THE IMPACT OF COVID-19 ON INDONESIA'S FINANCIAL SYSTEM STABILITY USING ARIMA INTERVENTION ANALYSIS

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Abstract

The financial system has an important role to play in helping the relocation of funds. If the financial system is in unstable condition it will disrupt production, consumption, and investment activities. Then, if financial institutions and financial markets that have a role as financial mediators are facing uncertainty, as a result the allocation of funds will not go well. Therefore, the financial system is strongly related to exchange rates and stocks. On March 2, 2020, the first case of Covid-19 occurred in Indonesia. As a result, the rupiah depreciated and in addition to impacting indonesia's weakening financial market conditions. Capital markets in Indonesia suffered a significant crash marked by a decline IHSG. The purpose of this research is to analyze the impact of Covid-19 on exchange rate movements and IHSG. This research uses the ARIMA intervention method. The results of the analysis showed the negative impact of Covid-19 on the stability of the financial system in Indonesia began to be felt after two weeks of confirmation of the first case. The depreciation of the rupiah is out of the ordinary since the 18th day and IHSG occurred since the 16th day after the announcement of the first case and temporary.

Keywords: Covid-19, Exchange Rate, JCI, Financial Stability, Arima Intervention

1. INTRODUCTION

The financial system has an important role to play in helping to reallocate funds. If there are units that have a surplus, the funds can be utilized by units that have a deficit. If the financial system is in an unstable condition, it will interfere with production, consumption, and investment activities. Then, if financial institutions and financial markets that have a role as financial mediators are facing uncertainty, as a result the allocation of funds will not go well. Therefore, the financial system is very concerned with exchange rates and stocks.

In financial markets, stock sellers can earn capital in the capital market, such as the stock market. The capital market can be an alternative place to make investments for those who have excess funds. Therefore, capital markets play an important role in financial system stability. This is because it can be used as a complement to the process of allocating funds or finance from the community to the rill sector (Rushandie, 2014). In addition, exchange rates also play an important role in the capital market. This is because the exchange rate affects the share price (Rohmanda, et al, 2014).

However, in the event of financial system instability, the public is not easy to trust, followed by a cautious attitude of investors. If investors start to panic, investors will withdraw their investments resulting in liquidity difficulties. Therefore, the importance of maintaining financial system stability in Indonesia. This is because the complexity and

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interconnectedness in the financial system can result in a crisis stemming from the financial sector and not only impacting the financial sector, but also impacting macroeconomic performance and resulting in high economic recovery costs (Indonesia Bank, 2014).

The economic problems that occur in Indonesia caused by global economic conditions prove that Indonesia is one of the countries that is easily affected by the condition of the world economy. Therefore, in 2020 Indonesia also experienced the impact of the Coronavirus Disease-2019 (Covid-19) pandemic.

In early 2020, the world was enraged by the discovery of new cases that unsettled the community. This is based on the presence of cases of pneumonia with unclear etiology in Wuhan City, Hubei Province, China at the end of 2019. The World Health Organization (WHO) announced the Covid-19 outbreak as a public emergency that is troubling the world precisely on January 30, 2020. On March 2, 2020, Indonesia reported for the first time two confirmed positive cases of Covid-19
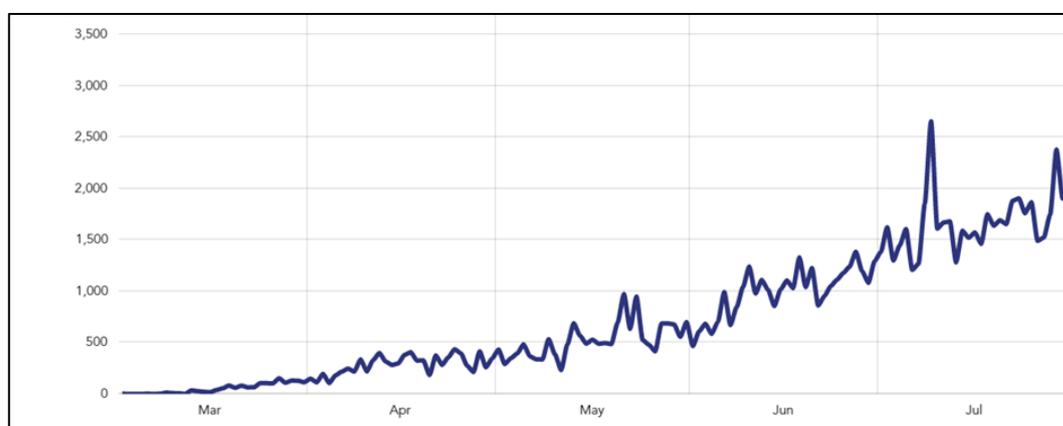
Source: covid19.go.id, 2020
Figure 1. Covid-19 Positive Confirmed Cases Per Day

Based on Figure 1, there was a very sharp increase on July 8 to July 9, 2020 from 1,853 people to 2,657 people, and there was a sharp decrease on July 9 to July 10, 2020 from 2,657 people to 1,611 people.

Covid-19 is spreading rapidly and transforming into a pandemic in various countries around the world. The current pandemic has a significant influence on various countries that have a rapidly growing number of active cases, including in Indonesia (Supriyanto, 2020). The surge in the number of people with high fatality rates in the last four months is very worrying and causes panic both the government, the public, and the business world.

Based on the publication of National Development Planning Agency, the government's response in conducting pandemic prevention efforts, namely through Large-Scale Social Restrictions in various regions, thus making the economy slow and even stop. This is due to distance learning for students, Work From Home (WFH) for formal sector workers, delays and cancellations of various events in various business sectors, to the ban on homecoming or traveling outside the area resulting in the termination of several modes of public transportation.

In addition, the panic caused by Covid-19 is also indicated to hit indonesia's financial markets, as seen from Indonesia Bank's data which states that during the covid-19 spread period in January to June 2020 there was a capital outflow of Rp 159.3 trillion. Capital outflow from foreign investors always creates high volatility both in the movement of the Rp / US$ exchange rate and the movement of stock indices during the crisis.

THE IMPACT OF COVID-19 ON INDONESIA'S FINANCIAL SYSTEM STABILITY USING ARIMA INTERVENTION ANALYSIS

Based on data from the World Bank in 2020, although Indonesia's currency exchange rate is very volatile, there are still some regions that are more severe than Indonesia, such as Colombia down 17.6 percent, Russia down 18.5 percent, and Mexico down 25 percent. Prior to Covid-19, the rupiah exchange rate was in the range of Rp.14,000/US$, but during the Covid-19 pandemic, the rupiah depreciated to Rp.16,600/ per US$. Based of Indonesia Bank, the rupiah exchange rate will continue to remain vulnerable during the spread of the Covid-19 outbreak which has caused panic in global markets, causing foreign funds to flee as well as liquidity pressures and the urge to get dollars to make the dollar superior to everything.

Rupiah fluctuations before the Covid-19 pandemic according to a number of economists are driven by a number of factors both external and internal. First, there is the sentiment of a hike in the benchmark interest rate by the Central Bank of the United States (Fed) as well as the risk of a trade war between the United States and China and other countries. As for internal factors, Indonesia faces the problem of trade deficit and current account deficit (CAD). The current account deficit has reached 3% of Gross Domestic Product (GDP).

The Covid-19 pandemic is not only affecting the health of the world's citizens. This outbreak has also eroded the global economy and spread to Indonesia. In addition to impacting the exchange rate, Covid-19 also impacted indonesia's weakening financial market conditions. Based of Indonesia Bank, the capital market in Indonesia experienced a significant crash marked by a decrease in the Jakarta Composite Index (JCI) which finally plunged. Everything is beyond prediction and not an easy thing to control. Prior to the first Covid-19 confirmation in Indonesia, JCI was at the level of 6,244 (January 24) weakened to 5,942 (February 20) and corrected again to the level of 5,361 (March 2). On March 12, when who announced the pandemic, JCI fell 4.2% to 4,937 when Thursday's session opened, which is a level that has not happened in nearly four years. On March 13, stock trading was suspended for the first time since 2008 due to the Covid-19 pandemic.

Based on Haryanto (2020), on April 16, 2020, JCI has been recorded at 28.27 percent since the beginning of 2020. Meanwhile, other countries experienced the same, for example: PHISIX Philippines corrected 29.3 percent, SPI Singapore corrected 18.95 percent, SET Thailand 24.03 percent and LSE UK 25.98 percent. The rupiah exchange rate is still fluctuating tends to weaken, while the stock market is inflamed in line with the rate of the JCI which is corrected quite deep. Economic growth is also expected to slow dramatically, eroded by the spread of the virus to various sectors of the economy. Therefore, it is very interesting and important to conduct an in-depth analysis of the impact of Covid-19 on exchange rate movements and JCI.

2. LITERATURE STUDY

Financial System Stability

Financial system stability is a condition that allows the national financial system to function effectively and effciently and be able to withstand internal and external vulnerabilities, so that the allocation of sources of funding or financing can contribute to the growth and stability of the national economy (Indonesia Bank, 2022). Therefore, financial stability has an important role in maintaining the economic stability of a country.

The financial system if it does not function properly can reduce the effectiveness of monetary policy, disrupt the smoothness of economic activities and slow growth to economic contraction. Therefore, the realization of financial system stability is a shared responsibility among financial sector authorities (Indonesia Bank, 2022).

ARIMA Intervention

The movement of time series data in practice is not always stable. This is because in a certain period of time the data experiences an unusual average pattern. These patterns are formed due to the occurrence of an event, such as natural disasters, government policies, economic crises, and others. Therefore, these unexpected events are called interventions.

The main purpose of intervention analysis is to measure the impact of interventions (Wei, 2006). The impacts in question include from when the impact occurred, how long it will last, and how big the impact will be. According to Wei (2006) interventions are divided into two types namely long-term interventions and short-term interventions. Long-term intervention (step function) is an intervention that occurs from the time of T onwards because it does not know when the intervention will end. Short-term intervention (pulse function) is an intervention that occurs from the time of T only or the time that has been known when the intervention ends. As for systematically can be written as follows:

1) Step function

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

2) Pulse function

$$I_t = P_t^{(T)} = \begin{cases} 0, & t \neq T \\ 1, & t = T \end{cases} \tag{2}$$

The form of multi input model can be written as follows:

$$Z_t = f(I_{jt}) + N_t \tag{3}$$

$$Z_t = \sum_{j=1}^{k} \frac{\omega_{sj}(B)B^{bj}}{\delta_{rj}(B)} I_{jt} + \frac{(1-\emptyset B)u_t}{(1-\theta B)(1-B)} \tag{4}$$

$$\omega_{sj}(B) = \omega_{0j} - \omega_{1j}B^1 - \cdots - \omega_{sj}B^s \tag{5}$$

description:

Z_t	: response variable time-t
I_{jt}	: intervention variable j when time-t
N_t	: ARIMA model
B	: *backshift order*
ω_{sj}	: parameter of the ARIMA intervention when the j intervention function
δ_{rj}	: parameter of the ARIMA intervention when the j intervention function
sj, bj, rj	: ARIMA order of intervention when the function of the j intervention

Before estimating the intervention model, it is necessary to first identify the intervention of the ARIMA order. In the analysis of ARIMA intervention there are three order, namely (Lee, M. H., et al, 2010):

- b order

  An order indicating the start time of the intervention.

- s order

The order indicates the time it takes for the intervention effect to return to stable.

- r order

The order states a pattern on the effects of intervention.

Determining the order b, r, s can be seen from the residual plot pattern of the ARIMA model before intervention. If the movement of residual value exceeds the $\pm 2\sigma$ or $\pm 3\sigma$ indicates the difference from the actual value with the forecasting value has a significant difference. In determining the best order, trial and error is required to produce the best model.

The possible responses that occur both step and pulse intervention responses are as follows (Wei, 2006):
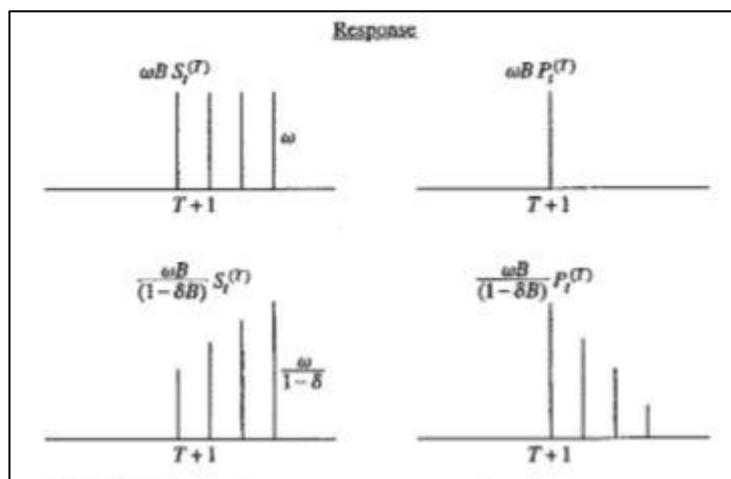
Source: Wei (2006)

Figure 2. Response Step and Pulse Function

Some research related to ARIMA intervention has been widely done. Research conducted by Nuralaina (2016) with the title " Analisis ARIMA Intervensi Fungsi Step Untuk Peramalan Nilai Kurs Rupiah Terhadap Dollar Amerika ". This study uses intervention analysis of step function. The findings of this study are the differences in the function of step in the data of Rupiah exchange rate against the US Dollar before and during the intervention. Also, intervention analysis is also used to forecast rupiah exchange rate in January 2016.

Furthermore, the research conducted by Mukhlis, et al (2015) entitled "Analisis Model Intervensi Fungsi Pulse. Studi Kasus: Peramalan Harga Saham Malaysia Airlines dan Jumlah Wisatawan Asing". In his research, the authors used ARIMA analysis method of pulse function intervention. The result of his research is that the disappearance of flight MH370 did not give an intervention effect on mas stock while the Bali bombing incident had an intervention effect with the decrease in the number of foreign tourists at the time of the incident and one month after the incident.

Then, related to the impact of Covid-19 on exchange rates and JCI, Shiyammurti, et al (2020) shows that the COVID-19 pandemic in Indonesia has lowered the Indonesian

15

economy due to the decline in the JCI. Indonesia Stock Exchange and rising interest rates and inflation rates in Indonesia. Similarly, rupiah exchange rate (Exchange Rate) is very influential for the Composite Stock Price Index, the higher the rupiah exchange rate, the lower the value of JCI.

Junaedi and Salistia (2020) stated that JCI movements are influenced by internal and external conditions. Internally, the Covid-19 pandemic and social distancing policies in the country have influenced the dynamics of the capital market (indicated by the JCI movement). Externally, the Covid-19 pandemic in China and Spain is affecting the dynamics of capital markets in Indonesia.

3. RESEARCH METHODOLOGY

Scope of Research

The scope of this research is to analyze the intervention or impact of Covid-19 on exchange rate movements and JCI using time series data. The data used in this study includes data on rupiah exchange rate against dollar and JCI collected per day during the period January 1, 2020 to June 11, 2020.

The intervention used in this study is the first case of Covid-19 in Indonesia which occurred on March 2, 2020. This study involves several variables, namely exchange rate and JCI as dependent variables and the first case of Covid-19 in Indonesia which is an intervention variable that is used as an independent variable.

The details of the variables used in this study are as follows:
1)   Exchange rate indicating the rupiah exchange rate against the dollar per day. The currency exchange rate against the current payment between the two countries. The exchange rate data used is JISDOR exchange rate which is the spot price of USD/IDR which is arranged based on the exchange rate of USD/ IDR transactions against interbank rupiah in the Indonesian foreign exchange market. JISDOR exchange rate provides a representative market price reference for spot transactions of USD/IDR of the Indonesian foreign exchange market. The exchange rate unit used in this study is rupiah.
2)   Jakarta Composite Index (JCI) is stock market indexes effectively used on the Indonesia Stock Exchange (IDX).
3)   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 follows:

$$S_t \begin{cases} 0 \\ 1 \end{cases}$$

(6)

number 0 indicates if t < 62 is before March 2, 2020 while the number 1 indicates if t ≥ 62 is on March 2, 2020 and after.

THE IMPACT OF COVID-19 ON INDONESIA'S FINANCIAL SYSTEM STABILITY USING ARIMA INTERVENTION ANALYSIS

Data

The data used in this study used secondary data obtained from the finance.yahoo.com website for JCI variables at close and Indonesia Bank for exchange rate variables. Data used in the form of daily data during the period January 1, 2020 to June 11, 2020.

Analysis Method

The analytical methods used in this study are descriptive and inference analysis. This analysis is used to describe the movement of exchange rates and JCI in general. In this analysis, exchange rate movements and JCI are displayed in the form of charts so that they can know the development of exchange rates and JCI during the research period. In addition, this analysis to find out the different conditions of exchange rate movements and JCI when before and after the intervention in general.

The inference analysis used in this study is the ARIMA method of intervention. Analysis is used to analyze the impact of interventions affecting time series data. Therefore, this analysis can find out when interventions start to impact, how much the intervention impacts the data, and find out if the impact of interventions has a temporary or permanent impact. The steps used in this study refer to Nuvitasari's research, et al (2009):

1) Grouping data

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

   - before the intervention are t = 1, 2, 3, ..., 61 (61 observations) as series data I

   - after the intervention are t = 62, 63, 64, ..., 163 (102 observations) as series data II

2) Checking stationary of series data I

3) Using series data I to form the ARIMA model before intervention

4) Diagnostic test to ARIMA model before

5) Perform data forecasting using ARIMA model before intervention for the next 60 days.

6) Calculating residual data for data. Residuals are obtained from the results of the reduction of the original data minus the results of forecasting data using the ARIMA model before intervention

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

8) Identify the intervention response by looking at the plot graph of residual values so as to determine the order b, s, and r

9) Estimation of intervention model

10) Diagnostic test to intervention model

11) Determine the best intervention model

4. RESULT AND DISCUSSION

Overview of Exchange Rate and JCI

Officially on March 2, 2020, Indonesia experienced the first case of Covid-19. As a result, rupiah exchange rate movements experienced a significant weakening. On March 20, 2020, the rupiah exchange rate was in the range of Rp. 16,000/US$. However, the turmoil in the rupiah depreciation did not last long. On April 13, 2020, the rupiah was in the range of Rp. 15,000/US$ while on May 11, 2020 the rupiah was in the range of Rp. 14,000/US$.
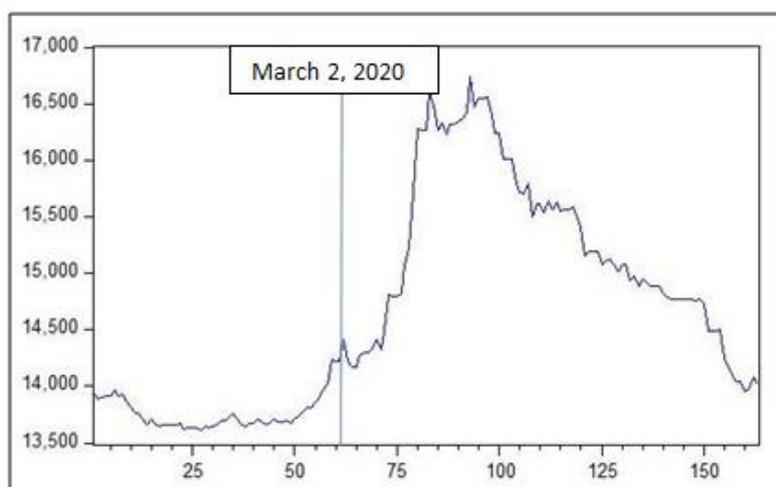
Source: Indonesia Bank (processed)
Figure 3. Exchange Rate Movements January 1, 2020 to June 11, 2020

Figure 3 shows the movement of exchange rates in Indonesia fluctuating. From January 1, 2020 to February 26, 2020, exchange rate movements tended to remain stable despite the weakening. From February 27, 2020 to March 16, 2020, the rupiah exchange rate was in the range of Rp. 14,000/US$. The rupiah continued to weaken due to adjustments in foreign capital inflows in the domestic financial markets. This is because the spread of Covid-19 has depressed the rupiah exchange rate since mid-February 2020.

Then, the spread of Covid-19 also impacted the movement of JCI. The weakening of rupiah exchange rate against the capital market is due to investors' concerns in making

18

investments. The depreciation of the rupiah against the dollar means that indonesia's economy is not in good shape. As a result, investors will conduct a sell-off until the economic condition is in good condition. Therefore, exchange rate conditions negatively affect the value of stock indices (Valadkhani, etc., 2006; Witjaksono, 2010).

Figure 4 shows the movement of JCI that has fluctuating. From January 17, 2020 to January 31, 2020, JCI movement continued to weaken. This is marked from the original in the range of 6,000 levels and continues to be corrected to the range of 5,000 levels. On February 1, 2020, JCI movement increased but did not last long.

After the first case of Covid-19 was announced, from March 4, 2020 to March 24, 2020, it continued to weaken and eventually fell to a level of 3,000. The corrected value of JCI is due to global capital market conditions that are not in good condition. The current pressure on global capital markets is caused by several things such as the Covid-19 pandemic, oil price wars, and interest rate reductions by the United States Federal Reserve (money.kompas.com).
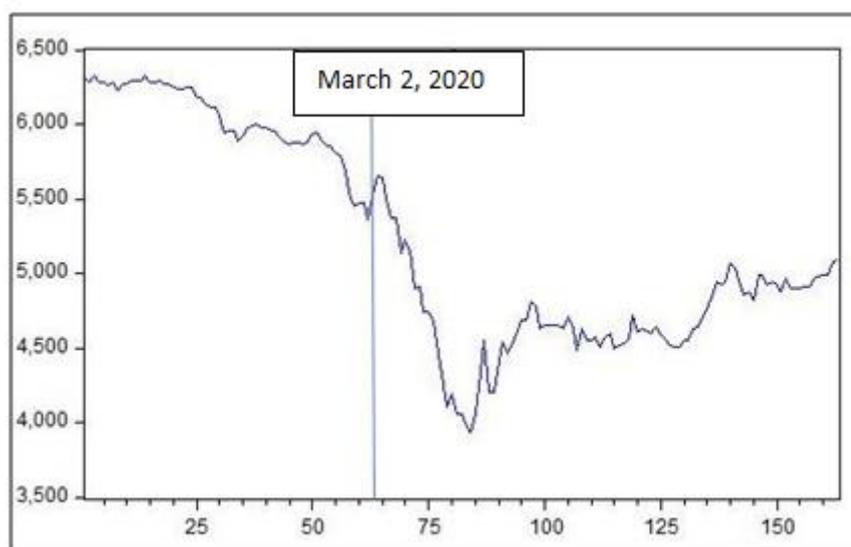
Source: finance.yahoo.com (processed)
Figure 4. JCI Movement January 1, 2020 to June, 11 2020

Pre Intervention ARIMA Box-Jenkins Model

Exchange Rate

The requirement in analyzing ARIMA Box-Jenkins method is that the data must be stationary in both variance and average. Figure 5 shows that exchange rate movement data from January 1, 2020 to March 1, 2020 is still not stationary. This is because the data pattern still has a trend.
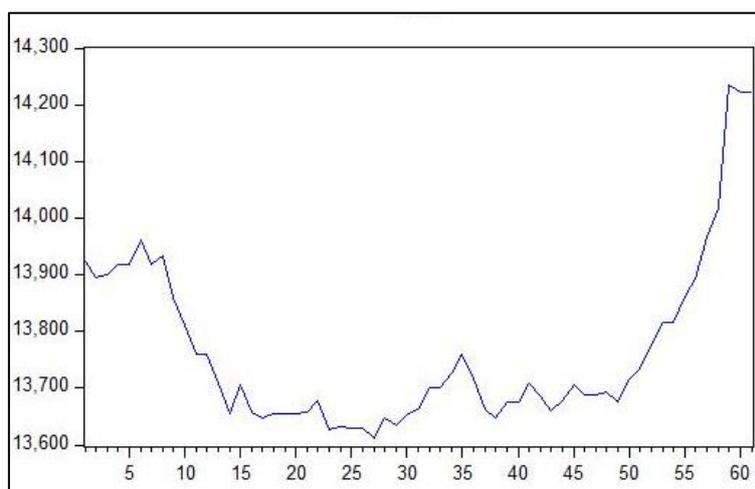
Source: Indonesia Bank (processed)
Figure 5. Plot Time Series Pre Intervention Exchange Rate Movement Data

Figure 5 shows that the data has not been stationary on variance and average. Meanwhile, in assuring whether the data has been stationary or not on average then conducted Augmented Dickey Fuller (ADF) test. The test results showed the p-value > 0.01. This indicates that the data has not been stationary at that level.

Due to the condition of the data has not been stationary, it is treated several steps to make the data stationary. In generating stationary data on variance, in this study pre intervention exchange rate movement data was transformed into a natural logarithm. Another case with the treatment to get stationary data on average. In generating stationary data on average, in this study pre intervention exchange rate movement data was carried out differencing process 1. Then, datastation testing is carried out using ADF test. The test results showed a p-value < 0.01. This indicates that the data has been stationary in differencing 1.

Then, it is necessary to do the identification process of ARIMA. In determining the results of the combination of Autoregressive (AR) and Moving Average (MA) it can be seen in the pattern of autocorrelation (ACF) and partial autocorrelation (PACF) so that it can determine the order p and q. In this study AR(2) and MA(2) were obtained so that the possible models are ARIMA(0,1,0), ARIMA(1,1,0), ARIMA(0,1,1), ARIMA(1,1,1), 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(1,1,1).

ARIMA model is said to be adequate if the model has residuals that meet the assumption of white noise. In knowing whether the model meets the assumption of white noise, it is necessary to conduct residual independence test. In this study residual independence test using Ljung-Box test.

THE IMPACT OF COVID-19 ON INDONESIA'S FINANCIAL SYSTEM STABILITY USING ARIMA INTERVENTION ANALYSIS

Based on Table 1 shows the calculation results obtained p-value at some lag of *p-value* $> \alpha$. This indicates that the test results showed a failure to H_0 at the level of significance $\alpha = 1$ percent. Therefore, the ARIMA model (1,1,1) has fulfilled the assumption of white noise and is good for the data forecasting process.

Table 1. Parameter Estimation results and Residual Independence Test

Parameter		White Noise Check	
Estimation	**P-value**	**Lag**	**P-value**
$\emptyset = 0.93084$	<.0001*	6	0.7480
$\theta = 0.78958$	0.0024*	12	0.6956
		18	0.9133
		24	0.7025

*at the level of α significance = 1 percent

Based on the estimated parameter, it can be written ARIMA model equation (1,1,1) as follows:

$$Y_t = 1,9255Y_{t-1} - 0,9255Y_{t-2} + u_t - 0,7888u_{t-1} \qquad (7)$$

JCI

As the treatment of exchange rate movement data, in analyzing the ARIMA Box-Jenkins method is the data must be in a stationary state both on variance and average. Figure 6 shows that JCI movement data from January 1, 2020 to March 1,
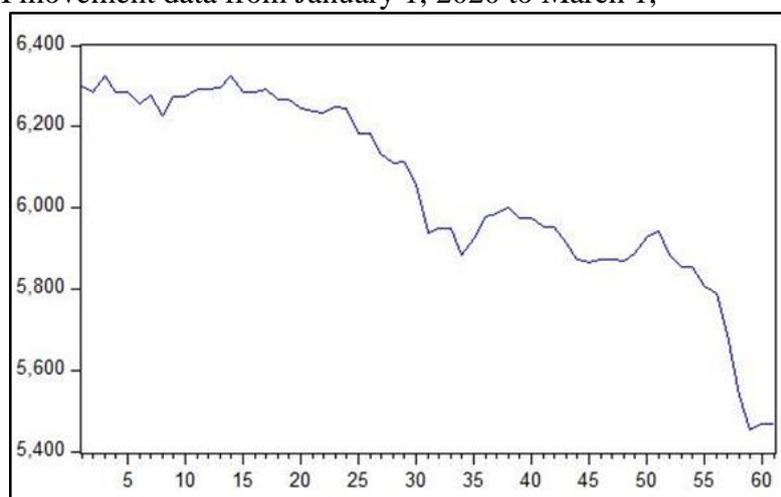
Source: finance.yahoo.com (processed)
Figure 6. Plot Time Series Pre Intervention JCI Movement Data

Figure 6 shows that the data is not yet stationary on variance and average. Meanwhile, in assuring whether the data has been stationary or not on average then conducted Augmented Dickey Fuller (ADF) test. The test results showed the p-value > 0.01. This indicates that the data has not been stationary at that level.

21

Due to the condition of the data has not been stationary, it is treated several steps to make the data stationary. In generating stationary data on variance, in this study, pre intervention JCI movement data was transformed into a natural logarithm. Another case with the treatment to get stationary data on average. In generating stationary data on average, in this study, pre intervention JCI movement data was carried out differencing process 1. Then, datastation testing is carried out using ADF test. The test results showed a p-value < 0.01. This indicates that the data has been stationary in differencing 1.

Then, it is necessary to do the identification process of ARIMA. In determining the results of the combination of Autoregressive (AR) and Moving Average (MA) it can be seen in the pattern of autocorrelation (ACF) and partial autocorrelation (PACF) so that it can determine the order p and q. In this study AR(1) and MA(1) were obtained so that the possible models are ARIMA(0,1,0), ARIMA(1,1,0), ARIMA(0,1,1), ARIMA(1,1,1). 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(1,1,0).

ARIMA model is said to be adequate if the model has residuals that meet the assumption of white noise. In knowing whether the model meets the assumption of white noise, it is necessary to conduct residual independence test. In this study residual independence test using Ljung-Box test.

Based on Table 2 shows the calculation results obtained p-value at some lag of *p-value* $> \alpha$. This indicates that the test results showed a failure to H_0 at the level of significance $\alpha = 1$ percent. Therefore, the ARIMA model (1,1,0) has fulfilled the assumption of white noise and is good for the data forecasting process.

Table 2. Parameter Estimation results and Residual Independence Test

Parameter		White Noise Check	
Estimation	**P-value**	**Lag**	**P-value**
$\emptyset = 0.33755$	0.0057*	6	0.6682
		12	0.7645
		18	0.8575
		24	0.8099

*at the level of α significance = 1 percent

Based on the estimated parameter, it can be written ARIMA model equation (1,1,0) as follows:

$$Y_t = 1{,}33756 Y_{t-1} - 0{,}33756 Y_{t-2} + u_t \qquad (8)$$

ARIMA Intervention Model

This study, the intervention used was the first case of Covid-19 in Indonesia which occurred on March 2, 2020 which is a step form. Identification of ARIMA intervention is done after obtaining the pre-intervention ARIMA model. From the equation of the ARIMA model of exchange rate movements and JCI, it is necessary to forecast to look for residual values. Forecasting is carried out for the next 60 days and residual value is obtained from the actual data reduction with forecasting data. In identifying the model is done by looking at the order b, s, and r. The determination of the order b, s, and r is done by looking at residual graph patterns that come out of the $\pm 2\,\sigma$. In this study, the σ for exchange rate movement data was 0.045030627 so that the obtained limit was 0.090061255. Then the σ for JCI movement data is 0.083950588 so that the obtained limit is 0.167901176.

Exchange Rate

Determining the order b, s, and r is done by looking at residual graph patterns that come out of the ±2σ. Figure 7 shows that lag 18 (T+18) is the first time residuals cross the ±2σ limit so that it can be estimated the value of order b is 18. The value for the order s is 1 (T+19) because there is a decrease after the order b=18. Furthermore, the value for the order r is expected to be zero (r=0) because the residual has no pattern, but after testing it turns out to be significant so that the order r=0. The determination of order b, s, and r in this study also involves trial and error process.
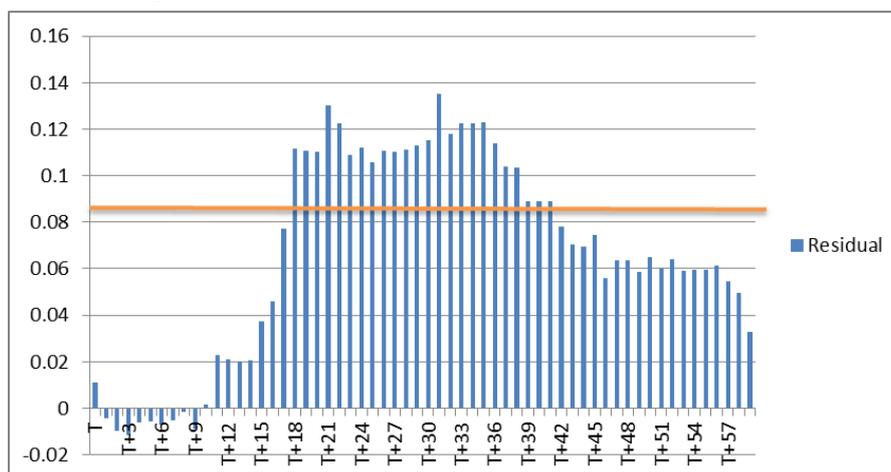
Figure 7. Residual Plot of Exchange Rate Movement Data

Then a parameter test was performed on the order and showed significant results at the level of α =1 percent significance shown in Table 3.

Table 3. Estimated Parameter Of ARIMA Intervention Exchange Rate Movement

Maximum Likelihood Estimation

23

Parameter	Estimation	P-value
θ_1	0.90768	<.0001*
$\emptyset_1$	0.96137	<.0001*
ω_0	0.02953	<.0001*
ω_1	-0.03317	<.0001*

*at the level of α significance = 1 percent

After obtaining the result of parameter estimation, it is necessary to test the assumption of white noise. In knowing whether the model meets the assumption of white noise, it is necessary to conduct residual independence test. In this study residual independence test using Ljung-Box test.

Table 4. ARIMA Intervention Residual Independence Test Exchange Rate Movement

White Noise Check	
Lag	P-value
6	0.0646
12	0.0200
18	0.0411
24	0.0173

Based on Table 4 shows the results failed to H_0 at a level of significance $\alpha = 1$ percent. This indicates that the ARIMA intervention model of exchange rate has met the assumption of white noise. Therefore, the ARIMA intervention model of that is formed can be said to be a good model. Mathematically, the ARIMA intervention model of exchange rate movement data due to the first case of Covid-19 in Indonesia with order b=18, s=1, r=0 can be written as follows:

$$Y_t = 0,02953B^{18} + 0,33170B^{19}1,9255Y_{t-1} - 0,9255Y_{t-2} + u_t - 0,7888u_{t-1} \qquad (9)$$

The order of parameter b is 18 (b=18), which means that the impact of the first positive case in Indonesia occurs on the 18th day after the first case. The long pause in the impact of this intervention is due to the market seeing the situation from Covid-19. Market concerns arose from WHO announcing the coronavirus outbreak as a pandemic as well as the establishment of Covid-19 as a national disaster in Indonesia. In addition, according to TRFX Garuda Berjangka director Ibrahim, the decline in retail sales data in the US reached minus 8.7 percent in March 2020 as well as economic projections from the world bank, IMF, and OECD which stated that global growth negatively contributed to the weakening of the rupiah against the US dollar.

Then the parameter value of the order indicates that there is a significant decrease felt, namely in the period T +19 or on March 21, 2020. This is due to market concerns with domestic economic projections.. SIndonesia's economy has the potential to grow negatively due to the Covid-19 outbreak and the peak of weakening occurred on T+22 or on March 24,

2020. This is because investors prefer to invest in other countries that are considered to have a bright economic future and rapid pandemic management, such as America.

However, this did not last long, the exchange rate strengthened again after the period of T+38 or on April 9, 2020. According to Indonesia Bank the strengthening was a result of BI's intervention in maintaining rupiah exchange rate stability, such as using foreign exchange reserves, lowering interest rates, lowering mandatory minimum demand deposits, and so on. In addition, rupiah exchange rate appreciation was also caused by global financial market risks that began to subside. One of them can be seen through the Volatility Index (VIX) which begins to show a downward trend from the highest level at 82.

But until T+58, the exchange rate is still not able to return to its original position before the pandemic. According to MNC Securities this is because Indonesia's trade balance recorded more trade deficit than surplus trade balance. In addition, global economic conditions are very influential on international trade transactions. This will continue for the future if a vaccine has not been found. However, the exchange rate may also weaken again if there are extreme cases such as at the beginning of pandemic.

JCI

Determining the order b, s, and r is done by looking at residual graph patterns that come out of the $\pm 2\,\sigma$. Figure 8 shows that lag 15 (T+15) is the first time residuals have crossed the $\pm 2\,\sigma$ limit. However, after the trial and error process, a b value of 16 is obtained. The value for the order s is 2 (T+18) because there is a decrease after the order b=16. Furthermore, the value for the order r is expected to be zero (r=0) because the residual has no pattern, but after testing it turns out to be significant so that the order r=0. The determination of the order b, s, and r in this study involves the process of trial and error.
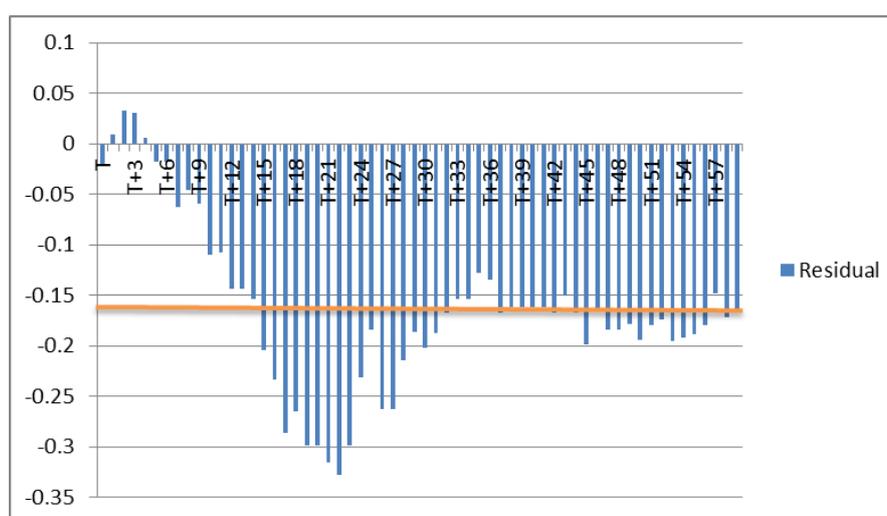
Figure 8. Residual Plot of JCI Movement Data

Then parameter test was performed on the order and showed significant results at the level of $\alpha =1$ percent significance shown in Table 5.

Table 5. Estimated Parameter Of ARIMA Intervention JCI Movement

Maximum Likelihood Estimation		
Parameter	**Estimation**	**P-value**
$\emptyset_1$	0.01558	0.8547
ω_0	-0.05055	0.0054*
ω_1	0.05330	0.0036*

*at the level of α significance = 1 percent

After obtaining the result of parameter estimation, it is necessary to test the assumption of white noise. In knowing whether the model meets the assumption of white noise, it is necessary to conduct residual independence test. In this study residual independence test using Ljung-Box test.

Table 6. ARIMA Intervention Residual Independence Test JCI Movement

White Noise Check	
Lag	**P-value**
6	0.0942
12	0.0695
18	0.1289
24	0.1308

Based on Table 6 shows the results failed to H_0 at the level of significance $\alpha = 1$ percent. This indicates that the ARIMA intervention model of exchange rate has met the assumption of white noise. Therefore, the ARIMA model of intervention that is formed can be said to be a good model. Mathematically, the ARIMA model of intervention in JCI movement data due to the first case of Covid-19 in Indonesia with order b=15, s=2, r=0 can be written as follows:

$$Y_t = -0{,}05055B^{16} - 0{,}05330B^{17} + 1{,}33756Y_{t-1} - 0{,}33756Y_{t-2} + u_t \qquad (10)$$

The equation above indicates that the function of the first intervention has signed parameter ω_0. The negative parameter value of ω_0 indicates that the first impact that occurs after a positive case is a decrease in the value of JCI. The order of parameter b is 16 (b=16), which means that the first positive case impact in Indonesia occurs on the 16th day after the first case. The long pause in the impact of this intervention is due to investors seeing the covid situation in various worlds including Indonesia.

THE IMPACT OF COVID-19 ON INDONESIA'S FINANCIAL SYSTEM STABILITY USING ARIMA INTERVENTION ANALYSIS

On March 11, 2020, WHO officially announced the coronavirus outbreak as a pandemic. Furthermore, the Indonesian government followed the steps by establishing the pandemic as a national disaster and the application of social distancing on March 15, 2020 (Kompas.com, 2020). The policy has drastically reduced the activities and movement of people in Jabodetabek and major cities. This can be seen from the decrease in the number of passengers in various means of transportation ranging from airplanes, commuter trains, buses, public transportation, taxis, online taxis, to online motorcycle taxis (Hadiwardoyo, 2020). The less conducive situation is what makes the economy less stable so that investors better attract their investment and put in a safer country, where the signs begin on March 17, 2020.

Then the parameter value of the order indicates that there is a significant decrease felt, namely in the period T +16 or on March 18, 2020. This is due to the increasing number of investors attracting capital from Indonesia where the peak of weakening occurred on T+22 or on March 24, 2020. However, this did not last long, JCI value strengthened again to the psychological level of 4000 after the period of T +32 or on April 3, 2020. According to the Indonesia Bank, , the strengthening shows the easing of investor panic in various worlds. According to him, the strengthening of JCI can not be separated from positive developments related to the handling of Covid-19 in various countries. Notably, after the United States senate approved a proposed fiscal stimulus package of 2 trillion U.S. dollars and the German Government disbursed fiscal stimulus of 860 billion U.S. dollars or 10 percent of its country's GDP. As a result Indices such as the Dow Jones gained nearly 2.4 percent and European stock indexes also rose along with emerging market stock indices such as Brazil, Mexico, Russia and others. This indicates that short-term intervention is occurring due to the Covid-19 pandemic to financial stability in Indonesia.

Based on Figure 8, it can also be seen that JCI has experienced a stable state, but the value is not as before the intervention. This will continue for the future if a vaccine has not been found. However, JCI may also experience further shocks if there are extreme cases such as at the beginning of pandemic.

From the explanation of the intervention model of JCI and exchange rate, it can be known that the addition of positive cases of Covid-19 does not have a continuous effect on financial stability in Indonesia, especially on the value of JCI. Such conditions were also demonstrated when the government announced the implementation of large-scale social restrictions back in Jakarta on September 14, 2020. On September 10, 2020, JCI experienced freefall and so did the rupiah against the U.S. dollar. The sharp drop occurred on the stock market at 10:36 a.m. Based of Jawa Pos, at that time, JCI corrected by 5 percent to 4,891.88 so that stock trading in IDX was suspended (halt trading) for about 30 minutes. However, slowly JCI and the rupiah exchange rate strengthened again after the implementation of large-scale social restrictions was announced again in Jakarta. This was shown on September 14,

2020 at 09.30 WIB JCI again jumped by 1.79 percent to 5,106 (investasi.kontan.co.id). Then on September 16, 2020 the rupiah exchange rate was Rp 14,844/US$ while on September 15, 2020 it was Rp 14,870/US$. Therefore, exchange rate conditions negatively affect the value of stock indices.

Several steps have been taken to maintain financial stability. The Financial Services Authority and the financial services industry, such as the capital market, remained operational when the large-scale social restrictions was re-enacted in Jakarta. This is because the financial services sector is included in 11 important business areas that are allowed to operate during large-scale social restrictions.

A series of pre-emptive policies have been carried out in the capital market in collaboration with self-regulatory organizations (SRO). This is demonstrated by the prohibition of short selling, share buyback policy without RUPS with significant fluctuating market conditions, changes in auto rejection restrictions to asymmetric, changes in halt trading restrictions, and adjustment of trading sessions in pre-opening. This is done to reduce volatility. In addition, relaxation policies are also carried out such as relaxation of the principle of openness, relaxation of obligations in the delivery of reports, and stimulus for the investment processing industry (Santoso, 2020).

5. CONCLUSION

The negative impact of Covid-19 on financial system stability in Indonesia began to be felt after two weeks of confirmation of the first case. Rupiah depreciation has been unusual since the 18th day, while the weakening of JCI occurred since the 16th day after the announcement of the first case.

Covid-19 intervention in rupiah exchange rate and JCI as a proxy for financial stability, is Gradual Temporary, namely that intervention affects exchange rate movements and JCI gradually and is temporary. The weakening continued until it reached its lowest point after the 22nd day then strengthened again and stabilized after the 38th day for the exchange rate and the 32nd day for JCI, although it was stable at a lower level than before Covid-19.

Based on these conclusions, when there is a high spike in confirmed positive cases of Covid-19, then; (1) The government and BI must be able to assure the market that financial stability will remain stable, (2) Businesses should not panic because the weakening of financial stability that occurs only err is not permanent, (3) The public must comply with health protocols established by the government to keep the Covid-19 case from continuing to increase, thus disrupting market confidence.

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