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Research article

The Relationship between Current COVID-19 and Indonesia Stock Market: Evidence from ARDL model

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Abstract: This study aims to prove how COVID-19 in response to the Indonesia stock market applying an Auto-Regressive Distributed Lag (ARDL) cointegration method. This study analyzes the relationship between the natural logarithm of daily trading volume of the Indonesia Stock Exchange and the natural logarithm of daily COVID-19 confirmed cases both in the short run and the long run. Bound test and cointegration were used to analyze the data daily from 2 March 2020 until 30 November 2020. The findings result show in the short-run, Indonesia stock market is only influenced by its lag, but not in the long-run. Meanwhile COVID-19 variable proved to be not significantly affected the stock market both in short and long-run. The model is predicted to re-stabilize at least over 1.7 months later.

Keywords: stock market, Covid-19, ARDL, bound test, IDX

JEL Classification: G01, G14, G17, G19

Abstrak: Studi ini bertujuan membuktikan bagaimana COVID-19 dalam merespon pasar saham indonesia dengan menerapkan metode kointegrasi Auto-Regressive Distributed Lag (ARDL). Penelitian ini menganalisis hubungan antara logaritma natural volume perdagangan harian Bursa Efek Indonesia dengan logaritma natural kasus konfirmasi COVID-19 harian baik dalam jangka pendek maupun jangka panjang. Pengujian bound test dan uji kointegrasi digunakan untuk menganalisis data harian dari 2 Maret 2020 hingga 30 November 2020. Hasil penelitian menunjukkan dalam jangka pendek, pasar saham Indonesia hanya dipengaruhi oleh lag variable dirinya sendiri, tetapi tidak dalam jangka panjang. Sedangkan variabel COVID-19 terbukti tidak berpengaruh signifikan terhadap pasar saham baik dalam jangka pendek maupun jangka panjang. Model memprediksi volume perdagangan harian bursa efek akan kembali stabil setidaknya 1,7 bulan kemudian.

Kata Kunci: pasar saham, Covid-19, ARDL, *bound test, IDX*

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1. INTRODUCTION

Countries in the world are always struggling with pandemic since the beginning, such as SARS in 2003, the H1N1 influenza pandemic in 2009, the Middle East respiratory syndrome (MERS) 2012, and Ebola in 2014. At the end of December 2019, the world re-faced to the novel coronavirus which case the first confirmed in Wuhan, China. Although WHO declared the outbreak a Public Health Emergency of International Concern on 30 January 2020, but the first case which was confirmed in Indonesia just emerging when 2 March 2020 as many as 6 cases and continue to increase up to twice in mid-March 2020 (World Health Organization, 2020). To combat the pandemic, Indonesia following other countries has imposed significant restrictions on the movement of people in the mid

of April 2020. Among these restricted policies, the economic activity is particularly noticeable. The volume of business production decrease significantly, some enterprise will go bankrupt (Kartseva & Kuznetsova, 2020). Investor's motivations influence the stock market. If the stock market was experiencing shock, then investors tend to be pessimistic and holding the money they were to invest (Liu et al., 2020).

The pioneering work has conducted by Zumbach et al. (2000) examines the scale of market shocks which is called Scale of Market Shocks (SMS) based on stock market volatilities in different frequencies to analyze the price time series market based on events happening in the markets. Zumbach et al. (2000) observe by looking took USD/JPY and USD/DEM as their measurement scales of the relative impact daily news toward stock market. Basically, extreme movements in financial markets are initiated by external events such as political, economic new announcements and pandemic. These external factors have big influence to quantifiable price changes because of the internal dynamics markets. This approach gives objective perspective way to measure events and crises, and the ultimate goal would be to have a forecasting model for crises. Furthermore, this approach has been implied by Bisig et al. (2018) which is called Scale of Market Quakes (SMQ) and applying autoregressive conditional heteroscedasticity GARCH method measuring market volatility had been written by Subbotin et al. (2009) as the basic model and reference.

The approach used to measure the impact of the stock market shock continues to grow until now. Several studies have been found to measure the impact of Covid-19 on the stock market shock. The first line I used to study the impact of Covid-19 on the Saudi stock market using an ARDL method. Chaouachi & Slim (2020) identify the effect of short and long-run Covid-19 on to KSA Saudi stock market. The results of the research indicate if there is a negative impact on Covid-19 to KSA Saudi market shares in the long-run. On the one hand, study conducted by Liu et al. (2020) analyzed the impact of long-run of Covid-19 toward 21 leading stock market on 7 countries which is considered to be most affected by Covid-19 using Event Study Set-Up on AR and CAR method, the results indicate that if the stock market of the country's observation falls more quickly when a virus outbreak. Asian countries showed more negative abnormal returns when compared with other countries. However, (Le et al., 2020) explored the effects of Covid-10 lockdown on daily stock returns in Viet Nam using panel-regression model, using data from 30 January 2020 until 30 May 2020, the results showed that if Covid-19 confirmed cases increase during the lockdown period, then the return of the stock market will further decline significantly. Besides, study conducted by Lee & Chan (2020) explored the impact of Covid-19 toward stock market Malaysia in 13 cases of sectorial indices using OLS regression models, the conclusion of this research indicates that if the number of confirmed cases Covid-19 in Malaysia has increase, then the performance of the KLCI index in all industry sectors except Real Investment Fund (REIT) has decrease.

Additionally, study conducted by Machmuddah et al. (2020) used descriptive statistical methods and multiple regressions to try to analyze stock prices of consumer goods before and after Covid-19, the results showed that if there is a difference striking closing stock price between before and after Covid-19. They recommend that investors have to more cautious to invest their capital, especially in companies that provide necessities such as food, pharmacy, beverages, etc. Besides, study conducted by Alber & Saleh (2020) examined the effects of Covid-19 world-wide spread on the stock market of GGC countries, the results noted that if Covid-19 affects the stock market GCC countries. Besides, the stock market appears to be more sensitive to Covid-19 news death cases. Summarizing the researches that have been found, we noted the difference point between these researches to others: (1) this paper provides the contributions on Covid-19 to stock market research in Indonesia; (2) as far as I know, this is the first research looking at both the long-run dynamics and short-run relationship between Covid-19 to the stock market using the ARDL method in Indonesia.

The Covid-19 pandemic affects the stock market in many areas of research. Such as study by Chaouachi & Slim (2020); Liu et al. (2020); Greenwald & Ludvigson (2020); Ashraf (2020); Alber & Saleh (2020); El-basuony (2020); and Trisnowati & Muditomo (2021) study about Covid-19 to stock market response, has the gap analysis sector shares IDX such as the study conducted by Sunarso et al. (2020); Widyanata & Bashir (2020); Al-awadhi et al. (2020); Sugandi (2020), Carissa & Khoirudin (2020); Olusola (2020) and (Zhang et al. (2020) has study the impact of the Covid-19 on stock market

returns, financial markets and monetary policy during pandemic. Based on the result review of the previous studies, this study consider that it is necessary to examine the impact of Covid-19 on the stock market as the application of the ARDL model as a method. This will enrich the reference method for new study cases, especially for the observation which is done only from 2 March till 20 March 2020 as study conducted by Chaouachi & Slim (2020). Meanwhile, this study try is going to expand the examination in wider observation from 02 March 2020 until 30 November 2020. The remainder of this research proceeds; the next part shows the literature review and hypotheses. The third section focuses on methodology. Results are being discussed in section 4 with the robustness analysis model. The last one is section 5 which gives the summary and conclusions.

2. RESEARCH METHODS

2.1. Data and Source

The data used in this study are secondary daily update data. COVID-19 confirmed cases are taken from World Health Organization while the stock market is taken from Indonesia Stock Exchange. Observation research starts from 03 March 2020 until 30 November 2020. Stock market data needs to do interpolation log-linear on every weekend day and occasionally in from Friday-Sunday for IDX which does not publish reports daily time.

2.2. The Model Specification

This study is aimed to determine the impact of COVID-19 on the Indonesia stock market using Autoregressive Distributed Lag (ARDL) model which was developed by (Pesaran, 1997) and the cointegration Engel Granger and Johansen model. This method has several advantages; 1) the results are unbiased estimation. 2) ARDL models suitable for short time series period observation (Narayan, 2007). The optimum lag in this study uses the Akaike Information Criteria (AIC).

$$P_1(d) = P_{li}(d), d_i \leq d \leq d_{i+1}, i = 1,2 \dots, n-1, \text{ and}$$

$$P_{li}(d) = P_i \frac{h-s}{h} + P_{i+1} \frac{s}{h}, i = 1,2,..,n-1 \quad (1)$$

Where: $P_1(d)$ is the log interpolation function, $P_1(d)$ for $d_i \leq d \leq d_{i+1}$. This interpolation method ensures the curve data based on logarithm linear, although the number of data is still an average rough (Shang, 2020).

$$\Delta LOGSTOCK_{(t)} = c + \sum_{i=0}^{p} \alpha_{1i}\, \Delta LOG\_STOCK_{t-1} + \sum_{0}^{q} \alpha_{2t}\, \Delta LOGCOVID19_{(t-1)} + \beta_1\, LOGSTOCK_{(t-1)} + \beta_2 LOGCOVID19_{(t-1)} + \varepsilon_t \quad (2)$$

Where: in equation (2) $LOGSTOCK$ is trading volume of all shares in IDX; $LOGCOVID-19$ is the daily number of confirmed cases COVID-19; c is the constant; LOG (variable) is the natural logarithm; Δ is the first defference operator, α_1 and α_2 are the short-run coefficient; β_1 and β_2 are the long-run coefficient; ε_t is errorterm. Bound test to cointegration is used to analyze the effect of long-run based on Fisher statistic hypothesis. $H_0 = \beta_1 = \beta_2 = 0$. H_0 will be rejected if there is cointegration, where the F-statistic is greater than the value of the bounds I(1), and if F-statistic is lower than the value of the critical bounds $I(0)$.

$$LOGSTOCK_{(t)} = \left(\frac{C}{\beta_1}\right) - \left(\frac{\beta_2}{\beta_1}\right) LOGCOVID19_t \quad (3)$$

An error correction model (ECM) for equation (2) can be used to show the cointegration between the variables by following this equation:

$$\Delta LOGSTOCK_{(t)} = \sum_{i=1}^{p} \alpha_{1i} \Delta LOGSTOCK_{(t-1)} + \sum_{i=0}^{q} \alpha_{2i} \Delta LOGCOVID_{(t-1)} + \beta_1 ECM_{(t-1)} + \epsilon_t \quad (4)$$

$$ECM_{(t)} = LOGSTOCK_{(t)} - \left[-\left(\frac{C}{\beta_1}\right) - \left(\frac{\beta_2}{\beta_1}\right) LOGCOVID_{(t)}\right] \quad (5)$$

The hypotheses of this study as follow:

H_1: There exists a significant relationship between COVID-19 and the Stock Market in short-run.
H_2: There exists a significant relationship between COVID-19 and the Stock Market in long-run

3. RESULTS AND DISCUSSION

3.1. Descriptive Statistics

This section present descriptive statistics shows the development of the stock market and Covid-19; the results of the ARDL model; and LOGCOVID to LOGSTOCK analysis estimation. The last point will show some supplementary robustness checks.

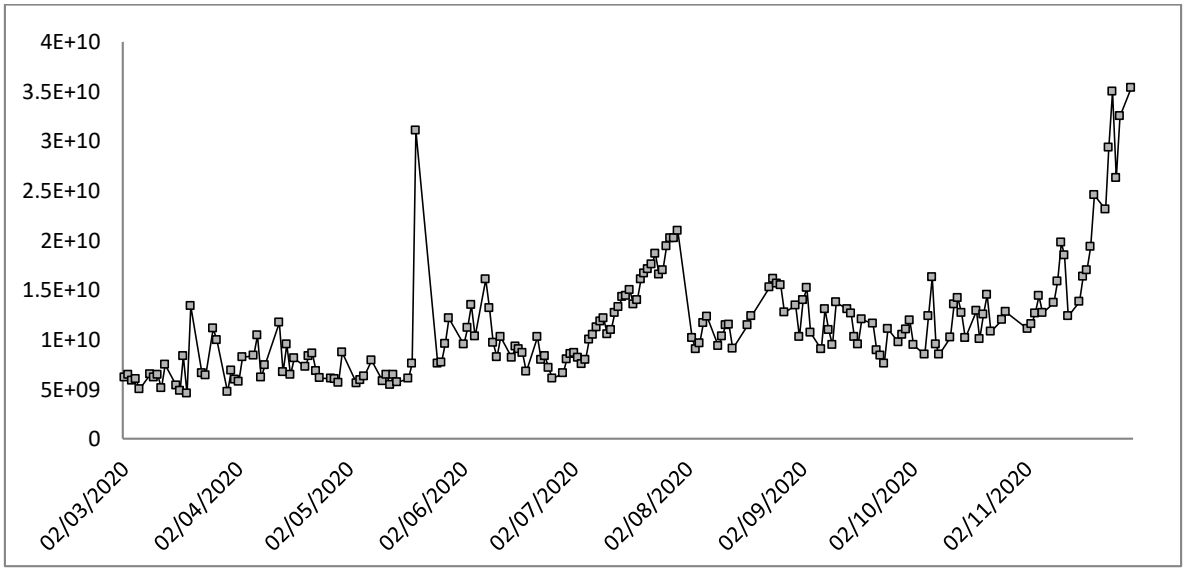

Figure 1. Daily Stock Trading Volume in Indonesia Exchange Stock from 2 March to 30-Nov 2020
Source: Indonesia Exchange Stock (2020)

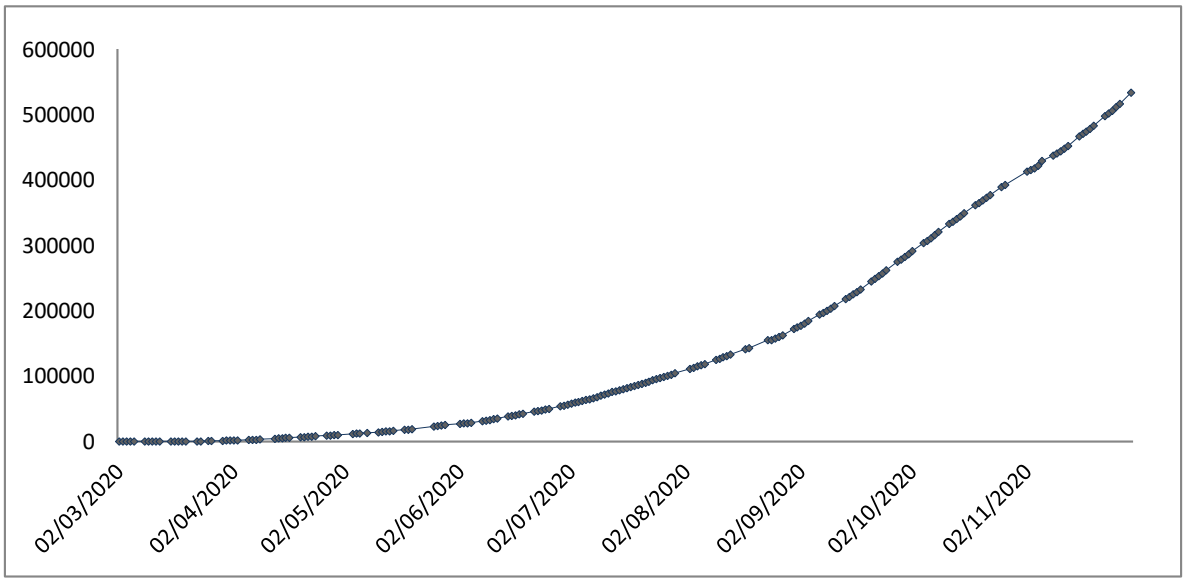

Figure 2. Daily confirmed cases COVID-19 from 2 March to 30 November 2020
Source: World Health Organization (2020)

Based on Figure 1, it can be concluded that stock market data tend to have the same average trend. This type of pattern is known as a random walk pattern. While the data for Covid-19 confirmed cases in Figure 2 shows that during the last 9 months since the appearance of the first case in Indonesia. It's contaminated with the Covid-19 have continued to increase.

3.2. The Unit Root tests

Before the estimation of ARDL, the first stage that should be examined is stationary all the variables. The results were obtained from the Augmented Dickey-Fuller unit root test in Table 1 present as follow:

Table 1. ADF Unit Root test

Variable	Based test	Statistics test		
		Critical value	t-stats	ADF-test
LOGSTOCK	Level	1%	-2.57	
		5%	-1.94	1.07
		10%	-1.62	
	First Difference	1%	-2.57	
		5%	-1.94	-10.64***
		10%	-1.62	
LOGCOVID19		1%	-3.99	
	Level	5%	-3.43	-2.47
		10%	-3.14	
		1%	-3.99	
	First Difference	5%	-3.43	-6.43***
		10%	-3.14	

*Note: This unit root rest uses the 5% significance level. I select 2 models: (a) model without trend for LOGSTOCK and (b) model with intercept and trend for LOGCOVID19. Test critical values are those of Mackinnon (1996)

Source: Author calculations

Based on the table above, it can be seen that the ADF-test at the second stationary level is greater than the critical value, both for the LOGSTOCK and LOGCOVID19 variables. The purpose of doing a stationary test on the data is to make the data unaffected by the variance, time and data are in a constant mean.

3.3. Empirical Results of ARDL Model

Table 2 shows the estimation results of the ARDL model (4,0) are significant if probability less than 5 percent. Meanwhile, the model significantly as a whole variable because of probability of F-statistic is 0.000.

Table 2. The Estimation Result of ARDL (4,0)

Dependent variable = LOGCOVID19				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.008	0.013	0.612	0.540
Δ(COVID)	0.081	0.140	0.578	0.563
Δ(STOCK) $_{t-1}$	-0.208***	0.060	-3.430	0.000
Δ(STOCK) $_{t-1}$	-0.132**	0.061	-2.168	0.031
Δ(STOCK) $_{t-1}$	-0.191***	0.061	-3.136	0.001
Δ(STOCK) $_{t-1}$	-0.149**	0.061	-2.439	0.015
R^2 = 0.0806				
F-statistic = 4.612				
Prob. (F-stat) = 0.000				

Source: Authors calculations

Table 2 indicates that if ΔSTOCK variable is influenced by its lag on the lag (1), lag (2), lag (3), lag (4) significantly, but not influenced by the COVID-19 variable as the probability is more than 5% (0.563). The four lags show a decrease in stock market trade in each period. Lag (1) causes a decrease in its stock market variable by -0.208 points. While in the second lag, the decrease was not as big as in the first lag with a value of -0.132 points and became the smallest value among the other lags (3). The stock market was affected by itself in the third lag of -0.191 points and again there was an increase in points in lag (4) of -0.149051 points. The next part is to test whether the model has a cointegration using the Bound test.

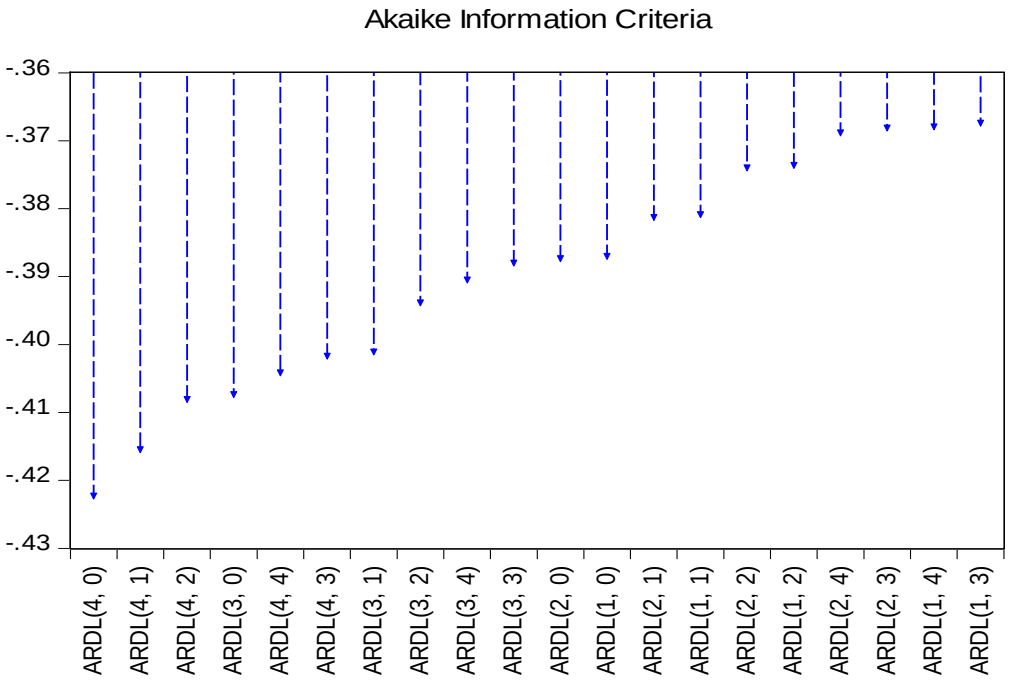

Figure 3. Akaike Information Criteria test
Source: Authors calculation

To determine the value of optimal lag (p, q) from the ARDL model, this study used Akaike Information Criteria (AIC). The ARDL (4.0) present the most optimal among 10 (Figure 1). This can be interpreted if ARDL (4) is the best model to be analyzed because the lag value is the smallest (Figure 3).

Table 3. Bound test of Cointegration Results

Model Spesification	F-Statistic	K	Critical Value Bounds			
			Lower Bound I(0)		Upper Bound I(1)	
ARDL(4,0)	43.30681*	1	1%	4.94	1%	5.58
			5%	3.62	5%	4.16
			10%	3.02	10%	3.51

Note: *indicate the significance at the level 5%

Source: Author calculations

The results of the Bound test indicates if there is a relationship of cointegration between the series [F-statistic is 43.306 more than *I*(1)], which shows the possible long-run relationship between Δ(COVID-19) and Δ(STOCK).

Table 4. The Dynamics of the Short and Long-run

Short-run estimation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.008	0.013	0.612	0.540
Δ(COVID)	0.081	0.140	0.578	0.563
Δ(STOCK)	-1.681***	0.147	-11.368	0.000
$\Delta(STOCK)_{t-1}$	0.472***	0.121	3.891	0.000
$\Delta(STOCK)_{t-2}$	0.340***	0.093	3.624	0.000
$\Delta(STOCK)_{t-3}$	0.149**	0.061	2.439	0.015
Long-run estimation				
Constant	0.004	0.007	0.614	0.539
Δ(COVID)	0.048	0.083	0.577	0.564

Source: Author calculations

Table 4 shows if there is short-run relationship for ΔSTOCK on lag (1), lag (2), lag (3) significantly. It demonstrated if the in a short time, ΔSTOCK only be influenced by its lag. While variable ΔCOVID is not influenced ΔSTOCK or its lag in the short and long-run. It is generally known that ΔCOVID does not significantly affect ΔSTOCK. It maybe becomes the consideration for investors to plan the strategy to arrange the number of transaction on the market: they can buy and hold stocks that in stable performance during the crisis and was able to survive during and after COVID-19 (conservative method). The investor also can sell them in the short-run even though in difficult circumstances during COVID-19.

Table 5. The ARDL result for Error Correction Coefficient

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta(STOCK)_{t-1}$	0.472*	0.120	3.915	0.000
$\Delta(STOCK)_{t-1}$	0.340*	0.093	3.650	0.000
$\Delta(STOCK)_{t-1}$	0.149*	0.060	2.463	0.014
$(Coint\text{-}Eq)_{t-1}$	-1.681*	0.146	-11.441	0.000

Note: *Coefficient value must negative and significance probability < 5%
Source: Author calculations

Based on Table 5, it can be seen if the coefficient is negative and has a significance of less than 5 percent. This estimation can be interpreted if the condition of the stock market will return to stability at least over 1.7 months later. Although there are significant variables that affect in short-run, and the probability F-statistic is also below the 5 percent significance level, it is prominent to check the validity. So this study conducted an autocorrelation test and heteroscedasticity test.

3.3. Robustness Check

The research use some diagnostic tests of residuals for robustness analysis such as LM autocorrelation, Heteroscedasticity test, and CUSUM test. From the result estimation, the model is not to be autocorrelation (p-value is 0.11 more than 5 percent) and not to be heteroscedasticity model (p-value is 0.61 more than 5 percent).

Table 6. Diagnostic test results

Diagnostic test's	Methods	F-test
Autocorrelation	Breusch-Godfrey (LM Test)	2.24 (0.11)
Heteroscedasticity	White Test	17.64 (0.61)

Note: *indicate the significance at level 10%, 5% and 1%
Source: Author calculations

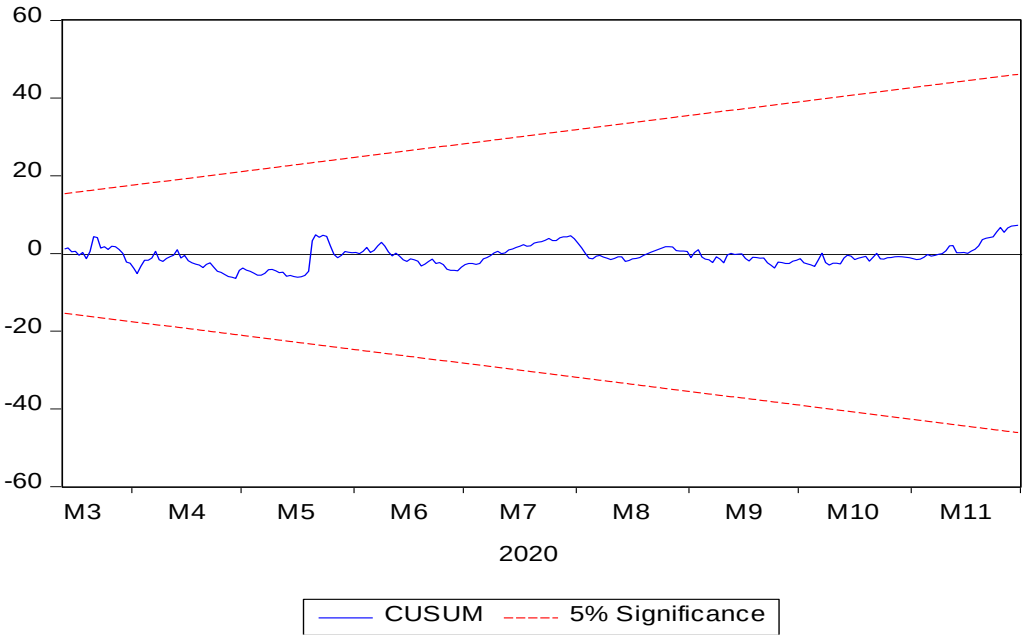

Figure 4. CUSUM Stability test
Source: Author calculations

Figure 4 illustrates the results of the CUSUM test which depicts all parameters in the model were stable over time, because recursive errors remain in all periods, within a confidence interval at a level of 5%. Based on the graph, it can be seen if the model can be used to estimate the impact of Covid-19 on stock market shocks in the short and long-run.

4. CONCLUSIONS

The study is focused to analyze the model of effect COVID-19 on the stock market in Indonesia from 2 March until 30 November 2020. The method that is used is the ARDL models. In the first stage, the data of each variable was transformed to the natural logarithm form, the stock market is noted by LOGSTOCK while COVID-19 confirmed cases are LOGCOVID19. The research on the impact of COVID-19 confirmed cases against the Indonesia stock market is still limited performed, while this study is contributed on emerging literature. Moreover, this research is not only discussing the relationship in short-run but also in the long-run when the estimation model back to the stability stage. This research indicates that if (a) there is a short-run relationship for ΔSTOCK variable influenced by its lag; (b) Meanwhile for the long-run, there is no relationship between COVID-19 and the stock market, or it is lag; and (c) the model is predicted to be re-stabilized at least over 1.7 months later. Robustness analysis was also conducted to strengthen the model. Therefore, we hope it takes a wider number of observations and recommendations to prevent serious shock or crises on Indonesia Stock Exchange research for better future research.

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