Journal of Economics, Finance and Management Studies

ISSN (print): 2644-0490, ISSN (online): 2644-0504

Volume 06 Issue 05 May 2023

Article DOI: 10.47191/jefms/v6-i5-44, Impact Factor: 7.144

Page No. 2248-2258

Examining the Impact of Covid-19 on Rupiah Exchange Rates and Joint Stock Price Index: A Comprehensive Analysis using Paired Sample T-Test and Vecm

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ABSTRACT: This research aimed to determine the simultaneous and partial impact before and during the occurrence of COVID-19 on the movement of the rupiah exchange rates and the Joint Stock Price Index (IHSG), both in the long and short term. A descriptive quantitative approach was used while data were collected through documentation. Moreover, the analytical method used was Paired Sample t-test and Vector Error Correction Model (VECM). The results indicated there was a significant simultaneous and partial change in the impact of the rupiah exchange rates and the Jakarta Composite Index (JCI) before and during the long-term COVID-19 pandemic.

KEYWORDS: COVID-19, Rupiah Exchange Rates, and Joint Stock Price Index (IHSG)
JEL Classification: E44, F41, F43

I. INTRODUCTION

In December 2019, a respiratory tract virus known as COVID-19 or Coronavirus (CoV) was initially identified in Wuhan City, located in Hubei Province, China. This particular virus predominantly targets the respiratory system in humans, initially presenting with flu-like symptoms, but it can progress to a severe acute respiratory syndrome (SARS). Recognizing the severity of the situation, the World Health Organization (WHO) declared the Coronavirus outbreak as an international emergency on January 30th, 2020.

The confirmation of COVID-19 in Indonesia came on March 2nd, 2020, with two reported cases. This outbreak instilled significant concern and panic among the public, government, and business sectors, prompting the government to implement preventive measures. The adoption of Large-Scale Social Restrictions (PSBB) in various regions of the country led to a slowdown in the economic cycle.

The development of COVID-19 in Indonesia exhibited a consistent rise since the announcement of the first two confirmed cases in March 2020. By April 2020, the outbreak had experienced a drastic surge to 10,118 confirmed cases, 1,522 recoveries, and 792 deaths. The numbers continued to escalate, reaching 108,376 cases, 65,907 recoveries, and 5,131 deaths in July 2020. By January 2021, the figures surged to 1,078,314 cases, 873,221 recoveries, and 29,998 deaths, and further increased to 3,409,658 cases, 2,770,092 recoveries, and 94,119 deaths until July 2021. Towards the end of November 2021, there was a significant surge to 4,256,409 confirmed cases, 4,104,657 recoveries, and 143,883 deaths.

Given the progression of the COVID-19 outbreak, it is crucial to promptly anticipate the situation to prevent panic and a snowball effect, such as the emergence of fluctuations in the rupiah exchange rate against the USD, which can have a worse effect than the 2008 financial crisis. The data on March 2nd, 2020, along with the announcement of the first confirmed case of COVID-19 in Indonesia, indicated that the rupiah exchange rate was at Rp14,413/USD and depreciated to Rp16,741/USD from March 20th, 2020 to April 2nd, 2020. It appreciated to Rp13,956/USD on June 8th, 2020, and again depreciated to Rp14,979/USD on September 11th, 2020. From November 10th, 2020, until November 30th, 2021, the rupiah exchange rates fluctuated to the level of Rp14,340/USD.

The impact of COVID-19 on the financial market was reflected in the volatility of the Jakarta Composite Index (JCI). During the pandemic, the JCI experienced fluctuations and declines, making it challenging to control. The data on the development of the IHSG on January 2nd, 2020, was recorded at the level of 6,283.58. On March 2nd, 2020, with the information of the first confirmed case of the COVID-19 outbreak in Indonesia, the JCI weakened to a level of 5,361.25 until March 24th, 2020, and subsequently to

3,937.63. There were also fluctuations from April 2020 until January 11th, 2021, when it increased to 6,382.94. However, on May 17th, 2021, the JCI fell again to the level of 5,833.86 and subsequently increased to 6,616.03 on November 15th, 2021. On November 30th, 2021, the JCI decreased by 1.13% to the level of 6,533.93. The movement of the IHSG occurred not only because of the ongoing increase in the COVID-19 pandemic, but the possibility that the Central Bank of Indonesia could cut the interest rates in the last quarter of 2020, and the news of the expansion of the COVID-19 vaccine.

Based on the description above, the following questions can be addressed:

1. Is there an impact of changes in the movement of the rupiah exchange rates and the Joint Stock Price Index (IHSG) before and during the COVID-19 pandemic simultaneously?
2. Is there any impact of changes in the movement of the rupiah exchange rates and the Joint Stock Price Index (IHSG) before and during the COVID-19 pandemic partially?

The remaining research is outlined as follows: Section II explains the theoretical approach and framework to analyze the impact before and during COVID-19 on the movement of rupiah exchange rates and the IHSG. Section III deliberates the data and method used. Section IV examines the results, while Section V summarizes the judgments.

II. PREVIOUS RESEARCH

This section will explain the theoretical approach, theoretical framework, and hypotheses of the impact before and during COVID-19 on rupiah exchange rates as well as the IHSG.

2.1. Theoretical Approach

CoV is a virus that primarily infects the respiratory system. This viral disease is also called COVID-19, which is an abbreviation derived from CO for Corona, VI for Virus, D for Disease, and 19 for 2019 when the pandemic first emerged. It was first detected in December 2019 in China, precisely Wuhan City, Hubei Province, China.

The financial market serves as a platform for the exchange of various financial products, including physical assets, securities, and foreign currencies. It includes all institutions and procedures and bridges buyers as well as sellers of financial instruments. In other words, it functions as a liaison between those who wish to sell and those who wish to purchase financial products.

The capital market is a marketplace where various long-term financial instruments, such as debt, equity (shares), derivative instruments, and other instruments, can be traded. Investment, as defined by (Mankiw, 2008), refers to the acquisition of goods by individuals or groups to increase their capital stock. Shares, as described by (Darmadji & Fakhrudin, 2012), represent an individual's or entity's ownership or participation in a corporation or limited liability company. Typically, shares are represented by legal documents that establish ownership of the company and confer certain rights to the holder of the securities. According to (Jogiyanto, 2008), the IHSG is a stock price index number that has been compiled and computed to produce a trend. In other words, it is a processed number that enables the comparison of events, specifically changes in stock price over time.

According to (Todaro & Smith, 2015), exchange rates refer to the rates or prices at which the Central Bank is willing to exchange the currency of one country for another. As explained by (Mankiw, 2008), the exchange rates between two countries reflect the price of the currency used by the residents of each country to engage in trade with each other.

2.2. Theoretical Framework

Considering Indonesian economic conditions before and during the COVID-19 pandemic, it is evident that they had an impact on weakening financial markets, including the capital market, investment, stocks, and the JCI. During the pandemic, the IHSG experienced fluctuations with several declines, making it difficult to control. This can consequently weaken the rupiah.

2.3. Hypothesis

The formulated hypotheses for this research are as follows:

H_1 = There is an impact of changes in the movement of the rupiah exchange rates and the IHSG before and during the COVID-19 pandemic simultaneously.

H_2 = There is an impact of changes in the movement of the rupiah exchange rates and the IHSG before and during the COVID-19 pandemic partially.

III. DATA AND METHOD

This research used a quantitative design with a descriptive approach. The secondary data used included COVID-19 data sourced from the Ministry of Health of Indonesia, rupiah exchange rates from the Central Bank of Indonesia, and JCI from Finance Yahoo.

The data were collected using the documentation method, and subsequently analyzed with different test methods, namely Paired Sample t-test, VAR, as well as Vector Error Correction Model using software tools, such as Eviews version 12 and SPSS.

VECM is derived from VAR, which is an estimation method developed by Cristopher A. Sims in 1980 (Sims, 1980). Sims formulated the general model equation for VAR with Lag 1 as follows:

$$Y_t = \alpha_{1i} + \sum \beta_{1i} Y_{t-1} + \sum Y_{1i} X_{t-1} + \varepsilon_t$$

$$X_t = \alpha_{2i} + \sum \beta_{2i} Y_{t-1} + \sum Y_{2i} X_{t-1} + \varepsilon_t$$

According to (Widarjono, 2013), the VAR model helps to analyze the interdependence connection between time series variables, and can be divided into two forms as follows:

The VAR model can be called unrestricted when it lacks cointegration. The building of the model does not focus on the existing theoretical basis but rather on the relationship between its variables. When the data are stationary at the class, there is no cointegration, indicating that the VAR model can be formed at the level (VAR in level). However, when the data are stationary at the level of differentiation, it is necessary to carry out a cointegration test, to form VAR in different models.

Time series data that are not stationary at the levels can be cointegrated. To check for cointegration in the model showing a theoretical relationship between the variables, it is necessary to use the VECM model, which is also known as the restricted VAR model (*restricted* VAR).

3.1. Stationary Test

According to (Widarjono, 2013), the data stationarity test can be conducted through the unit root test of the Augmented Dickey-Fuller Test (ADF). The test requirements proposed that H_0 stating the variable contains a unit root or is not stationary can be rejected when the ADF Probability value < 5% significant level. The stationary test of the data can be carried out at the first difference level when the variable is not stationary, and at the second distinction level when the variable is still not stationary at the first difference level.

The hypothesis for testing is as follows:

H_0 : = 0 , there is a unit root, not stationary

H_a :≠ 0, no unit root, stationary

3.2. Optimum Lag Determination

The main purpose of determining the optimum lag in the VAR model is to avoid serial correlations between error terms and internal endogenous variables that cause the estimator to be inconsistent. In order to determine the optimum lag, the criteria proposed by Akaike Information Criterion (AIC) can be used. These criteria are as follows:

$$\textbf{In AIC} = \frac{\mathbf{2k}}{\mathbf{n}} + \textbf{In}\left(\frac{\mathbf{SSR}}{\mathbf{n}}\right)$$

Where:

SSR = Total squared residual (sum of squared residual)

k = Number of estimation parameter variables

n = Number of observations

3.3. Cointegration Test

According to (Widarjono, 2013), cointegration testing is recommended when variables in the research are not stationary at the level or when they are stationary at a different level. When cointegration exists between the variables, the recommended VAR estimation model is the VECM. The VECM equation shows the influence between variables in the long and short term. On the other hand, when there is no cointegration, it is recommended to use the VAR in a difference model. The cointegration test is carried out using Johansen Cointegration with the condition that when the Trace Statistics value > Critical Value 5% with the Probability value < 5% significant level, cointegration will occur between variables in the model.

3.4. Vector Error Correction Model (VECM) Estimation

Estimation can be carried out using VECM when cointegration occurs in the model. The results of the estimation can provide a significant influence on the variables in the research in the short and long term. (Widarjono, 2013) explained that the individual coefficients on the VECM estimation results were not representative enough to explain the behavior of the variables, hence, IRF and VD Tests were required.

3.5. Granger Causality Test

The Granger Causality Test is generally recommended to investigate the connection between economic variables in the research model. In this test, the null hypothesis (H_0) is when one variable has no causality with other variables. The proposed condition is that when a pair of variables has a probability value < 5% significant level, the H_0 can be rejected, indicating a significant causal relationship between these variables.

3.6. Impulse Response Function (IRF) Test

According to (Basuki & Prawoto, 2016), the Impulse Response Function (IRF) test indicates the response of a variable to shocks from other variables in the model. The IRF graph illustrates the response of a variable to the influence of changes in other variables in the time lag or a certain period along with the strength of the response that occurs. As the IRF graph moves closer to the point of equilibrium (convergence), the effect of changes in one variable on others gets weaker and becomes only temporary. The horizontal line on the IRF curve shows the response time interval while the vertical line shows the strength of the response.

3.7. Variance Decomposition (VD) Test

According to (Gujarati, 2009), the VD test measures the magnitude of the difference between the variants before and after the shock, with both shocks originating from the variable itself and other variables. This test serves as a determinant of the dependent variable on the independent variable because it is able to explain the extent to which the percentage of the independent variable can affect the dependent.

3.8. Paired Sample T-test

Paired sample t-test is a test conducted on two paired samples, which have the same subject but experience two different treatments. Paired sample t-test or paired t-test is a method for testing the hypothesis when the data used is not independent (in pairs). As per Sugiyono's research in 2011, the paired sample t-test employs the formula given below:

$$t_{test} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} - 2r\left(\frac{S_1}{\sqrt{n_1}}\right)\left(\frac{S_2}{\sqrt{n_2}}\right)}}$$

description:

$\bar{x}_1$ =Average Exchange Rates and JCI before COVID-19

$\bar{x}_2$ =Average Exchange Rates and JCI during COVID-19

S_1^2 =Variance of Exchange Rates and JCI before COVID-19

S_2^2 =Variance of Exchange Rates and JCI during COVID-19

S_1 =Standard deviation of the Exchange Rates and JCI before COVID-19

S_2 =Standard deviation of the Exchange Rates and JCI during COVID-19

n_1 =Total Exchange Rates and JCI data before COVID-19

n_2 =Total Exchange Rates and JCI data during COVID-19

The hypothesis can be tested with the paired sample t-test using the following criteria:

- When $t_{arithmetic}$ t_{table} and probability (Asymp.Sig) < 0.05, H_0 is accepted and H_a is rejected
- When $t_{arithmetic}$ t_{table} and probability (Asymp.Sig) < 0.05, H_0 is rejected and H_a is accepted

IV. RESULT AND DISCUSSION

4.1. Result

The table above shows that the data stationarity test using the Augmented Dickey-Fuller Test (ADF) unit root test is stationary at the second class of difference or 2nd Difference with = 0.05%.

Table 1. Data Stationarity Test

Variable	ADF		
	t-Stats	Prob.	Information
COVID-19	-12.11280	0.0000	Stationary
EXCHANGE RATE	-13.75275	0.0000	Stationary
JCI	-16.44902	0.0000	Stationary

Source: Research Finding

The results of selecting the optimum lag on the variables indicate that most of the criteria recommend lag 5 as the optimum lag. Lag 5 is recommended by four criteria at once, namely the LR Test criteria, FPE, AIC, and HQ.

Table 2. Optimum Lag Determination

Criteria	Recommendation
LR Test	Lag 5
Final Prediction Error (FPE)	Lag 5
Akaike Information Criterion (AIC)	Lag 5
Schwarz Criterion (SC)	Lag 1
Hannan-Quinn (HQ)	Lag 5

Source: Research Finding

The cointegration test results in Tables 3 and 4 show a Trace Statistics value of 366.5628 in the first equation (None). This is greater than the Critical Value of 29.79707 with a probability value of 0.0000, which is smaller than the 5% significant level (0.005). Furthermore, the second equation (At most 1) shows a Trace Statistic value of 201.2837, which is greater than the Critical Value of 15.49471 with a probability value of 0.0000. The third equation (At most 2) shows a Trace Statistic value of 93.82202, which is greater than the Critical Value of 3.841466 with a probability value of 0.0000. This indicates that $H_{0 \text{ is}}$ rejected and H_1 is accepted. Therefore, there is cointegration.

In the subsequent test, Maximum Eigenvalue was used to check for cointegration between the variables in the research. Cointegration test results show that the maximum eigenvalue in the first equation (None) has a Max-Eigen Statistics value of 165.2791. This is greater than the Critical Value of 21.13162 with a probability value of 0.0000. The second equation (At most 1) shows a Max-Eigen Statistic value of 107.4617, which is greater than the Critical Value of 14.26460 with a probability value of 0.0000. The third equation (At most 2) shows a Max-Eigen Statistic value of 93.82202, which is greater than the Critical Value of 3.841466 with a probability value of 0.0000. This means that $H_{0 \text{ is}}$ rejected and H_1 is accepted, indicating there is cointegration. Therefore, the recommended model is VECM.

Based on the VECM estimation results in Table 5, the exchange rates variable has a positive and significant impact on COVID-19 with 5,22213. This means that every 1% increase in COVID-19 cases will cause a depreciation of the value of the Rupiah against the USD. The results of the analysis are in accordance with the hypothesis, namely the t-statistical value of the exchange rate of 5.22213 is greater than the t-table value of 1.9652. This indicates that H_0 is rejected and H_1 is accepted. In other words, the exchange rate variable has a positive and significant impact on COVID-19 in the long term.

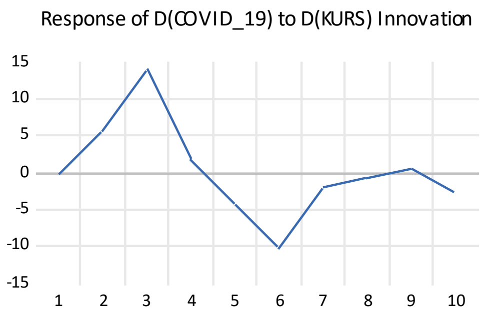
The JCI variable shows that there is a positive and significant impact on COVID-19, with a coefficient of 8.32428. This indicates that every 1% increase in COVID-19 cases will cause the IHSG to be corrected by 8.32. The results of the analysis are in accordance with the hypothesis, namely the JCI t-statistic value of 8.32428 or greater than the t-table value of 1.9652. This indicates that H_0 is rejected and H_1 is accepted. In other words, the JCI variable has a negative and significant impact on COVID-19 in the long term. Meanwhile, the VECM estimation in the short term shows that the exchange rate and JCI variables do not have a significant impact on the COVID-19 variable.

The results of the Granger Causality test in Table 6 are as follows:

1. The exchange rate variable has a statistically significant impact on COVID-19 with a Probability value of 0.0001, which is less than 0.05. This indicates the null hypothesis is rejected. The COVID-19 variable did not have a statistically significant impact on the exchange rate variable with a Probability value of 0.3623, which is greater than 0.05. This indicates the null hypothesis is accepted. It can be concluded that there is a one-way causality between the exchange rate and COVID-19 variables, namely only the exchange rate variable has a statistically significant impact on COVID-19 and not vice versa.
2. The JCI variable has a statistically significant impact on the COVID-19 variable with a Probability value of 0.0003, which is less than 0.05. This indicates the null hypothesis is rejected. The COVID-19 variable has a statistically significant impact on the JCI variable with a Probability value of 0.0006, which is less than 0.05. This indicates the null hypothesis is accepted. It can be concluded that there is a two-way causal relationship between the JCI and the COVID-19 variables, namely the JCI variable has a statistically significant impact on the COVID-19 variable and vice versa. In other words, the increasing number of COVID-19 cases will have an impact on the JCI, which is becoming weaker.
3. The JCI variable has a statistically significant impact on the exchange rate variable with a Prob value of 0.0001, which is less

than 0.05. This indicates the null hypothesis is rejected. The exchange rates variable has no statistically significant impact on the JCI with a Probability value of 9.E-05, which is greater than 0.05. This indicates the null hypothesis is accepted. The JCI has an impact on the exchange rate, indicating that an increase in the IHSG will cause a decrease in the rupiah exchange rates. It can be concluded that there is a one-way causality between the JCI variable and the exchange rates, namely only the JCI variable has a statistically significant impact on the exchange rates.

4. Impulse Response Function (IRF) Test

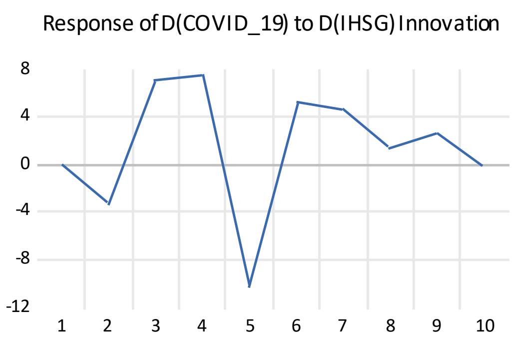


Graph 4.1 above illustrates that the COVID-19 response to the shock of the exchange rates variable from the first to the third period experiences a positive trend. This is demonstrated by the upward movement of the IRF line relative to the horizontal line until the third period. From the third to the sixth period, the response of COVID-19 to exchange rate shocks decreased, showing a negative trend. This is evidenced by the downward movement of the IRF line, which falls below the horizontal line until the sixth period. In the sixth to the ninth period, the COVID-19 response to exchange rate shocks increases by showing a positive trend. However, in the ninth period, the COVID-19 response to the exchange rate shock decreases again to the tenth period by consistently showing a negative trend.

The results of variance decomposition show that the COVID-19 variable has the largest contribution to its variance, accounting for 100%. This is because, in the first period, other variables such as the exchange rates and the JCI did not have any contribution, hence, the other variables have no effect on the shocks of COVID-19 in the very short term. The contribution of the COVID-19 variable gradually declines until the tenth period by 86%. This decline can be attributed to the presence of other variables contributing to the changes that occurred in the variable.

The decrease in the contribution of the COVID-19 variable variance starts in the second period, where it explains 98.97888% of the variance, while the remaining variance is influenced by the exchange rates variable (0.754678%) and the JCI (0.266437%). The contribution given by the exchange rates variable and the JCI is because the COVID-19 variable in the second period is no longer influenced by itself, although there is an influence from other variables due to their changes or fluctuations.

By the end of the period, the exchange rates have the second largest influence after the COVID-19 variable, which at the beginning, has an effect of 0.754678%, but progressively increases to 7.544519%. However, the JCI variable has the smallest effect, accounting for 5.770018% at the end of the period.



The above graph (Graph 4.2) demonstrates the response of COVID-19 to the shock of the JCI variable over the first and second periods, showing a declining trend. This is evident from the IRF line, which consistently remains below the horizontal line until the second period. In the second to fourth periods, the COVID-19 response to the JCI shock increases by showing a positive trend. This can be observed from the upward trend of the IRF line, surpassing the horizontal line until the fourth period. In the fourth to the fifth period, the COVID-19 response to exchange rate shocks decreases by showing a negative trend. In the fifth to the sixth period, the COVID-19 response to the JCI shock increases again by showing a positive trend. However, in the sixth period, the COVID-19 response to the JCI shock decreased again until the tenth period by continuously showing a negative trend.

Based on Table 8, the results of descriptive statistics are as follows:

1. The exchange rates have a mean value of 13,753.14, a standard deviation of 135,067, and a mean standard error of 20,841 before COVID-19, as well as a mean of 15,531.00, a standard deviation of 800,672, and a mean standard error of 123,546 during COVID-19.
2. The JCI has a mean of 6,049.45, a standard deviation of 222,262, and a mean standard error of 34,296 before COVID-19, as well as a mean of 4,693.95, a standard deviation of 407,678, and mean standard error of 62,906 during COVID-19.

Table 9 displays the findings of the correlation analysis examining the relationship between exchange rates and JCI data before and during the COVID-19 period. The decision criterion for interpreting the results is that a significant value of <0.05 indicates a correlation or relationship between the two variables. The significant values in these data are:

1. The exchange rates have a significant value of 0.001, which is less than 0.05. Therefore, there is a correlation between the exchange rate data before and during COVID-19.
2. The JCI has a significant value of 0.057, which is equal to 0.05. Therefore, there is a correlation between the JCI data before and during COVID-19.

The results of the paired sample t-test presented in Table 9 are as follows: The significant level of this test is 5% or 0.05. The basis for making decisions on what is proposed is when the value of sig. (2-tailed) < 0.05, $H_{0\text{ is}}$ rejected and $H_{1\text{ is}}$ accepted. These tables show a sig. ($_2$-tailed) of 0.000, which is less than 0.05. Therefore, H_0 is $_{\text{rejected}}$ and H_1 is accepted. It can be concluded that there is a change in the movement of the rupiah Exchange Rates before and during the COVID-19 pandemic.

In the JCI data, the value of sig. (2-tailed) is 0.000, which is less than 0.05. Therefore, H_0 is rejected and $H_{a\text{ is}}$ accepted. It can be concluded that there is a change in the movement of the IHSG before and during the COVID-19 pandemic.

4.2. DISCUSSIONS

4.2.1. The impact of changes in the movement of the Rupiah Exchange Rates and the IHSG before and during the simultaneous occurrence of the COVID-19 pandemic

The results of the analysis carried out showed that there was a simultaneous impact of significant changes between the rupiah exchange rates and the JCI before and during the COVID-19 pandemic. This indicates that COVID-19 has created worry and panic for individuals holding rupiahs, making them make decisions regarding whether they should retain or release the currency. This impact is also felt in global financial markets. The spread of the COVID-19 pandemic in Indonesia has resulted in fluctuations in both exchange rates and the JCI. Shortly after the first COVID-19 case was reported in Indonesia, panic ensued, causing a significant depreciation of the Rupiah and a decline in the index rate. As a response, the IDX issued a Lower Auto Rejection (ARB) policy, a condition that described the price of a stock when experiencing a gradual and significant decline over a certain period.

The weakening of the rupiah exchange rates against the USD also affected the JCI. This can attract investors to invest in the foreign exchange market. In addition, the weakening of the rupiah exchange rates can prompt a decline in net profit earned by the issuer, leading to a decrease in the share price.

In March 2020 the rupiah exchange rates fall by more than Rp16.000 per USD, accompanied by 6 declines in the Indonesian capital market. This highlights the need for economic actors and the government to anticipate the impact of the COVID-19 pandemic by taking several measures, one of which is the implementation of PSBB in several big cities in Indonesia. Failure to anticipate early can make the exchange rates to fluctuate, be in a vulnerable position, or weaken the JCI during the spread of COVID-19.

Based on the estimation results using the VAR/VECM method, the cointegration test showed a reciprocal relationship or cointegration among the three variables, namely COVID-19, rupiah exchange rates, and the JCI. The estimation results of VECM showed that the exchange rates and JCI variables in the long run, had a significant impact, with the t-statistic value greater than the t-table value. Specifically, the exchange rates variable had a t-statistic value of 5.22213 while the JCI variable had 8.32428 with a t-table of 1.9652. This indicates that both variables have a significant positive impact during the COVID-19 pandemic. The higher the number of COVID-19 cases, the greater the depreciation of the rupiah against the USD, or the more the rupiah required to earn one USD. Similarly, the higher the number of COVID-19 cases, the lower the JCI.

In the Granger causality test for the exchange rates and the JCI against COVID-19, there was a significant causality relationship. This indicates that the changes in the rupiah exchange rates and the JCI are caused by the COVID-19 pandemic.

The results of the IRF test showed that the shock of the standard deviation or innovation of the COVID-19 pandemic on the rupiah exchange rates or the exchange rates initially had a real impact. This impact increased and gradually decreased until it reached the negative zone and stabilized. As a result, the COVID-19 pandemic will affect the rupiah exchange rates on a daily basis in the long run. The standard deviation shock or COVID-19 pandemic innovation on the IHSG initially decreased to the negative zone and subsequently increased to the positive zone. It experienced a sharp decline again from positive to negative and gradually tended to increase and stabilize. The number of daily increases in the COVID-19 pandemic had a relatively long-term impact on the JCI, the rupiah exchange rates, and the IHSG.

Variance decomposition test in the short term, namely the third period, contributed 93.49% to the number of COVID-19, at an exchange rate of 5.13% and JCI of 1.36%. In the long term, namely the tenth period, the contribution of the number of COVID-19 decreased by 86.68%, while the contribution of the exchange rate and JCI increased by 7.54% and 5.77%, respectively. This means that COVID-19 has an impact on the movement of the rupiah exchange rates and the JCI in the long term.

4.2.2. The impact of changes in the movement of the Rupiah Exchange Rates and the IHSG before and during the COVID-19 pandemic partially

The results of the paired sample statistic test showed that the exchange rates variable had a mean of 13,753.14, a standard deviation of 135,067, and a mean standard error of 20,841 before COVID-19, as well as a mean of 15,531.00, a standard deviation of 800,672, and mean standard error of 123,546 during COVID-19. This indicates that the occurrence of COVID-19 has an impact on the movement of the exchange rates or the exchange rates of the rupiah against the USD. In the paired sample correlation test, the exchange rates had a significant value of 0.001, which was smaller than 0.05. Therefore, there is a correlation or relationship between exchange rate data before and during the COVID-19 pandemic.

In the paired sample t-test results, the t-count value was -13,142 with a sig value. (2-tailed) of 0.000, which was less than 0.05. This shows $H_{0\ is}$ rejected and H_a is accepted. It can be partially concluded that there was a significant impact of changes on the movement of the rupiah exchange rates before and during the COVID-19 pandemic. In other words, the presence of COVID-19 cases had an impact on the exchange rates. The impact caused by the presence of COVID-19 cases is negative, indicating that the increasing number of cases will cause changes or depreciation of the rupiah exchange rates against the USD.

Realistically, this condition is caused by the COVID-19 pandemic, which has impacted panic in both health and the economy. On the economic side, the impact of the COVID-19 panic has permeated all aspects, including the capital market and the financial market. Investors or economic actors have become more cautious in conducting business and transactions, which in turn has led to changes in exchange rates.

According to the Financial Services Authority (OJK), the IHSG experienced a sharp decline in 2020, reaching its lowest level in history due to COVID-19. As the regulator, OJK has made various efforts to prevent the JCI from falling or experiencing capital outflows. They also demanded the Indonesia Stock Exchange (IDX) to temporarily freeze trading (halt) shares when the JCI experiences a sharp decline within a single day. The IDX can conduct a *trading halt* for 30 minutes when the JCI experiences a decline of more than 5% or even *suspend* trading when a further decline of more than 15% is experienced.

For the IHSG variable, the results of the paired sample statistic indicated that JCI had a mean of 6,049.45, a standard deviation of 222,262, and a mean standard error of 34,296 before COVID-19, as well as a mean of 4,693.95, a standard deviation of 407,678, and mean standard error of 62,906 during COVID-19. This indicates that the occurrence of COVID-19 had an impact on the movement of the JCI. In the paired sample correlation test, the JCI had a significant value of 0.057, which was equal to 0.05. This indicates there is a correlation or connection between JCI data before and during COVID-19. In the paired sample t-test results, the t-count value was 21,830 with a sig value. (2-tailed) of 0.000, which was less than 0.05. Therefore, $H_{0\ is}$ rejected and H_a is accepted. It could be partially concluded that there was a substantial change impact on the movement of the IHSG before and during COVID-19.

This suggests that the presence of COVID-19 cases has had an impact on changes in the JCI movement. Consequently, as the number of COVID-19 cases increases, the JCI may experience further corrections. This can occur because investors are not always rational in reality. They may overreact in the short term when they are pessimistic or place much importance on these new events and ignore historical data. As a result, adverse news related to the rising number of COVID-19 cases and the high risk of dying has led to a significant decline in stock prices.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSION

The conclusions derived from the results and discussions presented in this research are as follows:

1) The results of the analysis showed that, simultaneously, there was a significant change in the impact of the rupiah exchange rates and the JCI before and during the long-term COVID-19 pandemic. Using the VECM method, the exchange rates variable and the JCI, in the long run, had a significant impact with the t-statistic value greater than the t-table value, namely the exchange rates variable of 5.22213 and the JCI variable of 8.32428 with a t-table value of 1.9652. This indicates that the exchange rates variable and the JCI have a significant positive impact during the COVID-19 pandemic.
2) The results of the analysis showed the paired sample t-test on the exchange rates had a t-test value of -13,142 with a sig value. (2-tailed) of 0.000, which was less than 0.05. Therefore, H_0 was rejected and Ha was accepted. It can be concluded that, partially, there was an impact of significant changes on the movement of the rupiah exchange rates before and during the COVID-19 pandemic. The higher the number of COVID-19 cases, the greater the depreciation of the rupiah against the USD or the more the rupiah required to earn one USD. Similarly, the higher the number of COVID-19 cases, the lower the JCI. The paired sample t-test on the JCI yielded a t-test value of 21,830 with a sig value. (2-tailed) of 0.000, which was less than 0.05. Therefore, H_0 was rejected and H_a was accepted. It can be concluded that, partially, there was a significant change in the movement of the IHSG before and during the COVID-19 pandemic. In other words, the COVID-19 cases had an impact on the JCI movement. As the number of COVID-19 patients increases, the JCI can be further corrected.

5.2. RECOMMENDATIONS

COVID-19 had a powerful effect, resulting in the weakening of the rupiah exchange rates and a decline in the IHSG. These issues can be resolved in the following ways:

1. Divert funds toward the procurement of equipment and tools to deal with the COVID-19 pandemic, as well as research that focused on finding anti-virus drugs.
2. Implement a trading halt or temporary suspension of the IHSG by PT. Indonesia Stock Exchange. This is carried out to maintain orderly and efficient securities trading.
3. Maximize monetary and macro-prudential policies by lowering interest rates and maintaining exchange rate stability.

ACKNOWLEDGMENTS

The authors are grateful to the Dean, Vice Dean, and Head of the Department of Economics, and Development Studies at the Faculty of Economics and Business, Tadulako University, academic peers, as well as the unknown referees for the insightful comments and contributions provided during the meeting. The authors are also grateful to the Central Bank of Indonesia Office in Jakarta and the Central Statistical Agency for the cooperation and provision of data.

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APPENDIX

Table 3. Cointegration Test (Maximum Eigen Value Test)

H_0	H_a	MES	95% Critical Value
r=0	r=1	165.2791**	21.13162
r≤1	r=2	107.4617**	14.26460
r≤2	r=3	93.82202**	3.841465

Source: Research Finding

Table 4. Cointegration Test (Trace Test)

H_0	H_a	Trace Statistics	95% Critical Value
r=0	r>1	366.5628**	29.79707
r≤1	r>2	201.2837**	15.49471
r≤2	r>1	93.82202**	3.841465

Source: Research Finding

Table 5. Vector Error Correction Model (VECM) Estimation

Variable	Coefficient	T-Stats
	Long-term	
EXCHANGE RATE	(2088.34)	[5.22213]
JCI	(3054.20)	[8.32428]
	Short-term	
CointEq1	(0.00063)	[0.01032]
EXCHANGE (Lag 1)	(7.36002)	[-0.07776]
EXCHANGE (Lag 2)	(7.09900)	[0.64417]
EXCHANGE (Lag 3)	(6.68461)	[0.66843]
EXCHANGE (Lag 4)	(5.47857)	[0.96337]
JCI (Lag 1)	(14.7188)	[-0.46398]
JCI (Lag 2)	(12.9831)	[-0.04856]
JCI (Lag 3)	(10.1393)	[0.02807]
JCI (Lag 4)	(6.96702)	[-0.05857]

Source: Research Finding

Table 6. Paired Granger Causality Test

Null Hypothesis:	Obs	F-Statistics k	Prob.
EXCHANGE against COVID_19	420	5.30095 ***	0.0001
COVID_19 against EXCHANGE		1.09541	0.3623
JCI against COVID_19	420	4.78715 ***	0.0003
COVID_19 against JCI		4.44426	0.0006
JCI against EXCHANGE	462	5.16819 ***	0.0001

EXCHANGE against JCI	5.32111 ***	9.E-05

Source: Research Finding

Table 7. Variance Decomposition Test

Period	SE	D(COVID_19)	D(EXCHANGE)	D(JCI)
1	64.05528	100,0000	0.000000	0.000000
2	64,61696	98.97888	0.754678	0.266437
3	66.51980	93.49471	5.136691	1.368602
4	67.05252	92.30083	5.109148	2.590021
5	67.97584	89.83420	5.383379	4.782418
6	68.93177	87.38620	7.393474	5.220322
7	69.11475	86.93524	7.428308	5.636453
8	69.13795	86,88976	7.435885	5.674353
9	69.30123	86,81757	7.404925	5.777505
10	69.35604	86.68546	7.544519	5.770018

Source: Research Finding

Table 8. Paired Sampled Statistics

		mean	N	Std. Deviation	Std. Error Mean
Pair 1	EXCHANGE BEFORE COVID-19	13,753.14	42	135,067	20,841
	EXCHANGE DURING COVID-19	15,531.00	42	800,672	123,546
Pair 2	JCI BEFORE COVID-19	6,049.45	42	222,262	34,296
	JCI DURING COVID-19	4,693.95	42	407,678	62,906

Source: Research Finding

Table 9. Paired Sample Correlations

		N	Correlation	Sig.
Pair 1	EXCHANGE BEFORE COVID-19 & EXCHANGE DURING COVID-19	42	-.506	.001
Pair 2	JCI BEFORE COVID-19 & JCI DURING COVID-19	42	.296	.057

Source: Research Finding