COVID-19 Pandemic and Exchange Rate: A Lesson Learned from Indonesia

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Abstract

This paper aims to capture the relationship between COVID-19 pandemic and exchange rate. We used high frequency data by employing daily data covering January 21, 2020 – June 29, 2022. Unlike most other studies that ignore the incubation period of COVID-19 in the number of daily transmission cases, we use the growth of COVID-19 as 14-day moving average of confirmed cases as main independent variables. Findings suggest that an increasing number of COVID-19 cases and related deaths has a long-term relationship with depreciation of rupiah exchange rate. The increase in the spread of COVID-19 which is broadcasted by the media drives market sentiment to be negative, through the efficient market hypothesis, the available information causes the rupiah to be depreciated. Amid the debate over the impact of the pandemic on the exchange rate, by using Indonesia as a lesson learned for emerging market economies, our research is a recent study that discusses this topic with completed data generating processes – when the pandemic has entered last wave phase. The disease outbreak channel is exists in the case of exchange rate behavior. The government needs to suppress massive news related to data on the spread of COVID-19 in various media, while still focusing on efforts to accelerate booster vaccination to tame the pandemic. A low interest rates imposed by the monetary authorities as an effort to encourage economic recovery can also put pressure on the exchange rate, so that other instruments such as foreign exchange intervention need to be optimized.

Keyword: *Indonesia, COVID-19 Pandemic, Rupiah Exchange Rate, and Efficient Market Hypothesis*.
JEL Classification: *F31, G18, and I18*.

1. Introduction

Covid 19 has not only caused a health crisis, but also an economic and social crisis in various countries on an unprecedented scale. The imposition of lockdown and social distancing by governement in the form of restrictions on the movement of people within national borders and even across countries has disrupted the supply of goods and services. This then causes a supply-demand mismatch and disrupts the national supply chain (Sethi et al., 2021).

COVID-19 infection first detected in Indonesia in March 2nd 2020 (See Figure 1). Social distancing measures and locdowns imposed in many locations have been in effect since mid-March (Olivia et al., 2020). It then followed by the largest depreciation of the rupiah on April 3, 2020, which touched the level of Rp. 16,622 per USD. It was the deepest level depreciaton rupiah after Asian Financial Crisis in 1998 which reached Rp16,800 per USD. From this phenomenon, it is expected that an increase of COVID-19 infections has depreciating effect of rupiah exchange rate, since disease outbreak channel state that the uncertainty related to the unpredicted nature of COVID-19 infection cases and related deaths, send the negatif sentiments to the financial market which then made this thing has predictive power on exchange rate behavior (Iyke, 2020).

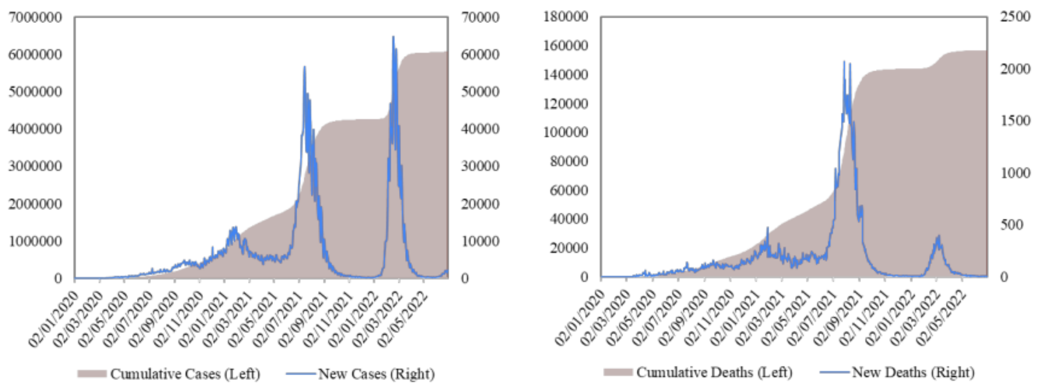


Figure 1. COVID-19 Infection Cases and Related Deaths in Indonesia

Source: WHO Coronavirus (COVID-19) Dashboard.

Empirical literature that study the relationship between COVID-19 and exchage rate is still in its infancy and the effect of COVID-19 on exchange rates is the subject of debate. Some studies found that an increase in the number of COVID-19 depreciates exchange rate (see Aquilante et al., 2022; Cardona-Arenas & Serna-Gomez, 2020; Sethi et al., 2021), another studies found the oposite (see (Camba & Camba, 2020), some studies found mixed effects (see Hoshikawa & Yoshimi, 2021; Iyke, 2020), and there is even other study that find no relationship (see Banerjee et al., 2020).

We shed light on this debate by conducting the analysis of the effect of the number on COVID-19 cases and related deaths on rupiah exchange rate using high frequency time series data by employing daily data covers period January 21st 2020 – June 29th 2022 (577 observations). By using single-country evidence (Indonesia) as a lesson learned for emerging market economies, our research is a current study that discusses this topic with completed data generating processes – when the pandemic has entered last wave phase. Unlike most other studies that ignore the incubation period of COVID-19 in the number of daily transmission cases that imply confirmed cases in a single day may fluctuate sharply, we follow Duan et al. (2021) to consider it and use the growth of COVID-19 which is 14-day moving average rate of confirmed cases and related deaths as our main independent variable.

In this context, the present research aim to investigate how the COVID-19 affect the rupiah exchange rate, while controling for the role of Jakarta composite index, interest rate, and world crude oil price. We employ an autoregressive distributed lag (ARDL) specification to see the relationship between COVID-19 and other determinant variables on rupiah exchange rate that converge toward a long-run equilibrium in the presence of staionary and non-stationary series.

The rest of the paper is organized as follows. Section 2 discusses the literature review. Section 3 focuses on the research method we used. We analyze the results Section 4 and we made the conclusion in Section 5.

2. Literature Review

The relationship betweeen COVID-19 and exchange rate can be explained by the teory of efficient market hypothesis, Taylor rule, and purchasing power parity. *Firstly*, efficient market hypothesis states that markets ar efficient, leaving no room to ge excess returns by investing since everthing is already fairly and accurately priced. Under this hypohesis, news related to COVID-19 infections refer to unexpected changes in the fundamental variables relevant for asset price determination (Taylor, 1995). So, the dynamics of exchange reflects all the information concerning the exchange rate (Fama, 1970). Taylor rule suggest that central bank should raise the interest rate when inflation is above target or GDP is above its potential. Capital flow can be used as a variable to capture monetary policy (Fang & Zhang, 2021). The incorporation of the exchange rate into discussions of monetary policy is to augment a closed-economy Taylor rule with the rate of currency depreciation. Because interest rate reacts not only to inflation and the output but also to movements in the exchange rate. *Secondly*, Taylor rule implies overshooting of the exchange rate following a shock (Heipertz et al., 2022). COVID-19 pandemic can be seen as a trigger for economic shocks where this has caused tremendous socio-economic disruption and induce capital outflow that depreciated exchange rate. *Thirdly*, Purchasing power parity theory states that the law of one price applies or in other words the price of a freely traded good or service will have the same price in any country. This theory assumes that the market mechanism runs perfectly, meaning that assumptions such as no transaction costs and taxes, homogeneity of the products traded, and the absence of uncertainty elements are met. Purchasing power parity implies that exchange rate depreciation occurs because the increase of price level. In the case of COVID-19, the increase in price levels could be triggered by a shortage of supply due to restrictions on economic activity imposed by the regulator or it could be due to excess demand from panic buying by the public.

Empirical literature related to the effect of COVID-19 pandemic on exchange rate still in infant stages. The literature can be divided into two groups. The first group concentrates on cross-country evidence, while the second focuses on single-country evidence. Benzid and Chebbi (2020) evaluate an impact of COVID-19 cases and related deaths in on exchaange rate volatility in Europa, China, and United Kingdom. Evidence form GARCH model show that an increase in COVID-19 cases and related deaths will increase volatility. In term of power prediction, Iyke (2020) tests the predictive ability of disease outbreaks on exchange rate retrun and volatility in 25 most affected countries by COVID-19. Evidence from GARCH model show contradictory results. An increase in COVID-19 predicts depreciation of five returns, namely USD–CHF, USD–EUR, USD–INR, USD–PLN, and USD–SEK, and predicts appreciation of USD–GBP and GBP–USD returns. Specially for USD–CAD, the predictability oscillates from appreciaton to depreciation this currency. In case of volatility, the effect is also asymmetric, an increase in COVID-19 could increase volatility of USD-CAD and ISD-EUR and could decrease volatility of USD-SEK and USD_GBP. Focusing on exchange rate volatility in 20 countries, Feng et al. (2021) find that an increase in confirmed COVID-19 cases does raise exchange rate volatility.

Comparison of the exchange rate response to the pandemic uncertainty between advance and emerging economies was examined by Sethi et al. (2021). Fixed effect model that analized 37 countries shows that an increase daily confirmed cases and related deaths imply depreciating countires currency. Regarding the effect of uncertainty created by pandemic on exchange rate, in advanced economies, it tend to be appreciated while in emerging economies the result is opposite. Higher sample used by Aquilante et al. (2022) by analyzing this phenomenon in 57 countries. A linear regression and panel vector autoregressive model prove that an increase in new COVID-19 cases associates to a depreciation of countries currency. Focusing on spillover shock of exchange rate in Europa, Japan, Canada, and United Kingdom, Narayan (2022) found that exchange rate spillover became 44% more important in COVID-19 period compared pre COVID-19 period.

The aforementioned cross-country studies are complemented by studies focusing on single-level evidence. Study in India show that an increase in confirmed COVID-19 cases caused no change in the value of the exchange rate (Banerjee et al., 2020). In Colombia, a short-term Colombian peso depreciation may be explained by financial market uncertainty, generated by the arrival of the COVID-19 virus (Cardona-Arenas & Serna-Gomez, 2020).

Some facts of exchange rate depreciation above are contrary to the results of research in the following countries. In Philippine, an increase in number of COVID-19 daily infections appreciates Philippine's peso (Camba & Camba, 2020). In Korea, after seven days of new COVID-19 cases, South Korean won tend to be appreciated indicating that investors may have repurchased its currency after an infection spike (Hoshikawa & Yoshimi, 2021).

There are also some single country literature that examines other aspects of the impact of COVID-19 on exchange rates. Narayan (2020) evaluate the evolution of exchange rate from the point of view of shock persistency in Japan. He found that in the early stage, shock to yen were having a non-transitory effect, while in subsequent stage, the shock became short-term or transitory. Fang and Zhang

(2021) emphasize on exchange rate fluctuation around the outbreak of COVID-10. They found that the impact of the COVID-19 pandemic on the RMB exchange rate is transient. RMB rate rose steadily before the outbreak but fluctuated during the pandemic.

3. Research Method

The purpose of this paper is to investigate the effect of COVID-19 pandemic on rupiah exchange rate, while controling for the role of Jakarta composite index, interest rate, and world crude oil price. Our sample covers period January 21st 2020 – June 29th 2020 in the form of daily data (577 observations). We use numbers of COVID-19 confirmed cases and related deaths provided by World Health Organization. Nominal exchange rate obtained via Google Finance trought Morningstar, Jakarta composite index are obtained from Indonesian stock exchange, and world crude oil price data are obtained from West Texas Intermediate (WTI). In addition, the proxy of interest rate is Bank Indonesia 7-day (reverse) repo rate. Given the limitation of availability of daily data, only selected explanatory variable are used as factor affecting of exchange rate in this study. Following Duan et al. (2021) and considering virus incubation and detection conditions that imply confirmed cases in a single day may fluctuate sharply, we use *COVID19_GROWTH* which is 14-day moving average rate of confirmed cases and related deaths cases as our main independent variable as formulated below:

$$COV19\_GROWTH_t = \sum_{t-13}^{t}[\ln(1 + Cumulative\_COVID\_19_t) - \ln(1 + Cumulative\_COVID\_19_{t-1})]/14 \quad (1)$$

Efforts to transform the COVID-19 variable in such a way in Equation 1 also contributes to eliminating heteroscedasticity and avoiding spurious regression (Wooldridge, 2020). Henceforth, to investigate the relationship among exchange rate and its determinant factors, the functional relationship is formulated as below.

$$ER_t = f(COV19\_CASEGROWTH_t, COV19\_DEATHGROWTH_t, JKSE_t, IR_t, WTI_t) \quad (2)$$

where,

ER_t : Nominal exchange rate at time *t*

$COV19\_CASEGROWTH_t$: COVID-19 confirmed cases growth rate in Indonesia at time *t*

$COV19\_DEATHGROWTH_t$: COVID-19 related deaths growth rate in Indonesia at time *t*

$JKSE_t$: Jakarta composit index at time *t*

IR_t : Central bank interest rate at time *t*

WTI_t : World crude oil price at time *t*

Considering and integrated order of the stationarity of the variables, this study employs ARDL bound testing developed by Pesaran, Shin, & Smith (2001). This provides both short run and long-run coeficient estimations. Before conducting long run estimation, bound test for examining the long-run association among variables using F-statisitc must be conducted first to check wether the null hypothesis of no cointegration among variables could be rejected or not. Once its null hypothesis is rejected, it can be justify to estimate the long-run coefficients.

Instead conducting analysis short-run estimations, this research focuses on long-run estimation to deriving causal relationship inference. The long-run ARDL (p, q_1, q_2, q_3, q_4, q_5) equilibrium model is as follows:

$$\ln(ER)_t = \alpha + \sum_{i=0}^{p} \beta_{1i} \ln(ER)_{t-i} + \sum_{i=0}^{q_1} \beta_{2i} \ln(COV19\_GROWTH)_{t-i} + \sum_{i=0}^{q_3} \beta_{3i} \ln(JKSE)_{t-i} + \sum_{i=0}^{q_4} \beta_{4i} IR_{t-i} + \sum_{i=0}^{q_5} \beta_{5i} WTI_{t-i} + \varepsilon_t \quad (3)$$

Where, α denotes constant term in the equation, β is the long-run coefficients, while p, q_1, q_2, q_3, q_4, q_5 represent lag length, and ε is the error term with white noise in equation.

4. Result and Discussion

Table 1 presents the descriptive statistics of variables used in this study, while Figure 2 shows all individual graph for series trends. During the study, the largest depreciation of the rupiah was Rp16,622 per USD on April 3, 2020 which almost touched the weakest level after June 17, 1998 which at that time reached Rp16,800 per USD. COVID-19 cumulative cases and cumulative related deaths in Indonesia show an increasing trend. The highest value of cumulative cases is 6,086,212 people and the highest value of cumulative related deaths is 156,731 people in Juni 6 2022. The Jakarta stock index touched 3,937.63 on March 24, 2020 which was the lowest level since June 12, 2012 which at that time touched 3,889.52. In addition, the mean of interest rate is 3.84 percent, while the mean of worl crude oil price is USD63 per barrel.

The first step in analyzing time series data using ARDL model is that all variabel have to be ensured that no variable is integrated of order two, I(2) or higher. Table 2 shows the result of Augmented Dickey-Fuller and Phillips-Perron unit root tests in a level form. It can be concluded that some variables still showing inconsistent test results in term of stationarity the a level (integrated of order zero, I(0)), except *COV19_CASEGROWTH* and *COV19_DEATHGROWTH*. While Table 3 show unit root test in a first difference form. It can be said that all variable used in this study are integrated of order one, I(1). Therefore, it conforms with prerequisites of the ARDL models.

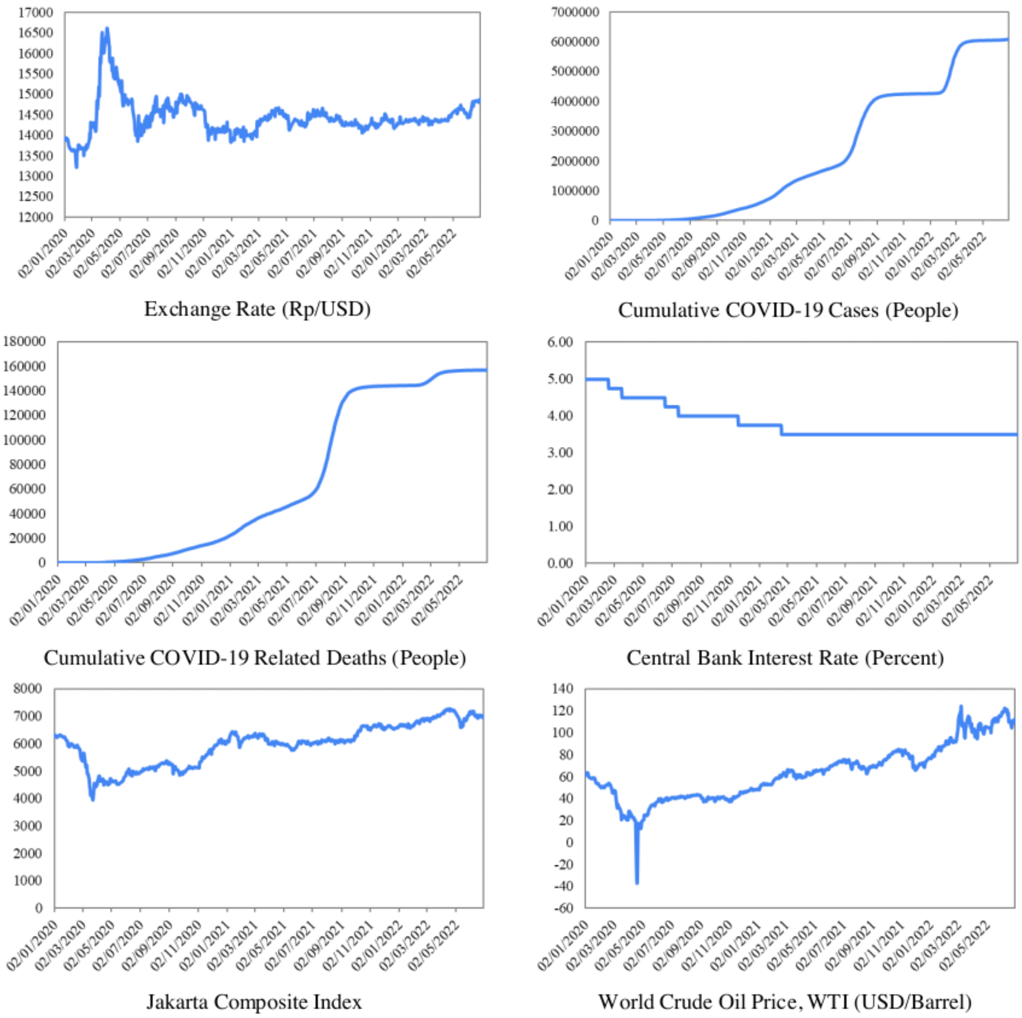


Figure 2. All Individual Graphs for Dataset Trends

Table 1. Descriptive Statitics

Variables (unit)	Mean	Maximum	Minimum	Std. Dev.	Observations
ER (Rp/USD)	14427.9200	16622.2000	13213.2400	445.4598	599.0000
COV19_CASE (people/day)	2220089.0000	6086212.0000	0.0000	2165381.0000	599.0000
COV19_DEATH (people/day)	65514.1700	156731.0000	0.0000	62769.6300	599.0000
JKSE (index)	5965.6940	7276.1900	3937.6300	747.8550	599.0000
IR (percent)	3.8418	5.0000	3.5000	0.4693	599.0000
WTI (USD/barrel)	62.9993	123.7000	-37.6300	24.7908	599.0000

Table 2. Result of Unit Test in Level

Variables	Augmented Dickey-Fuller		Phillips-Perron	
	Constant	Constant and Trend	Constant	Constant and Trend
ln (*ER*)	-2.5548	-2.5648	-3.2517	-3.2628
	(0.1032)	(0.2968)	(0.0177)**	(0.0736)*
COV19_CASEGROWTH	-2.5893	-3.5477	-3.0152	-3.56425
	(0.0958)*	(0.0354)**	(0.0341)**	(0.0338)**
COV19_DEATHGROWTH	-3.9309	-5.0160	-3.3945	-3.8485
	(0.0020)***	(0.0002)***	(0.0115)**	(0.0148)**
ln (*JKSE*)	-0.9211	-3.2391	-1.1165	-3.3493
	(0.7815)	(0.0779)*	(0.7109)	(0.0595)*
IR	-2.8090	-1.5711	-2.9158	-1.5097
	(0.0576)*	(0.8034)	(0.0441)**	(0.8256)
WTI	-0.3774	-3.8300	-0.4066	-4.0934
	(0.9102)	(0.0156)**	(0.9054)	(0.0068)**

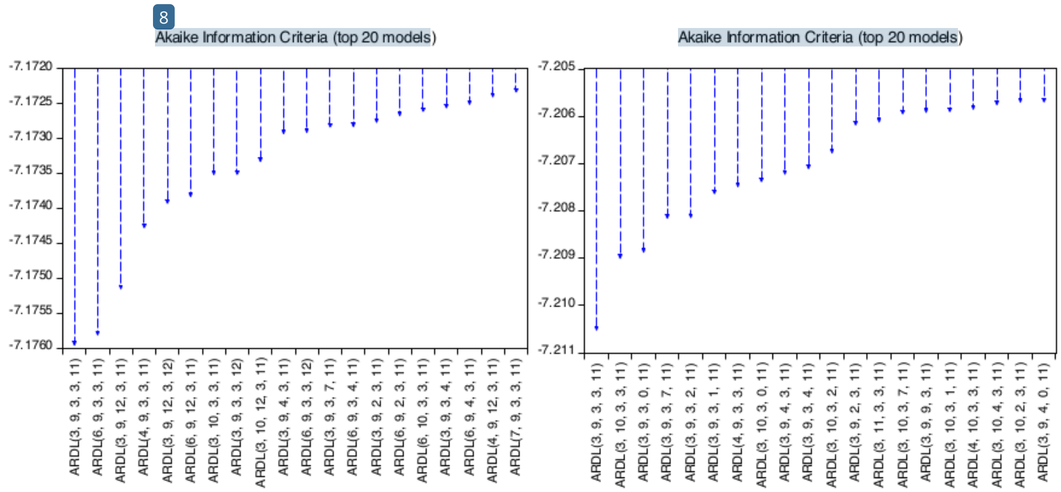
Notes:
P-value is in parenthesis
*, **, and ***, shows a level of significance of 10%, 5%, and 1% respectively.
H_0: Variable has a unit root.

The next step is to determine the appropriate lag length using the Akaike information criterion (AIC). Figure 3 shows the recursive search of the lag length. The result reveals that the model with lowest AIC is ARDL(3, 9, 3, 3, 11) for Model 1 and Model 2 as the most appropriate model.

Table 3. Result of Unit Test in First Difference

Variables	Augmented Dickey-Fuller		Phillips-Perron	
	Constant	Constant and Trend	Constant	Constant and Trend
Δln(*ER*)	-31.8852	-31.8585	-31.0859	-31.0626
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Δ*COV19_CASEGROWTH*	-7.1030	-7.1081	-21.5189	-21.5075
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Δ*COV19_DEATHGROWTH*	-5.1832	-5.1842	-23.4769	-23.4649
	(0.0000)***	(0.0001)***	(0.0000)***	(0.0000)***
Δln(*JKSE*)	-12.2460	-12.2927	-23.9573	-23.9728
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
ΔIR	-24.6415	-24.8512	-24.6462	-24.9165
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Δ*WTI*	-22.6102	-22.6751	-37.4977	-38.3472
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***

Notes:
P-value is in parenthesis
*, **, and ***, shows a level of significance of 10%, 5%, and 1% respectively.
H_0: Variable has a unit root.



Model 1: ARDL(3, 9, 3, 3, 11) Model 2: ARDL(3, 9, 3, 3, 11)

Figure 3. Lag Length Selection Summary

Table 4. Bounds Test Results

F-Statistic	K	Level of Significant	Critical Bounds		Remarks
			Lower Bound I(0)	Upper Bound I(1)	
Model 1: ARDL(3, 9, 3, 3, 11)					
6.0801	4	10%	2.2000	3.0900	Cointegrated
		5%	2.5600	3.4900	Cointegrated
		1%	3.2900	4.3700	Cointegrated
Model 2: ARDL(3, 9, 3, 3, 11)					
4.4410	4	10%	2.2000	3.0900	Cointegrated
		5%	2.5600	3.4900	Cointegrated
		1%	3.2900	4.3700	Cointegrated

Note:

K denotes the number of independent variables.

H_0: No cointegration.

Table 4 presents the coumputed F statistic based on bound test. It shows that computed F statistic is more than both lower bound and upper bound even at the lowest significant level, so, null hypothesis of no cointegration can be rejected. It can be concluded that there is long-run cointegrating relationship among variables used in this study. These results justify the use of long-run estimates of the ARDL model.

Table 5. Estimated Long-Run Coeficients

Dependen Variable: ln (*ER*)	Model 1	Model 2
	ARDL(3, 9, 3, 3, 11)	ARDL(3, 9, 3, 3, 11)
COV19_CASEGROWTH	0.4282***	
	(0.0587)	
COV19_DEATHGROWTH		0.4866***
		(0.0838)
ln (*JKSE*)	-0.2164***	-0.1857***
	(0.0474)	(0.0561)
IR	-0.0306***	-0.0195**
	(0.0083)	(0.0093)
WTI	0.0010***	0.0010***
	(0.0002)	(0.0003)
Constant	11.4989***	11.1962***
	(0.4099)	(0.4877)
N	577	577
H_0: No serial correlation[1]	0.4337	0.7004

Note:
[1] shows Prob. Chi-Square of Breusch-Godfrey Serial Correlation LM Test. *, **, and ***, shows a level of significance of 10%, 5%, and 1% respectively. Standard error is in brackets.

Table 5, reports the result of long-run estimates measuring the effect of COVID-19 infection cases and related deaths as well as other control variables on rupiah exchange rate. Both Model 1 and Model 2 used ARDL(3, 9, 3, 3, 11). They are non-autocorrelation as Breusch-Godfrey serial correlation LM test result indicating failed to reject null hypothesis. The values of the long-run coefficients indicate that the growth of COVID-19 infection cases occured in Indonesia has positif effect on rupiah exchange rate. In logarithmic form, it can be interpreted that 1 percent increase in the growth of COVID-19 infection cases causes 0.43 percent increase (depreciation) in the rupiah exchange rate. Similarly, 1 percent increase the growth of COVID-19 related deaths causes 0.49 percent increase (depreciation) in the rupiah exchange rate. These results show that increasing of COVID-19 cases and related deaths have relationship with depreciation in the rupiah exchange rate. Rupiah exchange rate against the USD has weakened due to economic disruption caused by the COVID-19 pandemic. It confirms the existence of the disease outbreak channel and support findings of several studies conducted by Aquilante et al. (2022), Cardona-Arenas and Serna-Gomez (2020) and Sethi et al. (2021). The increase in the spread of COVID-19 which is broadcasted by the media drives market sentiment to be negative, so that through the efficient market hypothesis, the available information causes the rupiah to be depreciated.

Jakarta stock index have negative effect on rupiah exchange rate. In logarithmic form, it can be interpreted that 1 percent increase in Jakarta stock index causes 0.22 percent decrease (appreciation) in rupiah exchange rate. Rising stock prices indicate portfolio investment in Indonesia is profitable. It attracts foreign investors to put their funds into the Indonesian stock market. The purchase of Indonesian shares increases the demand for the rupiah, so its currency appreciates.

Central bank interest rate have negative effect on rupiah exchange rate. 1 percent increase in central bank interest rate causes 3.06 percent decrease (appreciation) in rupiah exchange rate. Raising interest rates has led to an increase in the demand for the rupiah and appreciate its exchange rate. This finding support the study conducted Fang and Zhang (2021) in a case of RMB China and Garg and Prabheesh (2020) in a case of Brazil, Russia, India, China and South Africa (BRICS countries) and also Pham (2019) in case of Vietnam. Bank Indonesia 7-days (reverse) repo rate as a proxy of central bank interest rate has the highest effect compared to other explanatory variables used in this study in maintaining rupiah exchange rate. So, the use of monetary policy in dealing with exchange rate dynamics is still effective in the time COVID-19 outbreak.

The remaining variable – world crude oil price is found to have a positive effect to rupiah exchange rate. 1 USD increase in world crude oil price cause 0.1 percent increase (depreciation) in rupiah exchange rate. It indicate that Indonesia's dependence as a net importer of crude oil has consequences for the need to maintain foreign exchange reserves as a means of payment for imports. The increase in the price of crude oil makes the amount of foreign currency to be purchased also increases, thus making the supply of rupiah increase as well. This has contributed to the weakening of the rupiah exchange rate. This finding contradicts the study of Cardona-Arenas and Serna-Gomez (2020). It is because Cardona-Arenas and Serna-Gomez (2020) uses the case of Colombia which is a net exporter of crude oil, so that when crude oil prices rise, it actually increases the demand for Colombian peso currency and its currency will appreciates.

5. Conclusion

We conducted analysis of the effect of the number on COVID-19 cases and related deaths on rupiah exchange rate using daily time series data over periode January 21st 2020 – June 29th 2022, we provide evidence indicating that an increase in COVID-19 cases and related deaths depreciates rupiah exchange rate. This result indicate that the supply of information available to market participants related to data on the spread of COVID-19 has exposed them to a situation of uncertainty. It then through efficient market hypothesis makes the price of rupiah currency depreciate. In addition, another important finding is that the effect of interest rates on rupiah exchange rate shows a convincing magnitude. It indicates that interest rates are an effective instrument in maintaining the rupiah exchange rate.

Overal, our result suggest that the disease outbreak channel is exists in the case of exchange rate behavior. The government needs to suppress massive news related to data on the spread of COVID-19 in various media, while still focusing on efforts to accelerate booster vaccination to tame the pandemic. A low interest rates imposed by the monetary authorities as an effort to encourage economic recovery can put pressure on the exchange rate, so that other instruments such as foreign exchange intervention need to be optimized.

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