The Impact of Covid-19 on Gold Price in Indonesia Using ARIMA Intervention

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Abstract

On March 2, 2020, Indonesia experienced the first case of Covid 19. As a result, investors should be careful in investing so that investors choose gold in investing. Many studies explain that gold prices increase when economic conditions are not in good condition. So gold is a profitable investment in the pandemic. This study aims to analyze the impact of Covid-19 on gold prices in Indonesia. The research method uses ARIMA intervention. The results showed that the impact of Covid-19 on gold prices in Indonesia is gradually temporary, meaning the intervention to influence the movement of gold prices gradually and temporarily. The intervention of Covid-19 cases against gold prices in Indonesia began to be felt after two weeks after the first case of Covid-19 in Indonesia, which was demonstrated by the increase in the gold price out of the ordinary since the 16th day. On the 19th day after the intervention, the gold price in Indonesia decreased. Furthermore, the gold price in Indonesia is again rising and is expected to increase. The forecast results for the next 31 days show that the gold price in Indonesia has consistently increased. When Covid-19 has not been able to be resolved so that the confirmed positive case of Covid-19 continues to increase, gold investment is one of the safe investments. However, investors should pay attention to gold price movements if they want to invest in gold. Advice for further research is to use other intervention variables related to the increase in the gold price during the pandemic.

Keywords. *ARIMA Intervention, Covid-19, Gold Price*

***JEL Classification: C5, C22, E30***

A. INTRODUCTION

Coronavirus Disease 2019 or more commonly known as Covid-19 is one of the diseases that has attacked people in the world. Covid-19 is a new type of disease in humans that has never been identified before. The virus that causes Covid-19 is called Sars-Cov-2 (Kemkes, 2020).

Figure 1 shows that confirmed cases of Covid-19 continued to increase during the period from March 2 to August 7, 2020, in Indonesia. Based on Covid-19 Task Force data, as of August 7, 2020, the number of Covid-19 exposure in Indonesia spread across 34 provinces consisting of 483 districts or cities, the number of people confirmed positive for Covid-19 as many as 121,226, the number of patients recovered as many as 77,557 people while the number of patients who died as many as 5,593 people.

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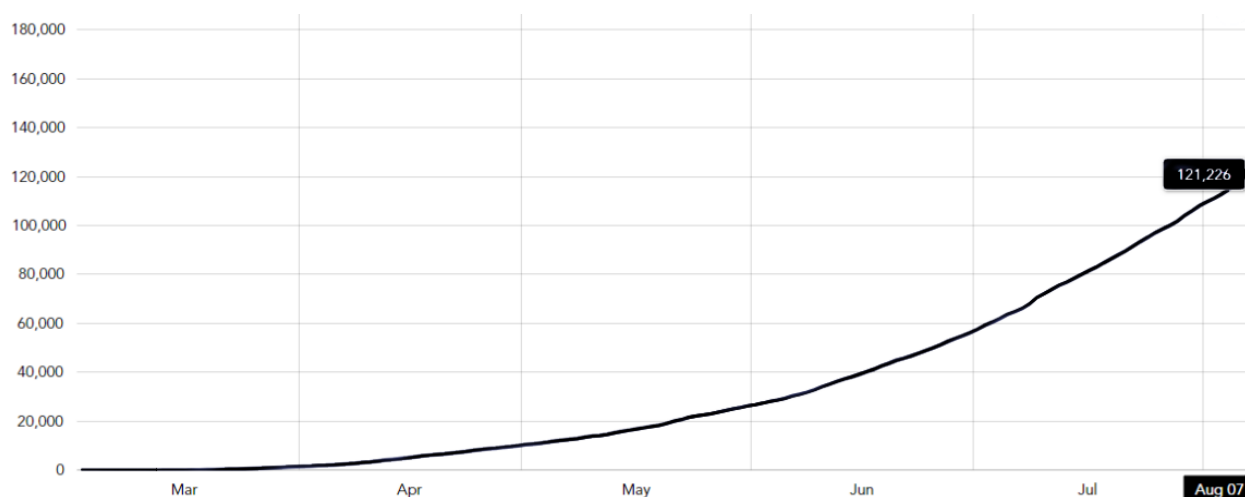
Source: covid19.go.id/peta-sebaran (2020), processed

Figure 1. Graph of Positive Cases of Covid-19 in Indonesia On March 2, 2020, to August 7, 2020

The increase in positive cases of Covid-19 impacts various fields, one of which is the economy. Based on BPS data, the economy in the third quarter of 2020 against the third quarter of 2019 experienced a growth contraction of 3.49 percent. The economic condition in Indonesia in the second quarter of 2020 against the second quarter of 2019 experienced a growth contraction of 5.32 percent. Economic conditions that have not improved have an effect on investment activities.

The investment consists of rill assets, such as gold and other valuables as well as investments in securities (Tambunan, 2020). Investment is an activity that must pay attention to returns and risks. In investing, the higher the return, the higher the risk that must be accepted. However, high returns do not necessarily interest investors. Similarly, investment instruments have low returns. According to Jensen & Jones in Tambunan (2020), returns are a way for investors to compare different investment alternatives. This is because the return can fulfill the desire of investors to invest. Markowitz in Tambunan (2020) assumed that investors preferred portfolios that were less risky than risky at a certain rate of return. During the Covid-19 period, investors should be careful in making investments. Not only is Indonesia's economy in poor condition, but other countries are also feeling the impact of Covid-19 on the economy. Currently, the spread of Covid-19 is out of control, making the economy uncertain. As a result, the investment market fluctuates.

Haryanto (2020) explained that the higher the case of Covid-19, the weaker the value of the JCI (Jakarta Composite Index). Trading on March 9, 2020, JCI declined and closed at 5,136.

This incident is a rare occurrence because the value of JCI can fall so deep except in serious circumstances such as the economic crisis (finance.detik.com, 2020). The decline in JCI value and economic conditions have not improved, so many investors are diverting their funds to other investment instruments, such as gold.

During the Covid-19 pandemic, gold is one of the safest types of investment. According to Beckmann et al. (2015) and Selmi (2018), gold is one of the safe heaven instruments. Bredin et al. (2015) stated that gold is a safe investment for investors in the long term. Gürgün, G., & Ünalmış, İ. (2014) states that for domestic investors, gold is a hedge in most countries. This result also persisted in the post-2008 crisis. In addition, as falls in equity markets become more severe, gold acts as a safe investment in some countries for domestic and foreign investors.

When observing past events, for example, the monetary crisis in 1998 caused some investors to switch from investing in stocks to investing in gold. One of them was experienced by someone who profited from investing in gold during the monetary crisis of 1998. At that time, the average price of gold purchased was around IDR 24,000 per gram. However, during the monetary crisis in 1998, the price of gold reached IDR 140,000 per gram (investasi.kontan.co.id, 2014). According to Johari (2017), when people are skeptical about stocks and derivative products so that people are looking for safer investments, one of them is gold. Similarly, the statement of Nugroho and Ramli (2016) namely that the price of gold increased during the global economic crisis from 2008 to 2010.

Sihono (2008), the current symptoms of the world economy, it is appropriate to conduct a study because it has signs that lead to a degree of sensitivity to economic depression, for example, the price of gold reached a record high.

Gold investment is a simple investment and easy to do by the community. This is because gold is easy to reach and recognized by the community. In addition, at this time information on the price of gold is easy to obtain. Worthington & Pahlavani (2007) states gold is not like most commodities. This is because gold can be durable, relatively moveable, universally accepted, and easily authenticated. According to Johari (2017), gold investments in the form of gold coins, gold bars, and jewelry have higher yields than deposits. In addition, it is more stable compared to stocks.

During the Covid-19 period, the price of gold tends to increase. In July 2020, the price of gold in Indonesia was in the range of IDR 900,000 per gram compared to the end of 2019 still in the range of IDR 600,000 per gram. Although the price of gold tends to increase, but many people are interested in investing in precious metal. This is because gold is a relatively safe asset against inflation and recession.

According to Miyazaki & Hamori (2013), the price of gold is determined by the demand and supply factors. Demand for gold is classified into 3 i.e. demand for the industry, demand for central banks, and demand for investment assets. In terms of supply, gold is supplied by mining, the remnants of gold products, and sales by the central bank.

Investors must have knowledge of the risks and advantages of investing in gold. According to Ariani (2015), after making an investment, investors can not be separated from various information about the type of investment chosen, so monitoring and supervision are required in order to obtain the expected profit.

The purpose of this research is to analyze in depth the impact of Covid-19 on gold price movements in Indonesia. Therefore, further analysis is needed since when Covid-19 began

to impact the gold price in Indonesia and how long the impact is felt (temporary or permanent). In addition, the forecast is carried out 31 days after the research period to find out the condition of gold prices in Indonesia.

B. LITERATURE REVIEW

Gold

According to *Kamus Besar Bahasa Indonesia* (KBBI), gold is a yellow precious metal that can be forged and formed, commonly made jewelry such as rings and necklaces (the symbol is Au, the atomic number is 79, the atomic weight is 196.9665). Gold is one of the most familiar precious metals in people's lives. This is because precious metal, especially after being a jewel is easy to obtain by the public.

In obtaining long-term profits, people prefer gold in investing. Gold is one of the safest investments when global economic conditions are not in good condition. Gold is a safe haven for the United States, UK, and Germany (Baur & Lucey, 2010; Baur & McDermott, 2010). Similarly, Wahyuni (2014) explained that gold is the safest investment compared to other types of investments. Many investors withdraw their funds from the company and divert their funds into gold investments in the event of high inflation. Investors consider gold to have hedging hedges. In the event of high inflation, the price of gold will increase and impact the rising return of gold. The same happens when in deflationary conditions.

According to Sholeh (2014), some of the reasons that make gold a much-demanded investment by the community are (1) security, (2) protection, (3) easily disbursed, (4) profitable, and (5) low risk. There are internal values that gold has that (1) gold is a symbol of pride, (2) the price of gold has a downward trend, (3) gold is used to maintain wealth, (4) gold is available in various forms, (5) gold can be pawned in the event of an emergency.

Nuryana (2015) explained that there are several fundamental reasons that push long-term gold prices up are supply constraints, demand growth, gold purchases by the world's central banks, rupiah exchange conditions, a weakening dollar, government bonds, speculation and ETFs, Chinese, and foreign markets.

Ariefiansyah and Ariefiansyah (in Husna, 2019) mention that there are several forms of gold that can be invested, namely:

1) Gold jewelry

Many are chosen from the side of women because in addition to being made an investment, but can also be used as one of the lifestyles.

2) Gold bullion

Pure gold with a content of 24 carats or 99.9 percent gold without any mixed elements.

3) Gold coins ONH (Ongkos Naik Haji)

The owners of gold coins are people who want to prepare to go to the hajj by saving early in the form of gold coins.

4) Gold dinar

The currency is equivalent to the 22-carat gold.

Gold Price

Gold has trading centers around the world that play a role in the formation of gold prices. The world gold price that is often used is the fixed gold price and the spot gold price.

Fixed gold price remains based on the price of gold in the London Bullion Market Association (LBMA). LBMA is where most of the world's gold trade deals occur. The price of gold remains set at 10:30 GMT (for London Gold AM Fix) and 15:00 GMT (London Gold PM Fix). Spot gold prices are real-time gold prices throughout the day based on developments and market reactions to the fixed gold price. The usual price to determine the price of local gold is the spot gold price. Spot gold price uses US dollar with units per troy ounce.

Research on gold price prediction has been widely conducted. Sari (2017) conducted research on the gold price prediction. This is because gold is an issue in the market because precious metal can be used for attractive investments.

Sitohang and Siringo (2018) conducted gold price forecasting research as well. This is because to know the level of accuracy in forecasting the price of gold so that it can be beneficial for investors to make planning in investments. Similarly, other gold price research such as Aditya et al. (2019), Wati et al. (2019), and Putri (2015).

Stationary Data

Stationary data is one of the conditions that must be met in analyzing time series data. This is because if there is data that is not stationary, it will result in a bad estimation method. Baltagi (2005) explains that if the time series data used for modeling is not stationary, spurious regression will occur. According to Winarno (in Muhammad, 2014) in the event of spurious regression then it can be seen from the high R-square, high determinant coefficient (F value), high significance (t) value, and low Durbin Watson value.

Gujarati (2009) describes a data stationary if it has the following characteristics:

1) Constant average at each observation time
$$Mean = E(Y_t) = \mu \qquad (1)$$

2) Constant variance or variety at any observation time
$$Varians = Var(Y_t) = E(Y_t - \mu)^2 = \sigma^2 \quad (2)$$

3) Covariance two series in constant condition at any observation time
$$Kovarians = \gamma_k = E[(Y_t - \mu)(Y_{t+k} - \mu)] \qquad (3)$$

Autoregressive Moving Average (ARMA)

Makridakis et al. (1997) explain the Autoregressive (AR) and Moving Average (MA) models can be combined so that they become ARMA models. Mathematically write down the ARMA model as follows:

$$Y_t = c + \emptyset_1 Y_{t-1} + \cdots + \emptyset_p Y_{t-p} + u_t - \theta_1 u_{t-1} - \cdots - \theta_q u_{t-q} \qquad (4)$$

Description:

Y_t : observation value at t-time

C : constant

$\emptyset_i$: AR parameter value with value i = 1, 2, 3, …, p

θ_i : MA parameter value with value i = 1, 2, 3, …, q

p : ordo AR

q : ordo MA

u_t : error value at t-time

Using the backshift notation, the ARMA model is written:

$$(1 - \emptyset_1 B - \cdots - \emptyset_p B^p)Y_t = c + (1 - \theta_1 B - \cdots - \theta_q B^q)u_t \qquad (5)$$

with $B^k Y_t = Y_{t-k}$ and $B^k e_t = \varepsilon_{t-k}; k = 1, 2, 3, …, p$

Autoregressive Integrited Moving Average (ARIMA)

The ARIMA model was first introduced in 1976 by Box and Jenkins. The ARIMA model is a development of the ARMA model that through differencing process. Wei (2006) explained that the ARIMA model is a modified ARMA model with the addition of an integrated term to ordo d that indicates data stationation. Ordo d on the ARIMA model shows a value of d > 0. This indicates that in order to obtain stationary data on average it is necessary to difference processes so that it can use the ARIMA model.

Mathematically write down the ARIMA model as follows:

$$(1 - \emptyset_1 B - \cdots - \emptyset_p B^p)(1 - B)^d Y_t = c + (1 - \theta_1 B - \cdots - \theta_q B^q)u_t \qquad (6)$$

Description:
Y_t : observation value at t-time
B   : backshift order
C   : constant
$\emptyset_i$: AR parameter value with value i = 1, 2, 3, ..., p
θ_i : MA parameter value with value i = 1, 2, 3, ..., q

Gujarati (2008) explained that a time series of data follows the ar (p), MA (q), ARMA (p and q) and ARIMA processes, so a Box-Jenkins procedure consisting of 4 stages is required:

1) Identification

This stage is the process of determining the known p, d, and q ordo of the autocorrelation (ACF) and partial autocorrelation (PACF) patterns. Then, order d is determined by the absence of differencing process.

2) Estimation

After getting the best value of order p, d, and q, the parameter estimation process of AR and MA is performed. Ordinary Least Square (OLS) or Maximum Likelihood is a technique used in the parameter estimation process.

3) Diagnostic checking

At this stage, a feasibility check of the best model is selected, such as an ARIMA model that must meet the assumption of white noise.

4) Forecasting

After passing the previous stages, the data forecasting process can be done using the best ARIMA model. After the forecasting process, it can also be calculated validation of forecasting.

ARIMA Intervention

The movement of time series data is generally unstable. According to Wei (2006), intervention is an external event that can affect time series data. Interventions in question such as natural disasters, government policies, economic conditions, criminality, etc. As a result, the movement of time series data forms a new pattern that is not what it used to be.

Wei (2006) explained that the main purpose of intervention analysis is to measure the impact of interventions. The impact in question is from when it occurs, how much it occurs, whether it is permanent or temporary.

There are two types of intervention variables (Box et al., 2016):

1) Step Function

The step function is an intervention that occurs at T time and after for a long period of

time. Such interventions usually occur due to government policies, unfinished pandemics, and so on. Mathematically it can be written as follows:

$$S_t^{(T)} = \begin{cases} 0 & t < T \\ 1 & t \geq T \end{cases} \tag{7}$$

Description:

t : observation time, t = 1, 2, 3, ..., final observation time

T : the time of intervention

2) Pulse Function

The pulse function is an intervention that occurs at T time and occurs in a short period of time. Such interventions usually occur due to natural disasters, criminality, holidays, and so on. Mathematically it can be written as follows:

$$P_t^{(T)} = \begin{cases} 0 & t \neq T \\ 1 & t = T \end{cases} \tag{8}$$

Description:

t : observation time, t = 1, 2, 3, ..., final observation time

T : the time of intervention

The multi-input model form can be written as follows (Wei, 2006):

$$Y_t = \theta_0 + \sum_{j=1}^{k} \frac{\omega_{sj}(B)B^{bj}}{\delta_{rj}} I_{jt} + \frac{\theta B}{\emptyset(B)} u_t \tag{9}$$

Description:

Y_t : observation value at t-time

θ_0 : constant

I_{jt} : j intervention variable at t-time (value 0 for pre intervention events and 1 for intervention events)

J : banyaknya intervensi yang terjadi, j = 1, 2, 3, ..., k

$\frac{\theta B}{\emptyset(B)} u_t$: ARIMA pre-intervention model

Before conducting the estimation process using the intervention ARIMA model, it must first identify the orders of the model. According to Lee et al. (2010), there are three types of orders in the intervention ARIMA model:

• Ordo b

Ordo b explains the start time of intervention.

• Ordo s

Ordo s describes the time it takes for the intervention effect to return to a stable state.

• Ordo r

Ordo r describes patterns formed as a result of the effects of intervention.

In determining the ordo b, s, and r are seen based on the residual plot patterns formed. Residual values are derived from a reduction between the actual value and the forecasting value using the ARIMA pre intervention model by looking at patterns that exceed $\pm 2\sigma$ atau $\pm 3\sigma$. In determining the best model, a trial and error process is required.

The following are possible responses that occur as a result of the intervention of step function and pulse function are (Wei, 2006):
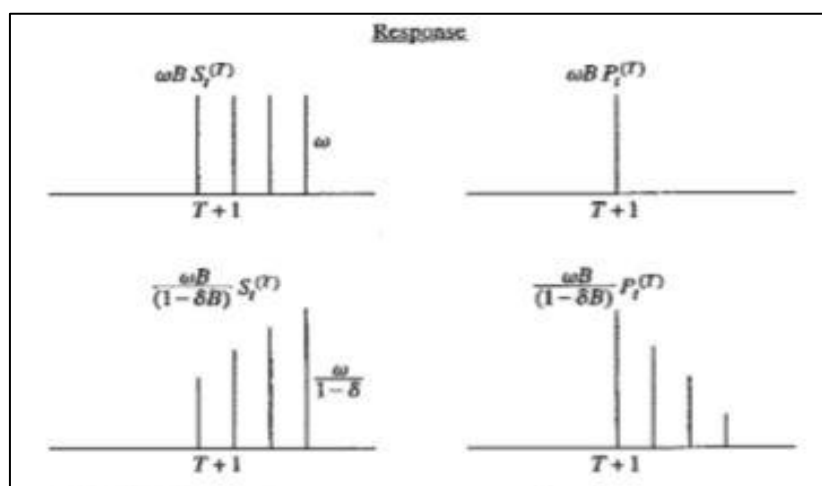
Source: Wei (2006)

Figure 2. Response of Intervensi Step Function and Pulse Function

Currently, there has been a lot of research done using ARIMA interventions. Wijayanti (2017) was conducted forecasting the Jakarta Composite Index (JCI) using intervention analysis. The use of intervention analysis is done because there are several external events affecting JCI. Such events such as the legalization of Tax Amnesty, the election of the President of the United States, and the holiday of Christmas. The results of the intervention analysis showed that the legalization of Tax Amnesty lowered the value of JCI by 99.69 points, the President of the United States lowered the value of JCI by 152.39 points, and the Christmas holiday lowered the value of JCI by 107.3 points.

Sari et al. (2016) conducted a step function intervention analysis research on the stock price with PT. Fast Food Indonesia Tbk case study. The main purpose of the research is to determine the best intervention model for PT share price data. Fast Food Indonesia Tbk period December 2013-January 2014. The results showed its forecast value was within the 95 percent threshold with a range of 70.82, MSE of 386.94 and RMSE of 19.671 so that it could be used to estimate daily data on PT's share price. Fast Food Indonesia Tbk period December 2013-January 2014 after intervention due to dividend policy which caused a significant decrease only around the time of intervention.

Mukhlis et al. (2015) conducted research analysis of pulse function intervention models in case studies of Malaysian stock price forecasting and the number of foreign tourists. The research was limited by the establishment of an intervention model of pulse function with events for MAS shares, namely the disappearance of flight MH370 in March 2014, while for the number of foreign tourists was the Bali bombing incident that occurred in October 2002. Analysis showed the disappearance of flight MH370 had no intervention effect on MAS stocks, while the Bali bombings had an intervention effect with a decrease in the number of foreign tourists at the time of the incident and one month after the incident.

Research during the Covid-19 pandemic was conducted by Shiyammurti et al. (2020). The results showed the Covid-19 pandemic could degrade Indonesia's economy. This is due to the decline in JCI and the depreciation

of the rupiah exchange rate. The weakening rupiah will lower the value of JCI. Similarly, Junaedi and Salistia (2020) research shows that the Covid-19 pandemic, WFH and PSBB policies can affect capital market dynamics.

C. RESEARCH METHODS

The Scope of Study

The scope of this study is to analyze the intervention or impact of the first case of Covid-19 in Indonesia on the price of gold using daily time series data. The data used in this study is the price of gold per gram in Indonesia with units of rupiah collected on a daily basis for a period from September 2, 2019, to August 7, 2020.

The intervention used in this study was the first case of Covid-19 in Indonesia on March 2, 2020. This study involved 2 variables, namely the price of gold in Indonesia as a dependent variable and the first case of Covid-19 in Indonesia, which is an intervention variable and as an independent variable.

The variables used in this research are as follows:

1) Gold price per gram in Indonesia with rupiah unit.

2) Variable intervention is the first case of Covid-19 in Indonesia that occurred on March 2, 2020. This intervention function follows a step function that can be defined as follow: $S_t \begin{cases} 0 \\ 1 \end{cases}$ (10)

The number 0 indicates if t < 131 is before March 2, 2020, while the number 1 indicates if t ≥ 131 is on March 2, 2020, and later.

The Method of Data Collection

The data used in this study is secondary data obtained from an institution that is gold.org. The price of gold used is obtained from the website gold.org, the reference of the London Bullion Market Association. This study used daily closing prices during the period of September 2, 2019, to August 7, 2020, except for holidays and no availability of data from gold price per troy ounce converted into gram units.

Analysis Method

The analytical methods used in this research include descriptive analysis and inference. Descriptive analysis is used to describe the general movement of gold prices during the research period using charts. In addition, this descriptive analysis requires a bar chart to find out the average price of gold each month during the research period.

The inference analysis used in this study uses ARIMA intervention methods. ARIMA interventions are used to analyze the impact of interventions that affect time series data. Therefore, the analysis can find out if the intervention has a temporary or permanent impact, know when the intervention began to impact, and how much impact the intervention had on the time series data. The steps of ARIMA intervention analysis used in this study refer to Nuvitasari et al. (2009) are:

1) Data grouping.

Grouping the data into two parts, namely the data before the intervention and after the intervention.

- The data before the intervention is t = 1, 2, 3, ...,131 (total of 131 observations) as series data I.

- Data on intervention until the last data is t = 132, 133, 134, ...,245 (total of 114 observations) as series data II.

2) Checking the stationary series data I.

3) Form an ARIMA model prior to intervention using series data I.

4) Diagnostic testing of the ARIMA model prior to intervention.

5) Perform data forecasting using ARIMA models before intervention.

6) Calculate residual obtained from the original data reduction results with data forecasting results using ARIMA model before intervention.

7) Create a plot graph of residual values with a limit of $\pm 2\sigma$.

8) Identify ARIMA interventions by looking at the plot graph of residual values so that it can determine from ordo b, s, and r.

9) Estimates of ARIMA intervention model.

10) Diagnostic testing of the ARIMA intervention model.

11) Determine the best ARIMA intervention model.

D. RESULTS AND DISCUSSION

Overview of Gold Price Movements in Indonesia

On March 2, 2020, Indonesia officially experienced the first case of Covid-19. As a result, gold price movements increased after a few days after the official announcement. As of March 2, 2020, the price of gold in Indonesia was still in the range of IDR 700,000 per gram. However, on March 23, 2020, the price of gold increased and was in the range of IDR 800,000 per gram.
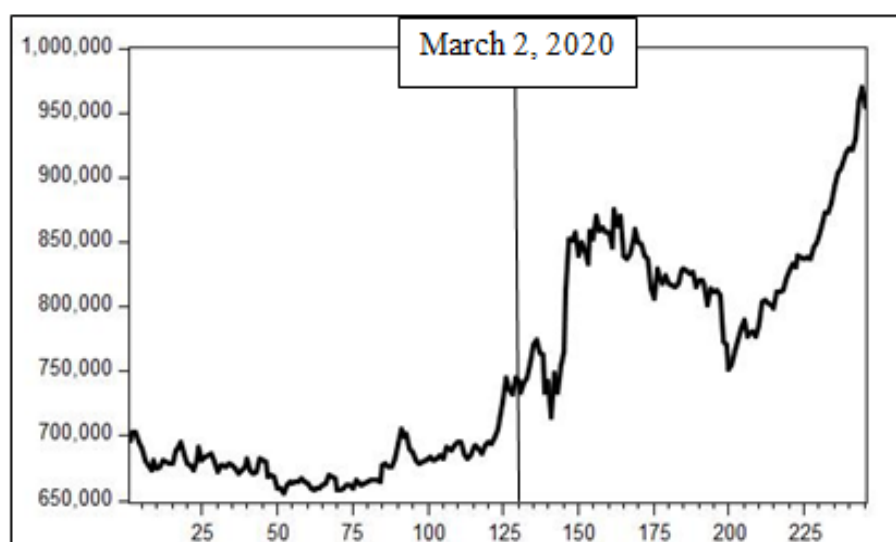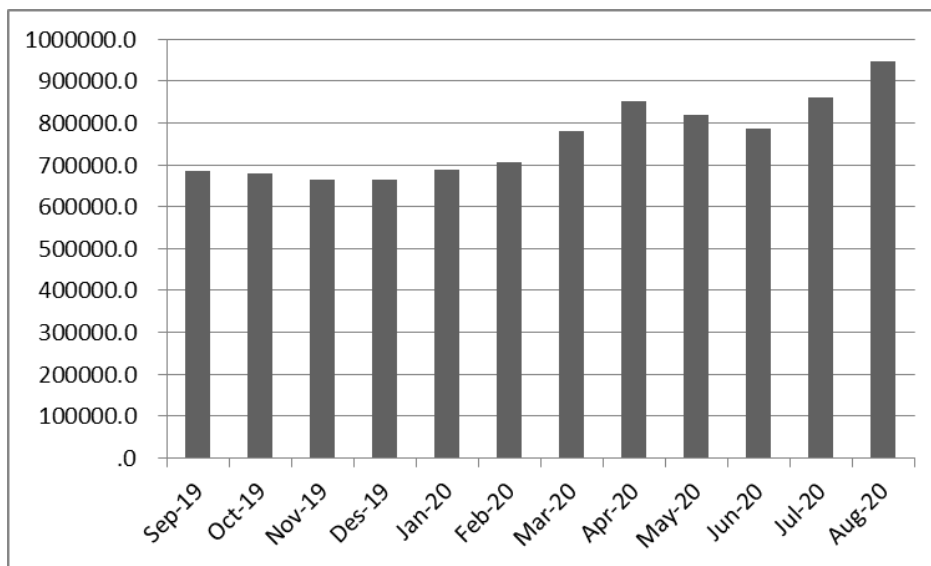

Source: gold.org, processed

Figure 3. Gold Price Movements in Indonesia from September 2, 2019 to August 7, 2020

Figure 3 shows that the movement of gold prices in Indonesia is volatile. From September to December 2019, the price of gold remained in the range of IDR 600,000 per gram. From February 19, 2020, to March 20, 2020, the price of gold was in the range of IDR 700,000 per gram. On March 23, 2020, the price of gold started in the range of IDR 800,000 per gram until finally reaching the price range of IDR 900,000 per gram in July 2020. Covid-19 resulted in the price of gold likely to increase.

This is because gold demand increased during the Covid-19 pandemic.

When viewed in detail, in the period September 2019 to August 2020 during the research period, the lowest average gold price occurred in November 2019, amounting to IDR 664,603, while the highest average gold price occurred in August 2020, which was IDR 946,918 (Figure 4).
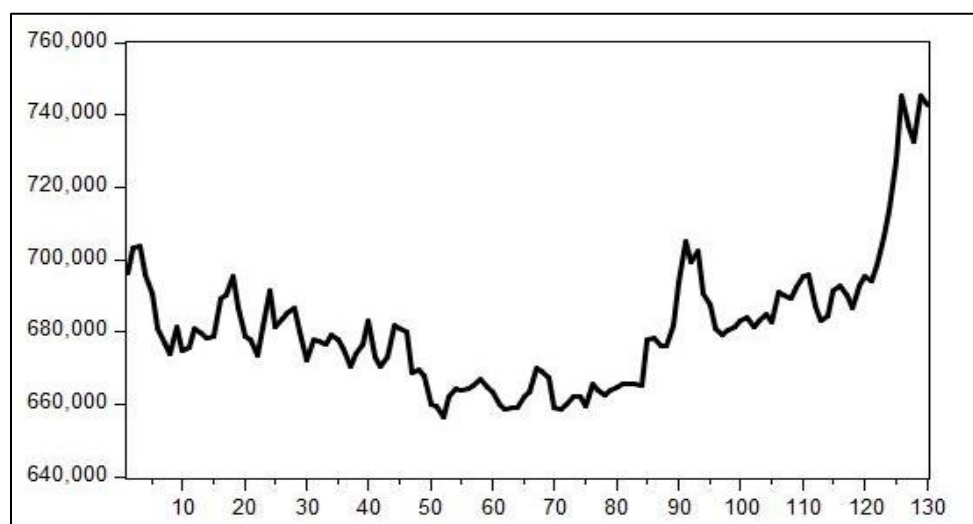

Source: gold.org, processed

Figure 4. Mean of Gold Price in Indonesia

ARIMA Box-Jenkins Pre-Intervention Model

Analyzing data using the ARIMA Box-Jenkins method, the requirement that must be met is that the data is stationary in both average and variance. Figure 5 shows that the data before the intervention is still not stationary. This can be proven by the trend patterns contained in the data.

Figure 5 shows the data has not been stationary on both average and variance. In proving whether or not the data has been stationary on average, an Augmented Dickey-Fuller (ADF) test is required. The ADF test showed a p-value > 0.1 which is 0.9396, so the data was not stationary at the level.

Source: gold.org, processed

Figure 5. Gold Price Movement Data Pre-Intervention Time Series Plot

In addressing data that has not been stationary on variance, data transformation is required. In this study, the data was transformed into a form of a natural logarithm. Then, it takes a differentencing process step so that the data becomes stationary on average. In the differencing process, 1 shows a p-value < of 0.1, which is 0.0000, so the data has been stationary on average.

In the process of identifying ARIMA, the results of the combination of Autoregressive (AR) and Moving Average (MA) are required. The results of the combination of AR and MA can be seen by looking at autocorrelation (ACF) and partial autocorrelation (PACF) patterns so that it can determine the order p and q. In this study obtained AR(2) and MA(2) so that the tentative ARIMA models formed are ARIMA(0,1,0), ARIMA(1,1,0), ARIMA(0,1,1), ARIMA(1,1,0), ARIMA(0,1,1), ARIMA(1,1 ARIMA(2,1,0), ARIMA(2,1,1), ARIMA(0,1,2), ARIMA (1,1,2), ARIMA (2,1,2). In obtaining the best model, it can be seen from the smallest AIC and SBC values. In the trial and error process, the best model is ARIMA (2,1,2).

An ARIMA model is said to be good when meeting white noise assumptions. A residual independence test is required to determine whether or not white noise assumptions are violated in the model. This study residual independence test using the Ljung-Box test.

The calculation results summarized in Table 1 indicate some lag have p-value > 0.1. This indicates that H_0 failed to reject at the level of significance $\alpha = 10$ percent. Therefore, the ARIMA model (2,1,2) has fulfilled the assumption of white noise and is good for the data forecasting process and can be done in the next process.

Table 1. Parameter Estimation Results and Residual Independence Test

Parameter		White Noise Test	
Estimation	P-value	Lag	P-value
$\emptyset_1 = 0.44897$	0.0603*	6	0.7035
$\emptyset_2 = -0.83395$	<.0001*	12	0.9963
$\theta_1 = 0.36832$	0.1699	18	0.9992
$\theta_2 = -0.76826$	0.0017*	24	0.9993

* level of significance α = 10 percent

Based on the estimated parameter results so the ARIMA model equations can be written (2,1,2) as follows:

$$Y_t = 1.44897Y_{t-1} - 1.28292Y_{t-2} + 0.83395Y_{t-3} + u_t + 0.36832u_{t-1} - 0.76826e_{u-2} \qquad (11)$$

ARIMA Model Intervention

The intervention used in this research is the first case of Covid-19 that occurred in Indonesia on March 2, 2020. The process of identifying ARIMA intervention is carried out after the selection of pre-intervention ARIMA models. In obtaining residual value, a reduction from the actual value with the forecasting value of the next 115 days is done using the pre-intervention ARIMA model. Identifying models is done by looking at orders b, s, and r.

Determination of orders b, s, and r is done by looking at residual chart patterns that exceed the $\pm 2\sigma$. In this research, the σ for gold movement data was 0,060215268, resulting in a limit of 0.120430537.

Figure 6 shows that lag 16 (T+16) is the first time the residual has crossed the $\pm 2\ \sigma$, so it can be expected to be an order value of b of 16. The value for the order s is 3 (T+19) because it occurs volatilely after the order b=16. Furthermore, the value for the r order is expected to be zero (r=0) because the residual has no pattern, but after the testing turns out to be significant, so the order r=0. The determination of orders b, s, and r in this research also involves trial and error.
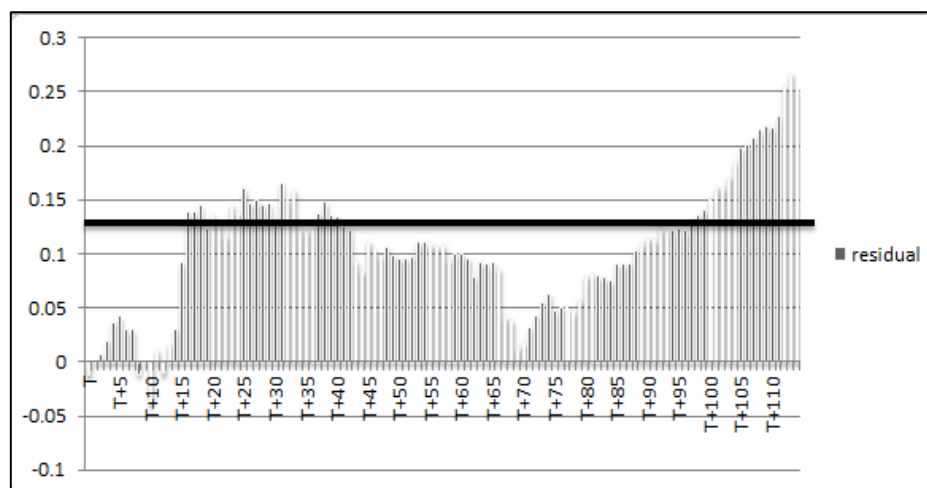
Figure 6. Gold Price Movement Data Residual Plot

After determining the order b, s, and r, the parameter testing of the results of the ordo is carried out. Table 2 shows that the ordo is significant at a rate of significance $\alpha = 10$ percent.

Table 2. ARIMA Parameter Estimation Results Intervention Gold Price Movement

Maximum Likelihood Estimation		
Parameter	Estimation	P-value
θ_1	0.78210	<.0001*
$\emptyset_1$	0.90024	<.0001*
ω_0	0.05145	<.0001*
ω_1	0.03300	0.0055*

* level of significance α = 10 percent

When obtaining parameter estimation results and finding out whether the model meets the assumption of white noise or not it is necessary to conduct a residual independence test presented in Table 3. In this study, the residual independence test uses the Ljung-Box test.

Table 3. Result of Residual Independence Test

Lag	P-value
6	0.1063
12	0.1932
18	0.4434
24	0.3052
30	0.2157
36	0.2917
42	0.3782

level of significance α = 10 percent

The calculation results summarized in Table 3 indicate some lag have p-value > 0.1. This indicates that H_0 failed to reject at the level of significance $\alpha = 10$ percent. Therefore, the ARIMA model of the formed intervention can be said to be a good model. Mathematically ARIMA model intervention on gold price movement data due to the first case of Covid-19 in Indonesia with order b=16, s=3, r=0 can be written as follows:

$$Y_t = \frac{0.05145B^{16}}{1-0.03300B}S_{t1} + \frac{(1-0.78210B)}{(1-0.90024B)(1-B)}u_t \quad (12)$$

The order of parameter b is 16 (b=16), which means the impact of the first positive case in Indonesia occurs on the 16th day after the first case. The length of the pause in the impact of this intervention is due to market participants seeing the situation from Covid-19. Market concerns began to emerge when those who announced the Covid-19 outbreak as a pandemic as well as the establishment of Covid-19 as a national disaster in Indonesia. The increase in the price of gold is inseparable from the Covid-19 outbreak. In addition, no proper vaccine has been found to address Covid-19. The second reason is that the global economic turmoil triggered the heat of relations between the United States and China. This is feared to trigger disruption in the global trade chain, disrupting the global economy, and Indonesia is also feeling the impact. High demand for gold used as a safe investment instrument amid heightened concerns of a world economic crisis that has led to the price of gold rising (tirto. id, 2020). This makes investors choose to put funds in safer investment products or safe havens.

Then the parameter value of the order s indicates that there was a significant decrease felt, namely in the period T+19 or on March 21, 2020, to T+70 or on June 8, 2020. This is due to market concerns with domestic economic projections expressed by the Minister of Finance, Sri Mulyani. Sri Mulyani stated that Indonesia's economy had the potential to grow negatively in the second quarter due to Covid-19. That prompted a profit-taking action by gold investors, although the US dollar weakened amid concerns over the physical availability of precious metals. In addition, during pandemics, people prefer to hold cash due to an unstable economy (tribunnews.com, 2020).

However, in June 2020, the price of gold strengthened again to the T+114 and is expected to continue to strengthen. According to Michael Matousek in money.kompas.com (2020), the rise in precious metal prices was driven by expectations for increased stimulus measures that support demand for safe-haven assets. This is due to gold gaining exponential popularity due to all aspects of inflation, such as the yield curve, money printing, and concerns about the economy and Covid-19.

Adequate intervention models based on model diagnosis can also be used for forecasting. In this study, forecasting was conducted for the next 31 days to see if the price of gold in Indonesia is likely to increase in about a month or not. The forecast results presented in Table 4 show that the price of gold in Indonesia always increases in the next 31 days. This is because the positive case of Covid-19 is still rising, and the Indonesian economy has not improved again.

Although the price of gold has increased, but some other commodity prices have declined. Gharib et al. (2020) explained that West Texas Intermediate oil prices would decline in April 2020.

Table 4. Forecast Results for The Next 31 Days

Number Observation	Forecasting Value	Number Observation	Forecasting Value
246	IDR 959,339	262	IDR 994,704
247	IDR 961,644	263	IDR 995,699
248	IDR 965,499	264	IDR 997,393
249	IDR 967,528	265	IDR 998,391
250	IDR 971,018	266	IDR 999,889
251	IDR 972,864	267	IDR 1,000,690
252	IDR 975,983	268	IDR 1,002,092
253	IDR 977,741	269	IDR 1,002,894
254	IDR 980,580	270	IDR 1,004,098
255	IDR 982,052	271	IDR 1,004,801
256	IDR 984,609	272	IDR 1,005,907
257	IDR 985,989	273	IDR 1,006,511
258	IDR 988,358	274	IDR 1,007,518
259	IDR 989,643	275	IDR 1,008,122
260	IDR 991,724	276	IDR 1,009,030
261	IDR 992,815		

E. CONCLUSION

The impact of Covid-19 on the price of gold in Indonesia began to be felt after two weeks of the first case of Covid-19 in Indonesia. The price of gold has increased out of the ordinary since the 16th. The intervention in the first case of Covid-19 in Indonesia is gradually temporary, which means that the intervention affects the movement of gold prices in Indonesia gradually and temporarily. On the 19th day after the intervention, the price of gold in Indonesia was lowered. Furthermore, the price of gold in Indonesia has strengthened again until the T+114 and is expected to continue to strengthen. The forecast results for the next 31 days show the gold price in Indonesia has always increased.

Based on this conclusion, when Covid-19 has not been able to be overcome so that cases confirmed positively Covid-19 continue to increase, then gold investment is one of the safe investments at the time of Covid-19. In addition, gold can be used as a long-term investment because the inflation rate tends to rise, so the price of gold will increase. However, investors should pay attention to the movement of gold prices if they are going to invest in gold. Advice for further research is to use other intervention variables related to the increase in the gold price during the pandemic.

REFERENCES

Aditya, F., Devianto, D., & Maiyastri, M. (2019). Peramalan Harga Emas Indonesia Menggunakan Metode Fuzzy Time Series Klasik. *Jurnal Matematika UNAND*, *8*(2).

Ariani, S. (2015). *Pengaruh literasi keuangan, locus of control, dan etnis terhadap pengambilan keputusan investasi* (Doctoral dissertation, STIE PERBANAS SURABAYA).

Baltagi, Badi H. (2005). *Econometric Analysis of Panel Data Third Edition.* England: John Wiley & Sons, Ltd.

Baur, D. G., & Lucey, B. M. (2010). Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. *Financial Review*, *45*(2), 217–229.

Baur, D. G., & McDermott, T. K. (2010). Is gold a safe haven? International evidence. *Journal of Banking & Finance*, *34*(8), 1886-1898.

Beckmann, J., Berger, T., & Czudaj, R. (2015). Does gold act as a hedge or a safe haven for stocks? A smooth transition approach. *Economic Modelling*, 48, 16-24.

Box, George E.P., et.al. (2016). *Time Series Analysis Forecasting and Control Fifth Edition*. New Jersey.

Bredin, D., Conlon, T., & Potì, V. (2015). Does gold glitter in the long-run? Gold as a hedge and safe haven across time and investment horizon. *International Review of Financial Analysis*, 41, 320-328. covid19.go.id/peta-sebaran 2020.

finance.detik.com. Perjalanan IHSG Sejak RI Positif Virus Corona. Retrieved November 8, 2020 from https://finance.detik.com/bursa-dan-valas/d-4972595/perjalanan-ihsg-sejak-ri-positif-virus-corona.

Gharib, C., Mefteh-Wali, S., & Jabeur, S. B. (2020). The bubble contagion effect of COVID-19 outbreak: Evidence from crude oil and gold markets. Finance Research Letters, 101703. doi:10.1016/j.frl.2020.101703.

gold.org. Gold Prices. https://www.gold.org/goldhub/data/gold-prices.

Gujarati, D. N. (2009). *Basic Econometrics Fifth Edition*. New York: McGraw Hill.

Gürgün, G., & Ünalmış, İ. (2014). Is gold a safe haven against equity market investment in emerging and developing countries?. *Finance Research Letters*, *11*(4), 341-348.

Haryanto. (2020). Dampak Covid-19 terhadap Pergerakan Nilai Tukar Rupiah dan Indeks Harga Saham Gabungan (IHSG). *Jurnal Perencanaan Pembangunan: The Indonesian Journal of Development Planning*, *4*(2).

Husna, Hamna Anisatul. (2019). *Analisis Kelebihan dan Kelemahan Investasi Emas Pada Bank Syariah Mandiri KCP Ajibarang*. Skripsi IAIN Purwokerto.

investasi.kontan.co.id.. Buntung di Saham, Untung di Emas. Retrieved Desember, 12 2020 from https://investasi.kontan.co.id/news/buntung-di-saham-untung-di-emas.

Johari, M. (2017). Investasi Emas Alternatif Berinvestasi di Tengah Krisis Global. *TAFAQQUH: Jurnal Hukum Ekonomi Syariah Dan Ahwal Syahsiyah*, *2*(2), 24-35.

Junaedi, D., & Salistia, F. (2020). Dampak Pandemi Covid-19 terhadap Pasar Modal di Indonesia. *Al-Kharaj: Jurnal Ekonomi, Keuangan & Bisnis Syariah*, *2*(2), 109-131.

Kemkes. (2020). *Pedoman Pencegahan dan Pengendalian Coronavirus Disease (Covid-19)*. Jakarta: Direktorat Jenderal Pencegahan dan Pengendalian Penyakit.

Lee, M. H., & Sanugi, B. (2010). Multi-input intervention model for evaluating the impact of the Asian crisis and terrorist attacks on tourist arrivals. *MATEMATIKA: Malaysian Journal of Industrial and Applied Mathematics*, 26, 83-106.

Makridakis, S. G., Wheelwright, S.C., and Hyndman, R. J. (1997). *Forecasting: Methods and Applications 3rd Edition*. New York: Wiley.

Miyazaki, T., & Hamori, S. (2013). Testing for causality between the gold return and stock market performance: evidence for 'gold investment in case of emergency'. *Applied financial economics*, *23*(1), 27-40.

money.kompas.com.. Kasus Covid-19 Meningkat, Harga Emas Terus Naik. RetrievedNovember 7, 2020, from https://money.kompas.com/read/2020/07/21/073600526/kasus-covid-19-meningkat-harga-emas-terus-naik?page=all.

Mukhlis, M., Kusnandar, D., & Sulistianingsih, E. (2015). Analisis Model Intervensi Fungsi Pulse Studi Kasus : Peramalan Harga Saham Malaysia Airlines dan Jumlah Wisatawan Asing. *BIMASTER 04*(3), 285–294.

Muhammad, M. (2014). Kointegrasi dan estimasi ecm pada data time series. *Jurnal konvergensi*, *4*(1), 41-51.

Nugroho, V., & Ramli, I. (2016). Krisis Ekonomi Krisis Politik Dunia Dan Ihsg. *Jurnal Ekonomi*, *21*(1), 61-75.

Nuryana, F. (2015). Analisis Pemilihan Instrumen Investasi Bisnis Emas, Valuta Asing dan Saham. *IQTISHADIA: Jurnal Ekonomi & Perbankan Syariah*, *1*(2), 196-220.

Nuvitasari, E., Suhartono, and Wibowo, S. H. (2009). *Analisis Intervensi Multi Input Fungsi Step dan Pulse untuk Peramalan Kunjungan Wisatawan ke Indonesia*. Thesis Institut Teknologi Sepuluh November Surabaya.

Putri, Rizki Hildalia. (2015). *Peramalan Harga Saham LQ45, Nilai Tukar Rupiah, dan Harga Emas dengan Pendekatan Univariat dan Multivariat Time Series*. Final Project. Sepuluh Nopember Institute of Technology, Surabaya.

Sari, R. N., Mariani, S., & Hendikawati, P. (2016). Analisis Intervensi Fungsi Step pada Harga Saham (Studi Kasus Saham PT Fast Food Indonesia Tbk). *Unnes Journal of Mathematics, 5*(2), 181-189.

Selmi, R., Mensi, W., Hammoudeh, S., & Bouoiyour, J. (2018). Is Bitcoin a hedge, a safe haven or a diversifier for oil price movements? A comparison with gold. *Energy Economics*, pp. 74, 787-801.

Shiyammurti, N. R. (2020). Dampak Pandemi Covid-19 Di Pt. Bursa Efek Indonesia (Bei). *Journal of Accounting Taxing and Auditing (JATA), 1*(1).

Sholeh, M. (2014). Emas Sebagai Instrumen Investasi Yang Aman Pada Saat Instrumen Investasi Keuangan Lain Mengalami Peningkatan Resiko. *Jurnal Akuntansi AKUNESA, 2*(2).

Sihono, T. (2008). Krisis Finansial Amerika Serikat dan Perekonomian Indonesia. *Jurnal Ekonomi dan Pendidikan, 5*(2).

Sitohang, S. (2018). Analisis Peramalan Harga Emas Dengan Metode Automatic Clustering And Fuzzy Logic Relationship. *Journal Information System Development (ISD), 3*(2).

Tambunan, D. (2020). Investasi Saham di Masa Pandemi COVID-19. *Widya Cipta: Jurnal Sekretari dan Manajemen, 4*(2), 117-123.

tirto.id. Di Balik Harga Emas yang Melambung Tinggi Saat Pandemi. Retrieved November 7, 2020 from https://tirto.id/di-balik-harga-emas-yang-melambung-tinggi-saat-pandemi-fXbr.

tribunnews.com. Harga Emas Dunia Merosot Sabtu 28 Maret 2020, Diduga Ini Penyebabnya. Retrieved November 7, 2020 from https://www.tribunnews.com/bisnis/2020/03/28/harga-emas-dunia-merosot-sabtu-28-maret-2020-diduga-ini-penyebabnya.

Wahyuni, A. N., Wahyudi, S., & Muharam, H. (2014). *Analisis Perbandingan Kinerja Investasi Emas Dan Investasi Saham Selama Masa Inflasi 1994–2013* (Doctoral dissertation, Diponegoro University).

Wati, L. R. S., Cholissodin, I., & Adikara, P. P. Implementasi Algoritme Extreme Learning Machine (ELM) Untuk Prediksi Harga Emas Bagi Investor. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer* e-ISSN, 2548, 964X.

Wei, William. W.S. (2006). *Time Series Analysis: Univariate and Multivariate 2nd Edition*. New Jersey: Pearson Education.

Worthington, A. C., & Pahlavani, M. (2007). Gold investment as an inflationary hedge: Cointegration evidence with allowance for endogenous structural breaks. *Applied Financial Economics Letters, 3*(4), 259-262

Wijayanti, Fidyah. (2017). *Pengaruh Pemilihan Umum Presiden Amerika Serikat Ke-45 dan Hari Raya Natal Terhadap Peramalan Indeks Harga Saham Gabungan (IHSG) Menggunakan Analisis Intervensi*. Undergraduate thesis Institut Teknologi Sepuluh Nopember.