The Impact of COVID-19 on Yield of Precious Metal: an Empirical Evidence

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Abstract. The current paper aims to establish the relationship between the COVID-19 pandemic and precious metals earnings, in particular, gold and silver earnings. The study analyzes the yield and variance of gold and silver using the VAR model, impulse response analysis, and the ARMA-GARCH model. The study found that the COVID-19 pandemic has a significant positive impact on the gold and silver yield in the short term, which makes the precious metals an excellent market for investment during the pandemic due to their hedging and haven characteristics.

Keywords: COVID-19, Precious Metals, Gold, Silver, Time Series Analysis.

1. Introduction

The emergence of coronavirus 2019 significantly impacted the global economy as the global gross domestic product dropped proportionately by approximately 3.9 percent, signifying the worst economic downturn since the Great Depression. As the number of infections and deaths continue to rise, COVID-19 and its containment measures had a substantial impact on stock markets and commodity markets. In the commodity market, COVID-19 led to the disruption of the supply chain and the falling of major commodities prices. Although the COVID-19 mitigation measures were essential to controlling the spread of the virus, the measures triggered severe economic dislocation, mainly supply chain disruptions and shrinking of global trade that led to an increase in commodity prices [1]. Moreover, mitigation measures were essential to disrupting commodity demand and supply. Therefore, the COVID-19 outbreak triggered a unique commodity market shock that affected commodity supply and demand.

Not only did the COVID-19 outbreak affect the commodity prices, but it also affected the stock market. Global stock markets had to face unprecedented uncertainties registering a great economic downturn, including the falling of stock market prices. Before the COVID-19 outbreak, the stock market was experiencing a peak; however, the emergence of COVID-19 triggered the free fall of share prices, transforming the stock market economies and the fortunes of the stock market business [2]. The coronavirus outbreak triggered a wide variation in the stock market, making the market riskier for investment. Studies through the EGARCH model ascertain that the COVID-19 outbreak has a negative effect on the stock market returns because it makes the market highly volatile [3].

Precious metals are naturally occurring rare metallic elements that have high economic value. They include elements such as gold, silver, platinum, and palladium. Since precious metals such as silver and gold fall within the stock market environment, studies predict that coronavirus also affected their earnings similar to other stock market players. These assets emerge as the only solution for investors to keep away from a flight-to-quality during the global financial crisis, which negatively affects financial markets. Precious metals emerge as solutions since they are considered safe investments during high uncertainty times. Precious metals' use during uncertainty periods highlights their resilience to the financial crisis that arises from their high volatility and prediction difficulties [4].

Despite the investors' preferences for precious metals during uncertainties, precious metals integration into the financial markets and the stock market is practically a new concept. While most investors view precious metals as a leveraging investment option for high-risk times, most market players use them to leverage trade wars. For instance, during the US-China trade war, precious metals became a key trading element as 80 percent of total US imports were precious metals [4]. Despite the use, precious metal prices and economic recession have a cointegrating relationship because precious metal prices are unstable over time, and any shift in economic conditions will significantly change the precious metal prices.

During the early days of the COVID-19 pandemic, the precious metal prices surged as the uncertainty of the pandemic shadowed the global economy. The onset of the pandemic saw a tremendous rise in gold prices. For instance, according to the World Bank report on precious metals prices, the third quarter of 2020 saw the gold prices reach an all-time high of US$2,067 per ounce; however, in the fourth quarter, the gold prices started to ease. Similarly, the silver prices increased to reach a record breakpoint of US$ 29 per ounce during the third quarter of 2020; however, in the fourth quarter, the silver prices started to decline significantly. Therefore, the World Bank report suggests that uncertainty leads to unprecedented change in precious metal prices since the emergence of uncertainty will increase precious metal prices.

Despite the increase in precious metal prices during the onset of the COVID-19 pandemic, the precious metals prices, gold, and silver, in particular, stabilized as the pandemic continued ravaging the economy. For instance, between October 2019 to August 2020, the gold prices rose from the US $ 1,500 to the US $ 2067 per ounce; however, after August 2020, the gold prices started to decline, and by December 2020, the gold prices were approximately US $1700 per ounce. Similarly, the silver prices rose from US$ 18 per ounce in October 2019 to US$ 29 per ounce in August 2020, and by December 2020, the silver prices were approximately US$ 24 per ounce. With the stabilizing characteristics of precious metal prices, investors, entrepreneurs, and business owners are starting to pay attention to precious metals as safe pairs of hands for investment portfolios during uncertain market times. This is because gold and silver have turned out to be prudent financial investments for leveraging financial and economic disruptions.

Precious metal prices, particularly gold and silver, tend to be stable and better when global equities decline. For instance, during the dot-com bubble period in the 2000s and the 2008 global financial crisis, the global equities prices declined, while the gold and silver prices increased and stabilized during these particular periods. Moreover, gold and silver markets are powerful hedging techniques against the financial market's systematic risks and uncertainty.

The stability of precious metal prices during periods of uncertainty has made several scholars investigate the COVID-19 pandemic’s impact on precious metal earnings. The scholars establish that the COVID-19 pandemic had a significant impact on the precious metal prices, gold, and silver specifically; their prices increased due to an increase in demand. The scholars found that the pandemic triggers high demand for these metals, increasing their prices. For instance, Ahadjie, Jerry, Ousman Gajigo, Danlami Gomwalk, and Fred Kabanda establish that the COVID-19 pandemic impacted precious metal prices. While platinum prices were falling concerning the base metal prices, the prices of silver and gold were increasing due to an increase in demand as the two metals are considered a haven during uncertainty periods [5]. Văn, Lê, and Nguyễn Khắc Quốc Bảo investigated the relationship between precious metals indexed from September 1999 to May 2022 and global stock under the COVID-19 pandemic and employed conditional correlation multivariate generalized autoregressive conditional heteroscedasticity (M-GARCH). The study found that before the COVID-19 outbreak, precious metals had a positive influence on the stock market and played a critical role due to their haven and hedging characteristics [6]. The positive influence was also evident during the COVID-19 period as the pandemic continued ravaging the economy, and the precious metal prices continued to increase.

Moreover, Usman Nuruddeen and Seyi Saint Akadiri examine the behavior of precious metals through an integrated and cointegrated modeling approach before and during the COVID-19 pandemic to establish its degree of persistence. The study establishes that precious metal prices function as a store of value and have the economic direction anchoring inflation and critical economic indicators providing various benefits to investors during high uncertainty periods [7]. Shang Yue et al. investigated the impact of infectious diseases on the precious metals’ permanent volatility using the GARCH-MIDAS model and established that pandemics usually have a positive and significant impact on precious metals' future market volatility. The study establishes that infectious diseases like COVID-19 have greater impacts on gold futures markets than on silver [8].

Most researchers investigating precious metals prices under-investment portfolios attribute these metals to hedging and the haven effect. Baur et al. studied the hedging effect of precious metals on geopolitical risks and found that precious metals are hedges against both geopolitical risks and threats since it is only gold and silver haven portfolios instability during crisis periods [9]. Sikiru et al. assessed the hedging capabilities of precious metals against pandemic-induced market risks using the infectious disease tracker that measures financial market uncertainty induced by the COVID-19 pandemic. The study results concur with the safe-haven property of precious metals before and during the COVID-19 pandemic [10]. The study highlights those precious metals like gold and silver are valuable for investors during crisis times as they provide a safe investment market for investors, entrepreneurs, and business individuals.

Although various scholars have investigated the havening and hedging effect of precious metals, limited literature has tried establishing and investigating the impact of COVID-19 on precious metals earnings. Therefore, in this paper, the researcher will focus on investigating how COVID-19 impacts precious metals earnings, particularly gold and silver earnings. The paper tries to establish the influence of COVID-19 on precious metals earnings by constructing an ARMA-GARCH model that analyzes the existing relationship between the COVID-19 additional confirmed cases and the price change of silver and gold. The study also constructs a VAR model and impulse response analysis to determine the short-term and long-term impact of the pandemic on silver and gold prices and changes in prices. Determining the relationship between COVID-19 and precious metal earnings and price change is vital because the cause-and-effect relationship will provide beneficial information that assists investors and policymakers coin sound decisions. Therefore, the main research question for consideration in this research is: how do COVID-19 impact precious metals earnings?

The rest of this paper is organized as follows: Part 2 is the research design, which includes data sources and model specification; part 3 is the research methodology, which includes the VAR identification, impulse response, ARMA identification, and ARMA-GARCH estimation results, while part 4 and 5 is the discussion and conclusion, respectively.

2. Research design

2.1 Data sources

The study utilizes precious metals, particularly gold and silver prices, and the global data on the daily-confirmed number of COVID-19 cases between December 12, 2019, and February 24, 2022, and the changes in gold and silver prices in that particular period. The new cases of COVID-19 data specify the daily number of COVID-19 cases reported globally. The gold and silver data, particularly the prices and percentage changes were obtained from investing.com, particularly the XAU/USD – Gold Spot US Dollar historical data and XAG/USD- silver Spot US Dollar historical data. The COVID-19 pandemic data were obtained from the World Health Organization database, particularly the covid19.who.int. The pandemic newly confirmed cases and the gold and silver change percentage were transformed to logarithmic form with a time range of January 3, 2020, to February 24, 2022, producing 574 observations.

The data set shows that the daily number of new cases has been increasing from January 2020 to February 2022. The silver and gold data set contains historical data specifying the price, open, high, low, and the percentage of change. Although the prices of silver and gold have been increasing, the yield has shifted between negative and positive. For instance, the new cases of COVID-19 increased from approximately below 10 in January 2020 to about 1.9 million in February 2022. Similarly, the gold and silver prices increased from USD 1,469.33 and USD 16.93, respectively, during the early days of the COVID-19 outbreak to USD 1,903.14 and USD 24.2, respectively in February 2022. Therefore, the data span of this study is from the full outbreak of the Covid-19 pandemic to the outbreak of the Russian-Ukrainian conflict.

2.2 The unit-root test

Unit root test is a statistical methodology that tests for stationarity in a time series variable. The unit root test is used to determine whether the financial and economic time series data exhibit non-stationarity in the mean and variance of their prices, exchange rate, and macroeconomic aggregate, such as GDP. Guaita Silvio posits that determining the unit root of a series helps explain the series features, and when a series exhibits no unit root, it is considered stationary and fluctuates around its mean in the long term [11]. Zivot Eric and Jiahui Wang articulate that unit root testing involves several aspects of non-stationarity and stationarity. In unit root testing, a deterministic linear trend predicts the AR process. These trends include the autoregressive unit root test and stationarity tests. The autoregressive unit test tests the null hypothesis (difference stationarity) against the alternative hypothesis. On the other hand, the stationarity test assumes that the null hypothesis is trend stationary [12].

This study utilizes the Autoregressive unit root tests, particularly the Dickey-Fuller Unit Root Tests, also known as the augmented Dickey-Fuller (ADF) test. Said and Dickey proposed the Dickey-Fuller Unit Root Test as an accommodating model to the ARMA (p, q) model and an improvement to the basic autoregressive unit root test. The Augmented Dickey-Fuller test tests the time series null hypothesis against the alternative with the assumption that the data dynamics have an ARMA structure. The ADF test focuses on regression test estimation of:

$$y_t = \beta D_t + \phi y_{t-1} + \sum_{j=1}^{p} \Delta y_{t-j} + \varepsilon_t \tag{1}$$

In the above estimation, Dt is the vector of deterministic terms, and Δyt-j is the approximation of the ARMA error structure. In the regression test above, the error term is assumed homoscedastic. ADF statistic is reported in formula (1).

$$\text{ADF} = 1 = \frac{\phi - 1}{SE(\phi)} \tag{2}$$

Other than the ADF regression analysis sequence, the lag length of the test is also important. Choosing a too small lag length will trigger bias from serial correlation error; however, choosing a too large lag length will make the test power suffer. Ng and Perron document the importance of selecting an adequate lag length, which includes producing results with stable test sizes and minimal power loss. To determine the appropriate lag length, Ng and Perron propose the setting up of upper bound Pmax for p, then estimating the ADF test regression with p = pmax. When the t-statistic absolute value of the last lagged difference is greater than 1.6, the lag length should be set at the p max to perform the unit root test [13].

2.3 VAR model specification

Vector Autoregressive (VAR) model is a multivariate autoregressive model in time series analysis, which analyzes the dynamic relationship between the interacting variables. The VAR models assume a structure whereby every variable assumes a linear function of past lags of itself and other variables' past lags. Thus, the VAR model assumes an equation structure where the right-hand side integrates the system's variables constant and lags. The genesis of the VAR model is attributed to Sims, who established a framework for modeling endogenous variables in a multivariate setting. Building on that, a significant contribution has been made to the VAR model including the addition of components like sign restriction, structural break, stochastic volatility, structural decomposition, and time-varying parameters incorporation [14].

The VAR model builds equations depending on the number of time series variables. For instance, in a time series model with two variables with one lag, the equation will be a VAR (p) model:

$$\boldsymbol{r}_t = \boldsymbol{\phi}_0 + \boldsymbol{\Phi}_1 \boldsymbol{r}_{t-1} + \cdots + \boldsymbol{\Phi}_p \boldsymbol{r}_{t-p} + \boldsymbol{a}_t \tag{3}$$

From the lag 1 VAR model, any increase in lag will result in the expansion of the equation. For instance, in the event there are three-time series variables, the VAR model will have six predictors on the right side of each equation; three lag 1 term and three lag 2 terms. Therefore, for a VAR(p) model, the first p lags of each variable in the system would inform the regression predictors for each variable.

2.4 ARMA-GARCH model specification

Robert Engle develops two analytical tools for time series data; the ARCH model and the GARCH model, which are helpful in the analysis and forecasting of volatility. The Autoregressive Conditionally Heteroscedastic (ARCH) model is used to analyze the variance of time series data, and it is used to describe the variance changing and possible volatility [15]. The ARCH model is used in situations with short periods of increased variation, particularly in the econometric and finance problem context that deals with investments or stock increase amounts. In the ARCH model, the variables of interest are the proportion gained or lost since the last time and the logarithm of the ratio of this time's value to last time's value. Moreover, the ARCH model is also applicable to time series data with periods of increasing and decreasing variance.

For instance, when modeling the variance of a series yt, the ARCH (1) model for the variance of model yt is conditional on yt-1, the variance at time t. Therefore, the ARCH (1) model will assume the following model:

$$Var(y_t|y_{t-1}) = \sigma^2 = \alpha_0 + \alpha_1 {y^2}_{t-1} \tag{4}$$

Similarly, Robert Engle developed the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to deal with heteroscedasticity in time series data. The goal of the GARCH model is to provide a measure of volatility that is useful in decision-making, particularly relating to risk analysis, derivative pricing, and portfolio selection. The challenge in ARCH/GARCH modeling is to specify how to utilize information in forecasting the returns means and variances. The first ARCH model focuses on rolling the standard deviation to a particular fixed number of observations, and it assumes that the following return's variance is the equally-weighted average of the square residuals. On the other hand, Bollerslev's GARCH model also utilizes the weighted average of past square residuals with a declining weight that does not surpass the zero mark [16]. The GARCH model provides parsimonious models that are easily estimated and are successful in conditional variances prediction. The widely applicable GARCH model specification attributes the best variance predictor to the weighted average of the long-term average variance, which is predicted based on the variance period and the most recent squared residual information, and it specifies the Bayesian updating.

3. Results

This section involves constructing and examining the unit root test using the ADF unit root test, the VAR modeling, impulse response construction, the ARMA ordering, and the construction of ARMA-GARCH modeling. The section begins with the ADF test results reporting through the VAR ordering modeling and impulse response analysis for the silver and gold yields. The best lag numbers were chosen based on STATA computation's AIC and HQIC information criteria.

The unit root test using the ADF test produces a varying t-statistics and p-values for the gold and silver prices and their yields, as shown in Table.1 below:

Table.1. ADF test

Variables	t-statistic	p-value
Price		
Gold	-2.889	0.1662
Silver	-1.760	0.7236
Yield		
Gold	-16.700	0.0000***
Silver	-15.315	0.0000***
Covid-19 pandemic		
New confirmed cases, the global	-3.824	0.0154**

The ADF test on gold and silver prices produces a t-statistic of -2.889 and -1.760 with a p-value of 0.1662 and 0.7236, respectively. The gold and silver yields produce t-statistic of -16.700 and -15.315 with a 0.000 p-value, respectively. On the other hand, in the new confirmed cases, the global produce a t-statistic of -3.824 with a p-value of 0.0154. With only 1 number of lags, the Dickey-Fuller test for unit root for the t-distribution critical value at 5 percent for gold is -1.648, for silver is -3.410, for gold yield is -3.410, and for silver is -3.410. Since the absolute values for the t-statistic are less than the absolute value of the critical values of the t-distribution, the gold and silver prices are non-stationary. The ADF analysis shows that gold and silver prices are unstable and non-stationarity; hence the gold and silver yields are used in VAR modeling to produce a yield series modeling. The ADF analysis also tests the stability of the daily number of newly confirmed diagnoses in the world. Therefore, the VAR order modeling takes into consideration the gold and silver yields in terms of the logarithmic rate of return and the logarithmic number of new cases.

3.1 VAR identification

In determining the VAR model, we decided to use 12 lags to determine the model. With the 12 lags, all the VAR models were stable. The results of the VAR analysis of gold and silver yield and the number of new cases are represented in the below table.

Table.2. VAR order identification

Lag	LL	LR	df	P	FPE
0	466.351				.000659
1	1693.99	2455.3	4	0.000	.0000085
2	1695.98	3.9903	4	0.407	.0000085
3	1702.37	12.765	4	0.012	.0000085
4	1728.24	51.752	4	0.000	.0000079
5	1735.49	14.485	4	0.006	.0000078
6	1753.71	36.444	4	0.000	.0000074
7	1788.42	69.428	4	0.000	.0000066
8	1791.91	6.9669	4	0.138	.0000067
9	1795.39	6.9663	4	0.138	.0000065
10	1806.19	21.602	4	0.000	.0000065
11	1812.15	11.915	4	0.018	.0000065
12	1820.37	16.445*	4	0.002	.0000064*

The VARSOC command used in the VAR model determination utilizes a 12 maximum lag that produces 12 lag orders with different final predictor errors (FPE) for both pre-estimation and post-estimation commands. The obtained information concurs with the pre-estimation version of VARSOC concerning the lag-order selection statistics for a series of vector auto-regression of order 1 through to the maximum lag 12.

In testing whether the 3-element VAR system built is stable, the varstable graph was developed, as shown in Figure 1 below. Figure 1 shows that all the VAR elements are stable since they are all within the VAR circle.

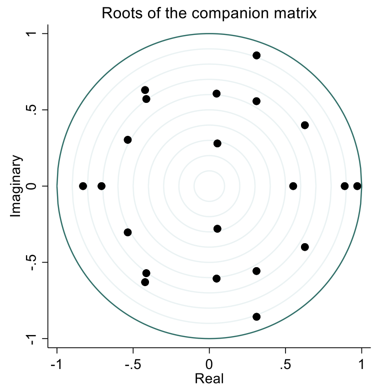

Figure 1 Stability test

3.2 Impulse Response

In both the gold yield and silver yield to the global new cases model, the study a Granger-causality relationship between the gold’s and silver’s log return rate and the log of newly confirmed additional cases. The directional Granger causality relationship implies that addition in COVID-19 newly confirmed cases might result in an increase in gold or silver rate of return. Despite observing the Granger-causality relationship in both gold and silver models, the impulse response for gold starts with a positive and then drops to the negative at approximately lag order 3. However, the impulse response for silver starts with a negative impact and then improves to a positive.

Gold Silver

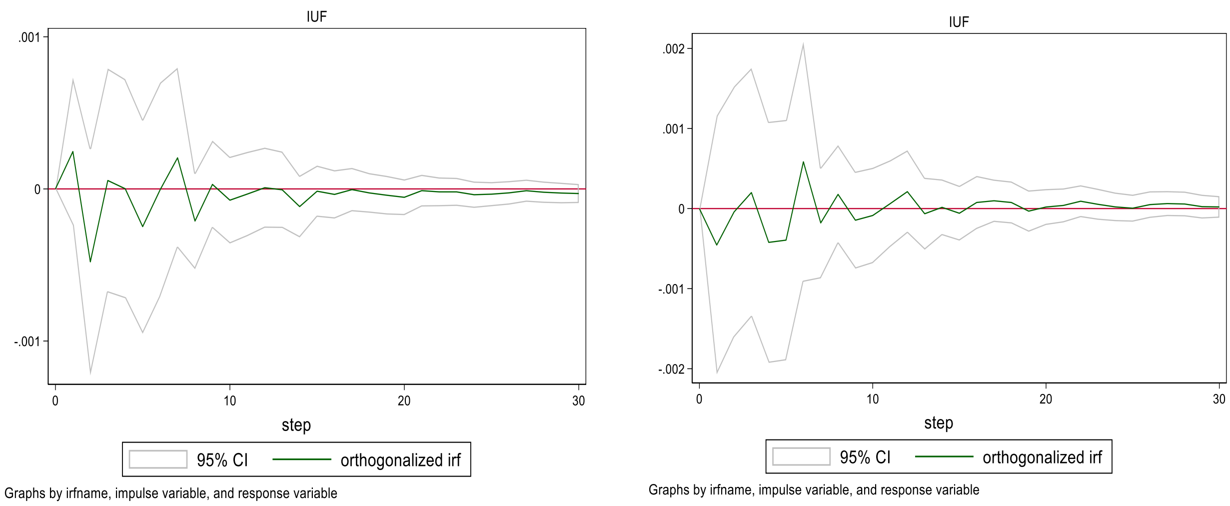

Figure 2 Impulse and Response analysis

3.3 ARMA identification

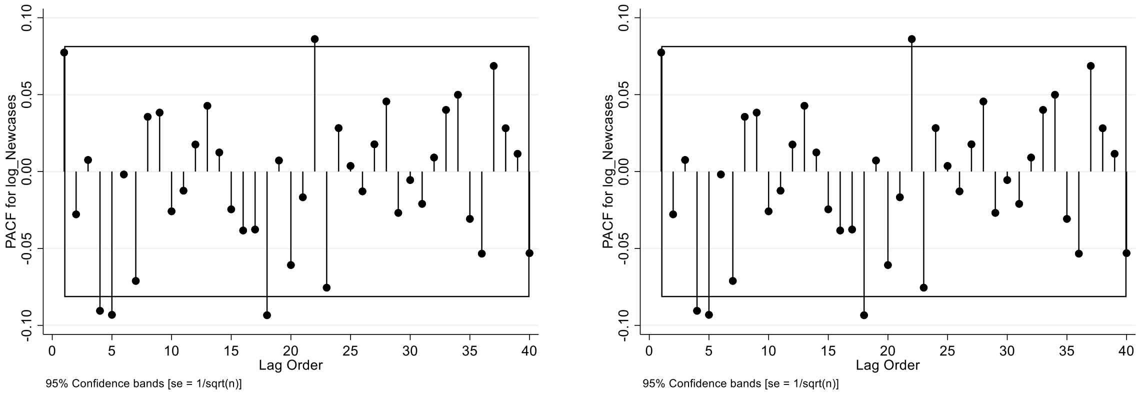

Figure 3 ARMA identification, gold

After determining the impulse response analysis, the autocorrelation and partial autocorrelation graphs were constructed to determine the suitability of the ARMA model. The gold's ACF and PACF produce sequencing orders to both negative and positive 0.055 to a tune of lag order 40. Similarly, silver's ACF and PACF models also produce similar sequencing orders and lag orders.

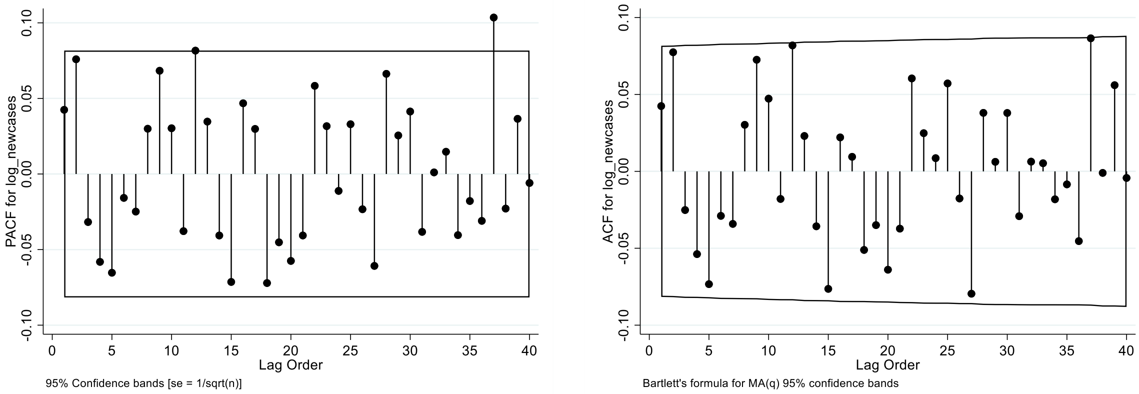

Figure 4 ARMA identification, silver

3.4 ARMA-GARCH estimation results

Table 3 shows the results of the 3-element model for both gold and silver. The table shows that ARCH and GARCH effect is present in all the six models. The ARCH and GARCH coefficients are statistically significant under the 5 percent confidence level. Moreover, the coefficient for the log of new confirmed cases, the global in the GARCH model, is statistically significant under the 5 percent confidence level, which implies a significant relationship between Covid-19 and precious mental volatility.

Table. 3. ARMA-GARCH model estimation results, variance equation

Variables	Gold			Silver		
	(1)	(2)	(3)	(4)	(5)	(6)
	New confirmed cases, the global					
T=0	.0322	-.1469*	.6238	.0389	.4884	1.7897
	(.0353)	(1.4816)	(1.1965)	(.0313)	(.5171)	(1.4557)
T=-1		.1779*	-1.9140**		-.4353	-5.1294***
		(1.4759)	(.8793)		(.4911)	(.8769)
T=-2			1.3451*			3.5646**
			(.8093)			(1.5038)
	GARCH					
ARCH (-1)	.1175***	.1173***	.0998***	.1856***	.1854***	.0899***
	(.0316)	(.0315)	(.2633)	(.0300)	(.0297)	(.0108)
GARCH (-1)	.7954***	.7954***	.8308***	.7007***	.7032***	.9005***
	(.0572)	(.0574)	(.0506)	(.0460)	(.0458)	(.0101)
Constant	-12.0256***	-12.0060***	-12.5931***	-10.4091***	-10.6183***	-15.3846***
	(.6007)	(.6116)	(.9693)	(.4310)	(.5910)	(1.923)

4. Discussion

The study's findings concur with the researchers' findings on the relationship between pandemic and precious metals earnings. The emergence of the pandemic has had a significant impact on the financial markets, stock markets, and precious metal markets in particular. The VAR-based impulse response analysis and the GARCH model establish that pandemic conditions would increase volatility in financial markets, and particularly precious metal markets.

The continuous increase in precious metals yield as the COVID-19 pandemic ravages the world economies is due to specific economic forces. The first economic force pulling toward precious metals' price movements is the investors' risk-averse nature that makes them flock to the gold and silver market due to its safe-haven nature and store of value during pandemic induced-recession periods. The second reason for the positive relationship between new cases of COVID-19 and gold and silver yield is the robust hedging effect precious metals provide investors with financial markets systematic risks and uncertainty during global supply disruptions. Moreover, the pandemic triggers stockpiling by investors seeking wealth protection that pushes precious metals prices proportionately.

Conclusion

In conclusion, the study aims at establishing the relationship between the COVID-19 pandemic and the precious metals earnings, particularly gold and silver, hence, determining the dynamic impact of COVID-19 on precious metals earnings. By building a 3-element VAR model, the impulse response, and the ARMA-GARCH model with gold and silver yields and the global addition of new COVID-19 cases, the study found that the global addition of new COVID-19 cases has a significant impact on precious metals earnings.

Therefore, the researcher recommends that investors should consider investing in precious metals during a pandemic because it hedges the investment against the uncertainties and systematic risks in the stock market, commodity market, and financial market. Moreover, investors should consider precious metals, particularly, gold and silver, because they provide a haven for investments during crisis periods.

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