM	0.0112	0.0190	0.0000	0.0002	1.0311	0.0146	0.0249	-0.0002	0.0002	1.0409
HMSP	-0.0658	-0.1124	-0.0016	-0.0009	0.8425	-0.0662	-0.1136	-0.0019	-0.0009	0.8428
ICBP	-0.0792	-0.1152	-0.0012	-0.0025	0.7904	-0.0774	-0.1126	-0.0013	-0.0024	0.7956
TLKM	-0.0937	-0.1450	-0.0016	-0.0009	0.7864	-0.0792	-0.1225	-0.0016	-0.0008	0.8155
Gold	0.0095	0.0159	0.0001	-0.0009	1.0257	0.0058	0.0097	0.0001	-0.0005	1.0155
ASII-Gold	0.0237	0.0398	0.0001	0.0003	1.0639	0.0745	0.1489	0.0004	0.0009	1.2153
BBCA-Gold	0.1019	0.1898	0.0005	0.0027	1.3084	0.1464	0.3088	0.0007	0.0030	1.4714
BBNI-Gold	0.0671	0.1242	0.0005	0.0008	1.1925	0.1227	0.2449	0.0008	0.0015	1.3957
BBRI-Gold	0.0557	0.0951	0.0004	0.0006	1.1494	0.1292	0.2168	0.0009	0.0016	1.3952
BMRI-Gold	0.0991	0.1900	0.0007	0.0010	1.2719	0.1786	0.3746	0.0012	0.0020	1.5515
GGRM-Gold	0.0421	0.0747	0.0004	0.0006	1.1240	0.0337	0.0568	0.0002	0.0006	1.0975
HMSP-Gold	-0.0374	-0.0660	-0.0005	-0.0006	0.9050	-0.0390	-0.0663	-0.0007	-0.0007	0.9034
ICBP-Gold	-0.0795	-0.1053	-0.0008	-0.0041	0.7844	-0.0711	-0.0971	-0.0007	-0.0027	0.8151
TLKM-Gold	-0.0963	-0.1433	-0.0009	-0.0011	0.7730	-0.0553	-0.0856	-0.0006	-0.0007	0.8645
Average	0.0185	0.0420	0.0000	0.0002	1.0699	0.0420	0.0888	0.0001	0.0004	1.1475
DURING THE COVID-19 PANDEMIC										
	DCC-GARCH					ADCC-GARCH				
Portfolio	Sharpe ratio	Sortino ratio	Jensen ratio	Treynor ratio	Omega ratio	Sharpe ratio	Sortino ratio	Jensen ratio	Treynor ratio	Omega ratio
ASII	-0.0668	-0.1076	0.0000	-0.0017	0.8318	-0.0656	-0.1057	0.0000	-0.0017	0.8349
BBCA	-0.0381	-0.0689	0.0009	-0.0009	0.8861	-0.0384	-0.0694	0.0009	-0.0009	0.8857
BBNI	-0.0941	-0.1534	-0.0009	-0.0023	0.7638	-0.0927	-0.1510	-0.0008	-0.0022	0.7672
BBRI	-0.0457	-0.0845	0.0010	-0.0011	0.8733	-0.0462	-0.0856	0.0009	-0.0011	0.8724
BMRI	-0.0600	-0.0984	0.0004	-0/0014	0.8450	-0.0619	-0.1018	0.0003	-0.0015	0.8405
GGRM	-0.0378	-0.0675	0.0009	-0.0010	0.8874	-0.0391	-0.0700	0.0009	-0.0010	1.4213
HMSP	-0.0602	-0.1070	0.0001	-0.0017	0.8407	-0.0594	-0.1058	0.0001	-0.0016	0.8427
ICBP	-0.0153	-0.0258	0.0012	-0.0004	0.9529	-0.0153	-0.0259	0.0012	-0.0004	0.9540
TLKM	-0.0796	-0.1414	-0.0004	-0.0020	0.7984	-0.0762	-0.1355	-0.0003	-0.0020	0.8058
Gold	0.1287	0.2356	0.0016	-0.0150	1.4479	0.1219	0.2226	0.0015	-0.0143	1.4213
ASII-Gold	-0.0174	-0.0292	0.0007	-0.0005	0.9539	-0.0102	-0.0172	0.0008	-0.0003	0.9727
BBCA-Gold	0.0375	0.0749	0.0015	0.0010	1.1215	0.0295	0.0578	0.0013	0.0008	1.0932
BBNI-Gold	-0.0666	-0.1018	-0.0002	-0.0021	0.8352	-0.0403	-0.0669	0.0004	-0.0011	0.8927
BBRI-Gold	0.0071	0.0120	0.0012	0.0002	1.0198	0.0017	0.0030	0.0013	0.0000	1.0049
BMRI-Gold	-0.0110	-0.0188	0.0010	-0.0003	0.9703	-0.0097	-0.0165	0.0010	-0.0003	0.9739
GGRM-Gold	0.0059	0.0109	0.0012	0.0002	1.0187	0.0093	0.0175	0.0012	0.0003	1.0298
HMSP-Gold	-0.0684	-0.1179	-0.0004	-0.0025	0.8217	-0.0121	-0.0221	0.0008	-0.0004	0.9648
ICBP-Gold	0.0429	0.0792	0.0014	0.0015	1.1389	0.0432	-0.0762	0.0013	0.0016	1.1369
TLKM-Gold	-0.0110	-0.0202	0.0006	-0.0003	0.9707	-0.0137	-0.0257	0.0006	-0.0004	0.9629
Average	-0.0237	-0.0384	0.0006	-0.0016	0.9462	-0.3752	-0.0327	0.0007	-0.0014	0.9830

Source: Secondary data, processed

The Performance of Dynamic Portfolios Unhedged and Hedged with Gold In The Period Before and During the COVID-19 Pandemic

The results on differences between Dynamics Portfolio that are Unhedged – Hedged can be seen in Table 7.

Table 7. Test Results on Differences between Dynamics Portfolio Unhedged - Hedged Before and During the COVID-19 Pandemic

DCC-GARCH BEFORE THE COVID-19 PANDEMIC					
No.	**Description**	**Mean Difference**	**T**	**Significance**	**Conclusion**
1.	Sharpe Unhedged - Hedged By Gold	-0.0012	-0.1385	0.8932	No Difference
2.	Sortino Unhedged – Hedged By Gold	-0.0016	-0.0882	0.9318	No Difference
3.	Jensen Unhedged – Hedged By Gold	0.0000	-0.2062	0.9417	No Difference
4.	Treynor Unhedged – Hedged By Gold	-0.0003	-1.6703	0.1333	No Difference
5.	Omega Unhedged – Hedged By Gold	0.0174	0.4736	0.6484	No Difference
ADCC-GARCH BEFORE THE COVID-19 PANDEMIC					
No.	**Description**	**Mean Difference**	**T**	**Significance**	**Conclusion**
1.	Sharpe Unhedged - Hedged By Gold	-0.0273	-2.9193	0.0193	Difference
2.	Sortino Unhedged – Hedged By Gold	-0.0584	-2.6265	0.0303	Difference
3.	Jensen Unhedged – Hedged By Gold	-0.0003	-1.5607	0.1571	No Difference
4.	Treynor Unhedged – Hedged By Gold	-0.0004	-3.1215	0.0141	Difference
5.	Omega Unhedged – Hedged By Gold	-0.0702	-1.7609	0.1162	No Difference
DCC-GARCH DURING THE COVID-19 PANDEMIC					
No.	**Description**	**Mean Difference**	**T**	**Significance**	**Conclusion**
1.	Sharpe Unhedged - Hedged By Gold	-0.0462	-5.6185	0.0004	Difference
2.	Sortino Unhedged – Hedged By Gold	-0.0826	-5.5991	0.0005	Difference
3.	Jensen Unhedged – Hedged By Gold	-0.0004	-2.9101	0.0195	Difference
4.	Treynor Unhedged – Hedged By Gold	-0.0010	-3.6980	0.0060	Difference
5.	Omega Unhedged – Hedged By Gold	-0.1301	-5.3867	0.0006	Difference
ADCC-GARCH DURING THE COVID-19 PANDEMIC					
No.	**Description**	**Mean Difference**	**T**	**Significance**	**Conclusion**
1.	Sharpe Unhedged - Hedged By Gold	-0.0547	-23.1520	0.0000	Difference
2.	Sortino Unhedged – Hedged By Gold	-0.0952	-19.1145	0.0000	Difference
3.	Jensen Unhedged – Hedged By Gold	-0.0006	-5.3803	0.0006	Difference
4.	Treynor Unhedged – Hedged By Gold	-0.0014	-13.6265	0.0000	Difference
5.	Omega Unhedged – Hedged By Gold	-0.0897	-1.4728	0.1790	No Difference

Source: Secondary data, processed

Comparison of DCC-GARCH and ADCC-GARCH Before and During The COVID-19 Pandemic
The results of DCC-GARCH and ADCC-GARCH before and during the COVID-19 Pandemic can be seen in Table 8.

Table 8. Comparison of DCC-GARCH and ADCC-GARCH Before and During the COVID-19 Pandemic

BEFORE THE COVID-19 PANDEMIC					
No.	**Description**	**Mean Difference**	**T**	**Significance**	**Conclusion**
1.	Sharpe DCC – ADCC	-0.0250	-4.0183	0.0008	Difference
2.	Sortino DCC – ADCC	-0.0497	-3.7051	0.0017	Difference
3.	Jensen DCC – ADCC	0.0000	-1.2658	0.2226	No Difference
4.	Treynor DCC – ADCC	-0.0001	-0.9891	0.3364	No Difference
5.	Omega DCC – ADCC	-0.0824	-3.8903	0.0011	Difference
DURING THE COVID-19 PANDEMIC					
No.	**Description**	**Mean Difference**	**T**	**Significance**	**Conclusion**
1.	Sharpe DCC – ADCC	-0.0045	-1.3057	0.2090	No Difference
2.	Sortino DCC – ADCC	-0.0067	-1.1592	0.2623	No Difference
3.	Jensen DCC – ADCC	0.0000	-1.2490	0.2285	No Difference
4.	Treynor DCC – ADCC	-0.0001	-1.3398	0.1979	No Difference
5.	Omega DCC – ADCC	-0.0403	-1.3308	0.2008	No Difference

Source: Secondary data, processed

Discussion

Analysis using DCC-GARCH and ADCC-GARCH
Overall, Table 4 shows that the average of DCC-GARCH and ADCC-GARCH among individual stocks with gold is low. Thus, the dynamic portfolio formulation between individual stocks and gold is accurate. According to Alkhazali & Zoubi (2020) combining stocks and gold can reduce risk, because gold is considered a good asset for diversification. With the diversification of individual investors and investment managers, the optimal portfolio can also be built (Jiang et al. 2019).

Optimal Hedge Ratio
The results of calculations using the DCC-GARCH analysis technique in Table 5 show that the lowest optimal hedge ratio value is in the BBCA-Gold portfolio before the COVID-19 pandemic of -93.3817% and the highest optimal hedge ratio value of 20.5345% is in the ICBP-Gold portfolio before the COVID-19 pandemic. This means that investors who own BBCA stocks must also buy gold to hedge their portfolios. The comparison is when buying Rp 1 stock of BBCA, it must be accompanied by the purchase of Rp 0.9328 of Gold. Meanwhile, for the hedged ICBP-Gold portfolio, when investors own ICBP stocks, it is also accompanied by selling gold. In comparison, when an investor buys Rp 1 stock of ICBP it is also accompanied by selling

Rp 0.2053 of gold. This applies to both short- and medium-term future contracts. Overall, with the DCC-GARCH technique before and during the COVID-19 pandemic, the optimal average value of the stock hedge ratio with gold was -7.8180% and -11.1935%.

Meanwhile, calculations using the ADCC-GARCH technique show that the lowest optimal hedge ratio value was in the BBRI-Gold portfolio of -21.2416% during the COVID-19 pandemic and the highest optimal hedge ratio value of 22.9518% was found in the ICBP-Gold portfolio before the COVID-19 pandemic. Thus, investors who buy BBRI stocks are also offset by buying gold to hedge their portfolios with a comparison to when investors buy Rp 1 stock of BBRI and must buy Rp 0.2124 of gold. Furthermore, in ICBP stock, an investor must sell gold to hedge their portfolio with a comparison to when an investor buys Rp 1 stock of ICBP and must also sell Rp 0.2295 of gold (valid in the form of long- and medium-term contracts in the future). Overall, in using the ADCC-GARCH technique before and during the COVID-19 pandemic, the optimal average value of the stock hedge ratio with gold was 0.7097% and -12.6180%.

Hedging Effectiveness

Table 5. shows the results of the hedging effectiveness value between individual stocks and gold before and during the COVID-19 pandemic using the DCC-GARCH and ADCC-GARCH techniques of each 69.7154% and 74.9621%. The lowest hedging effectiveness value was found in the ICBP-Gold portfolio before the COVID-19 pandemic of 55.9731%, which means that when adding gold to the portfolio consisting of ICBP, it can reduce 55.9731% of ICBP risk. Meanwhile, the highest hedging effectiveness value was found in the ASII-Gold portfolio before the COVID-19 pandemic amounting to 84.8319% which means that adding gold to the portfolio consisting of ASII can reduce 84.8319% of ASII risk. Thus, all individual stocks that are hedged with gold can produce hedging effectiveness of greater than 0 and gold can reduce the portfolio risk shown by the portfolio variant from 55.9731% to 84.8319%.

The results of calculations using the ADCC-GARCH technique before and during the COVID-19 pandemic show that the average effectiveness value between individual stocks and gold is 69.6249% and 74.0573%, respectively. The lowest hedging effectiveness value was found in the BBCA-Gold portfolio before the COVID-19 pandemic of 63.3247%, which means that when adding gold to the portfolio consisting of BBCA it can reduce 63.3247% of BBCA risk. On the other hand, the highest hedging effectiveness value was found in the BBRI-Gold portfolio during the COVID-19 pandemic of 77.3735% which means that when adding gold to the portfolio consisting of BBRI, it can reduce 77.3735% of BBRI risk. Thus, all individual stocks that are hedged with gold can produce hedging effectiveness of greater than 0 and gold can reduce the portfolio risk represented by the portfolio variant from 63.3247% to 77.3735%. The result of this research is in line with the research done by Robiyanto (2018b); Izadi & Hassan (2018); Adewuyi et al. (2019).

The Performance of Dynamic Portfolios Unhedged and Hedged with Gold In The Period Before and During the COVID-19 Pandemic

The calculation of the dynamic portfolio performance that is unhedged and hedged uses the DCC-GARCH technique before and during the COVID-19 pandemic in Table 7. Overall average difference test results on Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio, and Omega ratio shows that the t value is smaller than the t table value of 1.3968 with a significance level of 10%. The average Sharpe ratio, Sortino ratio, Jensen ratio, and Treynor ratio before the COVID-19 pandemic is shown in Table 6. The dynamic portfolio of individual stocks hedged with gold is greater than the unhedged portfolio with a difference of 0.0012; 0.0017; 0.0004; and 0.0004. Whereas in the Omega ratio, the dynamic portfolio of individual stocks that are unhedged tends to be bigger than the dynamic portfolio that is hedged with gold by 0.0175. Thus, the overall dynamic portfolio performance that was unhedged and hedged before the COVID-19 pandemic was relatively the same and did not show any significant changes.

Furthermore, during the COVID-19 pandemic using the DCC-GARCH analysis technique which is shown in Table 6. the average value of the Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio, and Omega ratio in the dynamic portfolio hedged with gold is greater than the dynamic portfolio which is unhedged with a difference of 0.0463; 0.0826; 0.0004; 0.0011 and 0.1301. This shows that overall, there is a significant difference between a dynamic portfolio that is unhedged and hedged with gold during the COVID-19 pandemic.

On the other hand, the results of the calculation of the performance difference test for dynamic portfolios that are unhedged and hedged with gold in Table 7. also show that the calculation using the DCC-GARCH analysis technique before the COVID-19 pandemic consistently has no difference. This is due to the conditions before the COVID-19 pandemic which tended to be stable and did not require safety assets. Therefore, adding gold to the portfolio does not show any difference between the portfolio performance that is unhedged and hedged with gold. Meanwhile, during the COVID-19 pandemic, market conditions were volatile, thus safe-haven assets such as gold were needed in the portfolio so that their performance would improve.

The results of the calculation of dynamic portfolio performance that are unhedged and hedged with gold using the ADCC-GARCH analysis technique before and during the COVID-19 pandemic can be seen in Table 7. The results of the average difference test on the Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio, and Omega ratio show that the value of t count is smaller than the value of the t-table of 1.3968 with a significance level of 10%. In Table 6, the average value of the Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio, and Omega ratio in the portfolios hedged with gold is greater than the unhedged portfolios with a difference of 0.0274; 0.0584; 0.0003; 0.0004, and 0.0702. This means that the dynamic portfolio performance that was unhedged and hedged with gold before the COVID-19 pandemic showed a significant difference except for the Jensen ratio and the Omega ratio.

In Table 6. during the COVID-19 pandemic using the ADCC-GARCH analysis technique, the average value of the Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio and Omega ratio in a dynamic portfolio that is hedged with gold is greater than a dynamic portfolio

that is unhedged by a difference of 0.0547; 0.0952; 0.0006; 0.0014 and 0.0897. This shows a significant difference between dynamic portfolios that are unhedged and those that were hedged with gold during the COVID-19 pandemic, except for the Omega ratio.

Based on different test calculations, it can be seen that almost all the performance of dynamic portfolios that are unhedged and hedged with gold using the ADCC-GARCH technique before and during the COVID-19 pandemic consistently showed differences. This is because the ADCC-GARCH technique was able to capture the effect of asymmetric volatility for the future. Therefore, adding gold as a safe asset can reduce risk and improve portfolio performance.

The results of this research also found that the DCC-GARCH technique before the COVID-19 gold pandemic could improve the performance of the HMSP-Gold and ICBP-Gold portfolios (by calculating the Jensen ratio and the Treynor ratio). Meanwhile, during the COVID-19 pandemic, gold could also improve the performance of the BBCA-Gold portfolio (by calculating the Sharpe ratio and Omega ratio) and the TLKM-Gold portfolio (by calculating the Sortino ratio).

In addition, this research also found that with the ADCC-GARCH technique before the COVID-19 pandemic, gold could improve the performance of the BMRI-Gold and HMSP-Gold portfolios (by calculating the Sortino ratio and the Jensen ratio). During the COVID-19 pandemic, gold could also increase the performance of the BBCA-Gold portfolio (by calculating the Sharpe ratio, Sortino ratio, and Omega ratio) as well as the ICBP-Gold portfolio (by calculating the Treynor ratio). This research is in line with Conover et al. (2010); Robiyanto (2018b); Alkhazali & Zoubi (2020); Zhang et al. (2020) who found that gold can improve portfolio performance and reduce portfolio risk.

Comparison of DCC-GARCH and ADCC-GARCH Before and During the COVID-19 Pandemic

The results of the comparison of the average difference test between the DCC-GARCH and ADCC-GARCH analysis techniques in the period before and during the COVID-19 pandemic in Table 8 show that the t count value is smaller than the t table of 1.3968 with a 10% significance level. In the period before the COVID-19 pandemic, the average value of Sharpe ratio, Sortino ratio and Omega ratio using DCC-GARCH and ADCC-GARCH analysis techniques each had a difference of 0.0250; 0.0498, and 0.0825. This shows a significant difference. Meanwhile, the Jensen ratio and the Treynor ratio have an average difference of 0.0001 and 0.0002 which indicates that there is no significant difference using the DCC-GARCH or ADCC-GARCH analysis techniques. During the COVID-19 pandemic, the average Sharpe ratio, Sortino ratio, Jensen ratio, Treynor ratio, and Omega ratio using the DCC-GARCH and ADCC-GARCH analysis techniques had an average difference of 0.0045; 0.0067; 0.0001; 0.0002; 0.0403 and indicates that there are no significant changes.

Based on the results from different tests using the DCC-GARCH and ADCC-GARCH techniques before the COVID-19 pandemic, which is shown in Table 8. it was found that there was a difference using the Sharpe ratio, Sortino ratio, and Omega ratio calculations because the

variability method was used in calculations. Meanwhile, during the COVID-19 pandemic, there was no difference in performance using both the DCC-GARCH and ADCC-GARCH techniques because financial market conditions were volatile and adding gold as a hedging instrument did not change the performance of the two techniques. In addition, the analysis in both time periods proved that the ADCC-GARCH analysis technique was better than the DCC-GARCH analysis technique because it had a higher average value. This research is in line with Basher & Sadorsky (2016); Jin et al. (2020); Cui & Feng (2020).

CONCLUSIONS

The purpose of this research is to review whether the dynamic portfolio formation of gold and IDX30 individual stocks have a better performance than dynamic portfolios formed by IDX30 individual stocks alone. This research uses the DCC-GARCH and ADCC-GARCH analysis techniques with the period before and during the COVID-19 pandemic. The results show that with the DCC-GARCH analysis technique in the period before the COVID-19 pandemic, the performance of hedged and unhedged value dynamic portfolios had no difference because the conditions were still stable. Thus, no safe-haven assets were needed. Meanwhile, in the period during the COVID-19 pandemic, the performance of the hedged and unhedged dynamic portfolios was different. Furthermore, with the ADCC-GARCH analysis technique in the period before and during the COVID-19 pandemic, the performance that was hedged and unhedged had a difference. This is because the ADCC-GARCH technique was able to capture asymmetric volatility in the future because adding gold as a safe-haven asset in the period before and during the COVID-19 pandemic can reduce risk and improve portfolio performance. In addition, it was also found that the ADCC-GARCH analysis technique was better than DCC-GARCH.

Therefore, investment managers and individual investors need to add gold as a hedging instrument for BBCA, HMSP, and ICBP stocks in order to reduce risk. Investment managers and individual investors must also be able to balance investments dynamically. In addition, there is also no need to buy physical instruments, but to take a gold futures contract position with a not-so-large amount of funds due to the lifting factor in the futures contract and saving transaction costs.

This research also has limitations, that is the available gold-futures data is not as complete as stock data. Therefore, many stock data were eliminated and the data used had the same amount. In addition, this research also uses a different asset class instrument which is gold. Thus, interested researchers may look for more complete data on future instruments and add different asset class instruments besides gold.

List of Abbreviations

ADCC: Asymmetric Dynamic Conditional Correlation; ADCC-GARCH: Asymmetric Dynamic Conditional Correlation – Generalized Autoregressive Conditional Heteroscedasticity; DCC: Dynamic Conditional Correlation; DCC-GARCH: Dynamic Conditional Correlation –

Generalized Autoregressive Conditional Heteroscedasticity; COVID-19: Coronavirus Disease-2019; GARCH: Generalized Autoregressive Conditional Heteroscedasticity; IDX-30: Indonesia Stock Exchange-30; ADCC-GARCH: Asymmetric Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity; DCC-GARCH: Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroscedasticity

Authors' Contribution

Conceptualization: AFY, R. Data curation: AFY. Formal analysis: AFY, R. Investigation: AFY, R. Methodology: AFY, R. Project administration: AFY. Resources: AFY, R. Supervision: R. Validation: AFY, R. Visualization: AFY, R. Writing – original draft: AFY, R. Writing – review and editing: AFY, R.

Authors' Information

Ashalia Fitri Yuliana (AFY) graduated from the Faculty of Economics and Business (2021), Satya Wacana Christian University, Salatiga. She holds a Broker-Dealer Representative license from the Indonesia Financial Service Authority (previously the Indonesia Capital Market Supervisory Agency). Currently, she works as an equity analyst at PT Samuel Sekuritas Indonesia. Her research interests are capital market and commodity market.

Robiyanto (R) graduated from the Doctoral Program in Economics (2015), Faculty of Economics and Business, Diponegoro University, Semarang, Indonesia, and he holds a master of management degree in Finance (2000) from the same university. His first degree in Management (1998) was obtained from Satya Wacana Christian University, Salatiga, Indonesia. His second Doctoral degree was obtained from Doctoral Program in Environmental Studies (2021), Soegijapranata Catholic University, Semarang, Indonesia. He holds an Investment Manager Representative license and Broker-Dealer Representative license from the Indonesia Financial Service Authority (previously the Indonesia Capital Market Supervisory Agency). He is active as an academic researcher. His research interests are capital market, commodity market, market efficiency, corporate governance, and portfolio management.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no competing interests.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from icdx.co.id, idx.co.id, and Yahoo Finance. All data is easily accessed through those websites.

REFERENCES

Adewuyi, A. O., Awodumi, O. B., & Abodunde, T. T. (2019). Analysing The Gold-Stock Nexus Using VARMA-BEKK-AGARCH and Quantile Regression Models: New Evidence From South Africa and Nigeria. *Resources Policy*, *61*(February), 348–362. https://doi.org/10.1016/j.resourpol.2019.02.015

Alkhazali, O. M., & Zoubi, T. A. (2020). Gold and Portfolio Diversification: A Stochastic Dominance Analysis of The Dow Jones Islamic Indices. *Pacific-Basin Finance Journal*, *60*(January), 101264. https://doi.org/10.1016/j.pacfin.2020.101264

Basher, S. A., & Sadorsky, P. (2016). Hedging Emerging Market Stock Prices with Oil, Gold, VIX, and Bonds: A Comparison between DCC, ADCC, and GO-GARCH. *Energy Economics*, *54*, 235–247. https://doi.org/10.1016/j.eneco.2015.11.022

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*(2), 217–229. https://doi.org/10.1111/j.1540-6288.2010.00244.x

BEI. (2020). *Indeks Saham*. https://www.idx.co.id/produk/indeks/

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).

Cappiello, L., Engle, R. F., & Sheppard, K. (2006). Asymmetric Dynamics in The Correlations of Global Equity and Bond Returns. *Journal of Financial Econometrics*, *4*(4), 537–572. https://doi.org/10.1093/jjfinec/nbl005

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. https://doi.org/10.7835/jccberj- 2008-0015

Conover, C. M., Jensen, G. R., Johnson, R. R., & Mercer, J. M. (2010). Is Now the Time to Add Commodities to Your Portfolio? *The Journal of Investing*, *19*(3), 10–19. https://doi.org/10.3905/joi.2010.19.3.010

Cui, Y., & Feng, Y. (2020). Composite Hedge and Utility Maximization for Optimal Futures Hedging. *International Review of Economics and Finance*, *68*(March), 15–32. https://doi.org/10.1016/j.iref.2020.03.002

Defri, F., & Moch. Dzulkirom AR. (2017). Analisis Pembentukan Portofolio Optimal Saham Perusahaan Indeks Sri Kehati - Bursa Efek Indonesia Menggunakan Model Indeks Tunggal (2013-2015). *Jurnal Administrasi Bisnis*, *47*(1), 147–156. http://administrasibisnis.studentjournal.ub.ac.id/index.php/jab/article/view/1827/2209

El Abed, R., & Zardoub, A. (2019). On The Co-movements Among Gold and Other Financial Markets: A Multivariate Time-Varying Asymmetric Approach. *International Economics and Economic Policy*, *16*(4), 701–719. https://doi.org/10.1007/s10368-019-00444-3

El Hedi Arouri, M., Lahiani, A., & Nguyen, D. K. (2015). World Gold Prices and Stock Returns in China: Insights for Hedging and Diversification Strategies. *Economic Modelling*, *44*(January 1982), 273–282. https://doi.org/10.1016/j.econmod.2014.10.030

Gjika, D., & Horváth, R. (2013). Stock Market Comovements in Central Europe: Evidence from The Asymmetric DCC model. *Economic Modelling*, *33*, 55–64. https://doi.org/10.1016/j.econmod.2013.03.015

Hamdani, A. S., Murhadi, W. R., & Sutejo, B. S. (2015). Pembentukan Portofolio Optimal Pada Indeks Kompas 100 Periode 2013-2014. *Calyptra : Jurnal Ilmiah Mahasiswa Surabaya*, *4*(2), 1–13. https://doi.org/2302-8203

Hoang, T. H. Van, 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*, *42*(1467200501), 98–108. https://doi.org/10.1016/j.irfa.2014.11.020

Izadi, S., & Hassan, M. K. (2018). Portfolio and Hedging Effectiveness of Financial Assets of The G7 Countries. *Eurasian Economic Review*, *8*(2), 183–213. https://doi.org/10.1007/s40822-017-0090-0

Jiang, Y., Jiang, C., Nie, H., & Mo, B. (2019). The Time-Varying Linkages Between Global Oil Market and China's Commodity sectors: Evidence from DCC-GJR-GARCH Analyses. *Energy*, *166*, 577–586. https://doi.org/10.1016/j.energy.2018.10.116

Jin, J., Han, L., Wu, L., & Zeng, H. (2020). The Hedging Effectiveness of Global Sectors in Emerging and Developed Stock Markets. *International Review of Economics and Finance*, *66*, 92–117. https://doi.org/10.1016/j.iref.2019.11.001

Katadata. (2020). Turun 4,9% ke Level 3.989, IHSG Sentuh Level Terendah dalam 8 Tahun. *Katadata.Co.Id*. https://katadata.co.id/happyfajrian/finansial/5e9a4212bd70b/turun-49-ke-level-3989-ihsg-sentuh-level-terendah-dalam-8-tahun

Kewal, S. S. (2013). Pembentukan Portofolio Optimal Saham-Saham Pada Periode Bullish Di Bursa Efek Indonesia. *Jurnal Economia*, *9*(1), 81–91. https://doi.org/10.21831/economia.v9i1.1378

Kontan. (2020). Gelombang Kedua Corona Mengerek Harga Emas Melewati US$ 1800 per troy ounce. *Kontan.Co.Id*. https://investasi.kontan.co.id/news/gelombang-kedua-corona-mengerek-harga-emas-melewati-us-1800-per-ons-troi

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. https://doi.org/10.1080/13504850500447331

Markowitz, H. M. (1952). Portfolio Selection. *Journal of Finance*, *7*(1), 77–91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

Markowitz, H. M. (1959). *Portfolio Selection: Efficient Diversification of Investments*. John Wiley & Sons, Inc. https://www.jstor.org/stable/j.ctt1bh4c8h

Oktaviani, B. N., & Wijayanto, A. (2016). Aplikasi Single Index Model dalam Pembentukan Portofolio Optimal Saham LQ45 dan Jakarta Islamic Index. *Management Analysis Journal*, *5*(3), 189–202. https://doi.org/10.15294/maj.v5i3.10651

Pamilangan, A., & Robiyanto, R. (2019b). Perumusan Portofolio Dinamis Cryptocurrency

dengan Saham-Saham LQ45. *Jurnal Ilmu Sosial Dan Humaniora*, *8*(2), 283–292. https://doi.org/2303-2898

Raza, N., Ali, S., Jawad, S., Shahzad, H., & Ali, S. (2018). Do Commodities Effectively Hedge Real Estate Risk ? A Multi-Scale Asymmetric DCC Approach. *Resources Policy*, *August 2017*, 1–19. https://doi.org/10.1016/j.resourpol.2018.01.001

Raza, N., Ali, S., Shahzad, S. J. H., Rehman, M. U., & Salman, A. (2019). Can Alternative Hedging Assets Add Value to Islamic-Conventional Portfolio Mix: Evidence from MGARCH Models. *Resources Policy*, *61*(January), 210–230. https://doi.org/10.1016/j.resourpol.2019.02.013

Robiyanto. (2020). *Buku Ajar Manajemen Risiko: Aset Pelindung Nilai (Hedge) dan Aset Teraman (Safe Haven)*. CV.Tiga Media Pratama.

Robiyanto, R. (2018). Testing of The Gold's Role as a Safe Haven and Hedge for Sharia Stocks in Indonesia. *Al-Iqtishad: Jurnal Ilmu Ekonomi Syariah*, *10*(2), 255–266. https://doi.org/10.15408/aiq.v10i2.6527

Robiyanto, Robiyanto. (2017). The Analysis of Capital Market Integration in Asean Region By Using the OGARCH Approach. *Jurnal Keuangan Dan Perbankan*, *21*(2), 169–175. https://doi.org/10.26905/jkdp.v21i2.1138

Robiyanto, Robiyanto. (2018a). DCC-GARCH Application in Formulating Dynamic Portfolio between Stocks in the Indonesia Stock Exchange with Gold. *Indonesian Capital Market Review*, *10*(1), 13–23. https://doi.org/10.21002/icmr.v10i1.10821

Robiyanto, Robiyanto. (2018b). Gold VS bonds: What is the safe-haven for the Indonesian and Malaysian capital market? *Gadjah Mada International Journal of Business*, *20*(3), 277–302. https://doi.org/10.22146/gamaijb.27775

Robiyanto, Robiyanto, Ernayani, R., & Ismail, R. S. (2019). Formulation of a Dynamic Portfolio with Stocks and Fixed-Income Instruments in The Indonesian Capital Market. *Organizations and Markets in Emerging Economies*, *10*(1), 132–146. https://doi.org/10.15388/omee.2019.10.00007

Robiyanto, Robiyanto, Wahyudi, S., & Pangestuti, I. R. D. (2017). 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. https://doi.org/10.22146/gamaijb.26260

Trabelsi, N., Gozgor, G., Tiwari, A. K., & Hammoudeh, S. (2020). Effects of Price of Gold on Bombay Stock Exchange Sectoral Indices : New Evidence for Portfolio Risk Management. *Research in International Business and Finance*. https://doi.org/10.1016/j.ribaf.2020.101316

Zhang, Y., Wang, M., Xiong, X., & Zou, G. (2020). Volatility Spillovers Between Stock, Bond, Oil, and Gold with Portfolio Implications: Evidence from China. *Finance Research Letters*, *October 2019*, 101786. https://doi.org/10.1016/j.frl.2020.101786