Economics and Finance in Indonesia

Volume 69
Number 2 *December 2023*

Article 1

12-2023

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Febiyansah, Panky Tri (2023) "Exchange Rate Responses and Volatility Spillover Effects during the COVID-19 Pandemic in Indonesia," *Economics and Finance in Indonesia*: Vol. 69: No. 2, Article 1.
DOI: 10.47291/efi.2023.06
Available at: https://scholarhub.ui.ac.id/efi/vol69/iss2/1

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Cover Page Footnote

I thank to the Central Banking Conference in 2021 held by Asian Development Bank Institute and all participants and the discussant for their invaluable comments and suggestions. All errors are mine.

This article is available in Economics and Finance in Indonesia: https://scholarhub.ui.ac.id/efi/vol69/iss2/1

Economics and Finance in Indonesia
Vol. 69 No. 2, December 2023 : 87–97
p-ISSN 0126-155X; e-ISSN 2442-9260

Exchange Rate Responses and Volatility Spillover Effects during the COVID-19 Pandemic in Indonesia

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Manuscript Received: 8 October 2023; Revised: 9 January 2024; Accepted: 2 February 2024

Abstract

This paper aims to assess the impact of the confirmed COVID-19 cases, the timing of the outbreak, and physical measures on the returns and spillover effects of exchange rate in Indonesia. The model will be tested by the exponential generalized autoregressive conditional heteroskedastic (EGARCH) process and the spillover volatility index. The study discovers that the confirmed cases, outbreak news, and the implementation of large-scale social restrictions simultaneously contribute to a leverage effect on the volatility of a direct quote of Indonesian Rupiah to Australian Dollar, Euro, US Dollar, Singapore Dollar, and Great British Pound. To a certain extent, the heat-wave as well as the meteor-shower effects as a result of clustering events and intense spillover effects in the currency market of Indonesia are observed.

Keywords: COVID-19, exchange rate return, spillover effect, volatility

JEL classifications: C32; F31; I18

1. Introduction

The COVID-19 pandemic has reverberated across the world, including in Indonesia, directly affecting the lives and expectations of people and rendering the economy deteriorating (Eschachasthi 2021). Consequently, the government has responded to the crisis with several measures, such as physical-limitation policies. Since Indonesia is categorized as an open economy country, it is imperative to examine the specific effect of the pandemic on the currency market of Indonesia. Understanding the exchange rate of Indonesia in response to the pandemic is critical to investors, financial actors, exporters, and importers. To capture the complete picture, this study attempts to combine the analysis from the perspective of returns and volatility spillovers.

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Several recent studies have examined the impact of the COVID-19 crisis on the dynamics of the foreign exchange system. Iyke (2020) demonstrates that the COVID-19 pandemic has predictive power over the exchange rate model with a direct quote exchange rate of USD to 25 most affected countries. Non-economic variables, represented by coronavirus disease data, can effectively predict the exchange rate returns and volatility. To complement this finding, Narayan (2020) explores a short-run impact of COVID-19, indicating the changing behavior of JPY to USD in response to the shock. The pandemic has resulted in a transitory effect on the JPY-USD nexus which previously displayed a resistant performance to several other shocks. Moreover, the shock of the COVID-19 outbreak induces volatility spillovers and triggers a contagious effect from a domestic currency to foreign currencies, profoundly related to trade and economic relationships, as evident in a case study on Chinese RMB (Wei et al. 2020). Simultaneously, during the earlier crisis outbreak, there was a spike in exchange rate volatility

Published by UI Scholars Hub, 2023

spillovers attributed to investors taking advantage of the best information available in the market (Garg & Prabheesh 2021).

In order to extend the findings provided by Iyke (2020), Narayan (2020), Wei et al. (2020), as well as Garg & Prabheesh, this study aims to investigate the intuition of return responses and volatility spillover effects of the Indonesian exchange rate on seven foreign currencies affected by the COVID-19 pandemic. This study utilized seven direct quotes of Indonesian rupiah (IDR) to Australian Dollar (AUD), Euro (EUR), US Dollar (USD), Singapore Dollar (SGD), Great British Pound (GBP), Japanese Yen (JPY) and Chinese Yuan (CNY). The seven currencies represent countries with close relations to Indonesia as trading partners, economic neighbors, and primary sources of foreign direct investments. The independent variables consist of the announcements of the COVID-19 outbreak, total confirmed cases, and the implementation of physical-distancing policies (Large-Scale Social Restrictions (LSRR)). To depict a comprehensive view, the study covers samples from 02/12/2019 to 24/05/2021. This period of study accommodates the clustering events which can be beneficial to generate more robust estimation.

To the best of the knowledge of the author, none of the existing studies has specifically examined the returns and spillover effects of exchange rate dynamics in response to the COVID-19 pandemic in Indonesia. As the pandemic has been a national interest, it is essential to understand how various factors, such as the news of COVID-19 outbreak, the announcement of confirmed cases, and the implementation of nationwide physical restriction policies, influence the behavior of exchange rate returns and spillovers in the currency market. The first hypothesis of this study posits that both the health crisis news as well as physical measures will deliver a leverage effect on the Indonesian exchange rate market. Second, different from the hypothesis proposed by Garg & Prabheesh (2021), this study expects that the immediate relief of exchange rate tensions is not autonomous or "surprise effect", but likely stems from physical limitation policies. The last hypothesis suggests that the effect of COVID-19 may manifest as both the heat wave and meteor shower phenomena which were not observed in previous crises.

The empirical analysis for this paper involves several distinct stages. First, following previous studies (Sharma et al 2019; Iyke 2020), the paper introduces the COVID-19 indicator and accommodates two breaks, consisting of an outbreak announcement and the news of physical policy measures, in the equation of variance. Second, to explore the source of volatility in exchange rate returns, this study employed the estimated variance of prior models to examine the spillover effects between markets following Diebold & Yilmaz (2009). This approach allows for testing the intuition of exchange rate behavior during the pandemic.

The findings of this study differ from those of Iyke (2020) as well as Garg & Prabheesh (2021). IDR experiences sudden depreciation against seven currencies in response to the unanticipated crisis, followed by immediate appreciation subsequent to the implementation of physical distancing measures. It is confirmed that the heat wave and meteor shower hypotheses manifest sequentially during the study period. The findings also reveal that spillovers intensively propagate volatility whereas exchange rate volatility is more responsive compared to exchange rate returns in association with the effects of the pandemic on the Indonesian market. It potentially delivers a leverage effect on six bilateral exchange rates, thereby increasing the vulnerability of the behavior of returns in relation to macroeconomic conditions. In addition, the efficient market hypothesis continues to hold true in the case of the exchange rate of Indonesia during the pandemic.

This paper is structured as follows. Section 2 explores related literature reviews concerning the efficient market and volatility. Section 3 narrates methodology, including data description and models. Section 4 presents the descriptive analysis and the methodology of the results. Sections 5 and 6 describe the robustness test and the conclusion.

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DOI: 10.47291/efi.2023.06

2. Literature Review

In theory, the activity in the asset market should be efficient with rational actors and symmetric information. This efficient market hypothesis proposes asset prices to fully reflect all information (Fama 1970; Sharma et al 2019; Iyke 2020). As a result, asset returns only respond to news immediately, which tend to follow a random walk process that is difficult to predict. Thus, the news quickly disseminates throughout the markets and asset prices respond instantaneously when it is absorbed. On the other hand, Malkiel (2003) argues that the behavior of asset prices is partially predictable due to inherent imperfections in the rationality of market actors. As the consequence, distortions and expected patterns seem to occur continuously and even persist in the short terms. In the case of the COVID-19 pandemic, the efficient market theory implies that the news of the announced outbreak, the daily report of confirmed cases, and the news of policies applied will influence the actors and trigger a sudden reaction in the currency market. The instantaneous jump of exchange rates leads to either a one-shot movement and a return to normal levels or a pattern of returns.

Regarding the behavior of exchange rate returns, various empirical studies have investigated the responses of asset markets to COVID-19. Feng et al. (2021) consider a general method of moment (GMM) estimation to explore how the pandemic influences the exchange rate volatility while policy measures, such as containment measures, school closures, workplace closures, public transport closures, and stay-at-home arrangements, prevent long-term implications. Meanwhile, Phan & Narayan (2020) discover that stock markets overreact to the unexpected outbreak news. Fortunately, self-corrections occur when subsequent measures and information become available. In line with their findings, the stock market in India experiences volatility during COVID-19 compared to pre-conditions as demonstrated in an event study (Bora & Basistha 2021). Moreover, Aloui (2021) presents interesting findings that the pandemic can alter the behavior of investors in response to the effect of monetary policy on exchange rates.

In terms of capturing the wide spread of disturbances and uncertainties during the health crisis, several studies have investigated contagion effects and volatility spillovers. Baillie & Bollerslev (1991), Alba (1999), Hong (2001), Baele (2005), Inagaki (2007), Bubák, Kočenda & Žikeš (2011), Gabauer & Gupta (2018), and Misra et al. (2020) discuss how contagion can spread from particular asset markets to others in the idiosyncratic period of great global market volatility. Akhtaruzzaman et al. (2021) reveal the increasing spillover effects during the COVID-19 crisis in which financial companies being particularly more conspicuous in transmitting contagion compared to others. Moreover, Wei et al. (2020) examine time-varying belt and road (B&R) exchange rate patterns in terms of Chinese currency, comparing the events prior and during the pandemic. The findings indicate that the contagion is significant and affecting the stability of Chinese currency and increasing uncertainty.

A concept of volatility spillovers arises due to clustering events, with heat-wave and meteor-shower hypotheses first introduced by Engle, Ito & Lin (1990). The heat wave hypothesis is associated with volatility in particular periods in a market while the meteor shower effect defines the spread of volatility across markets (Ito, Engle & Lin 1992; Ibrahim & Brzeszczynski 2009). Ito, Engle & Lin (1992) demonstrate the existence of meteor showers in the global market. On the other hand, Hogan & Melvin (1994) test the meteor shower hypothesis on the effects of news or announcements and diverse expectations. They reveal that persistent impacts tend to be localized in a country, affecting both exchange rate returns and volatility. Meanwhile, Melvin & Melvin (2003) propose that both hypotheses occur, yet emphasizing the significant importance of the heat wave effect. Despite being a global phenomenon, the pandemic events were characterized as country-specific, leading to the intuition of heat waves that should be more prominent than meteor showers.

3. Method

3.1. Data Description

The COVID-19 pandemic has had a profound and severe impact on Indonesia. The rapid surge in confirmed cases and deaths have influenced home-market exchange rates. An unanticipated announcement of the outbreak delivered intense nerves in the Indonesian market, even though the first outbreak news was started in December 2019 in Wuhan, China. Subsequent to the announcement of the first case, Indonesia has initiated health and economic measures from social distancing policies, stabilization, to economic recovery packages.

The data overview is presented in Figures 1 and 2. All direct quotes were sourced from the Indonesian Economic and Financial Statistics (Bank Indonesia 2021) released by the Central Bank of Indonesia while the outbreak announcement and confirmed cases were obtained from the Ministry of Health of Indonesia and the COVID-19 Task Force (Satgas COVID-19) report. Figure 1 illustrates sudden significant depreciations in six currencies and a low drop in AUD when the pandemic hit. In addition to exchange rates at the spot market, this figure consists of the total of confirmed cases (TCC) and the news of government interventions. The policies are separated into two components, the outbreak announcement (OBA) and Large-Scale Social Restrictions (LSSR). Referring to the Presidential Decree No. 7 and 11/2020, OBA started from the official announcement of the first COVID-19 cases on 2 March 2020 to 11 March 2020 where the World Health Organization (WHO) declared COVID-19 as the global pandemic. LSSR had been respectively applied across the provinces from 6 April to 9 June 2020. The beginning date corresponds to the date on which the first province applied LSSR. Meanwhile, the last date corresponds to when the first round of LSSR ended in the last province.

The rapid increase in the COVID-19 cases in Indonesia is presented in Figure 2. To date, the count of confirmed cases has begun by 2 March 2020. In this study, confirmed cases represent the cumulative incidences of daily cases. Since the news of total cases has been announced by the government on a daily basis, TCC is assumed to capture the effect of the pandemic on public expectations through public information. Moreover, both Figure 1 and Figure 2 point out that exchange rate returns have high volatility in the following days after the outbreak news. The pattern of returns is relatively homogenous, which is stationary and clustered. On the other hand, the plots also mark mild effects, even amidst the exponential increase in cases. Both figures also indicate that the formal news of the first case has greater volatility effects on returns compared to LSSR.

The EGARCH model was employed for estimation in this study. This technique proves effective as it can handle volatility clusters due to an idiosyncratic period of exchange rate returns (Mandelbrot 1963; Nelson 1991). Nelson (1991) also notes that EGARCH can mitigate the issues of persistent conditional variance. Moreover, this econometric model is beneficial to capture the asymmetric effect during the period of this study. The returns of bilateral exchange rates are calculated as follows:

$$\mathrm{ERR_{i,t}} = \ln\left(\frac{\mathrm{ER_{i,t}}}{\mathrm{ER_{i,t-1}}}\right) \times 100 \tag{1}$$

Where $\mathrm{ER_{i,t}}$ and $\mathrm{ER_{i,t-1}}$ denote the Indonesian exchange rate in the spot market at time t and a previous period $\mathrm{t}-1$, respectively. Following the models outlined by Iyke (2020) and Sharma et al. (2019), the EGARCH functional form of regression has the general equation as follows:

$$\mathrm{ERR_{i,t}} = \alpha_{\mathrm{i,0}} + \sum_{\mathrm{j=1}}^{\mathrm{P}} \alpha_{\mathrm{i,j}} \mathrm{ERR_{i,t-j}} + \sum_{\mathrm{k=1}}^{3} \beta_{\mathrm{k,t}} \mathrm{X_{k,t}} + \varepsilon_{\mathrm{i,t}} \tag{2}$$

$\mathrm{X_{k,t}}$ represents three independent variables consisting of TCC, OBA, and LSSR. Specifically, OBA and LSSR are dummy components. Since $\varepsilon_{\mathrm{t}} = \mathrm{z_t}\sigma_{\mathrm{t}}$, where $\mathrm{z_t}$ represents white noise, the conditional variance of EGARCH(M,N) model follows the fol-

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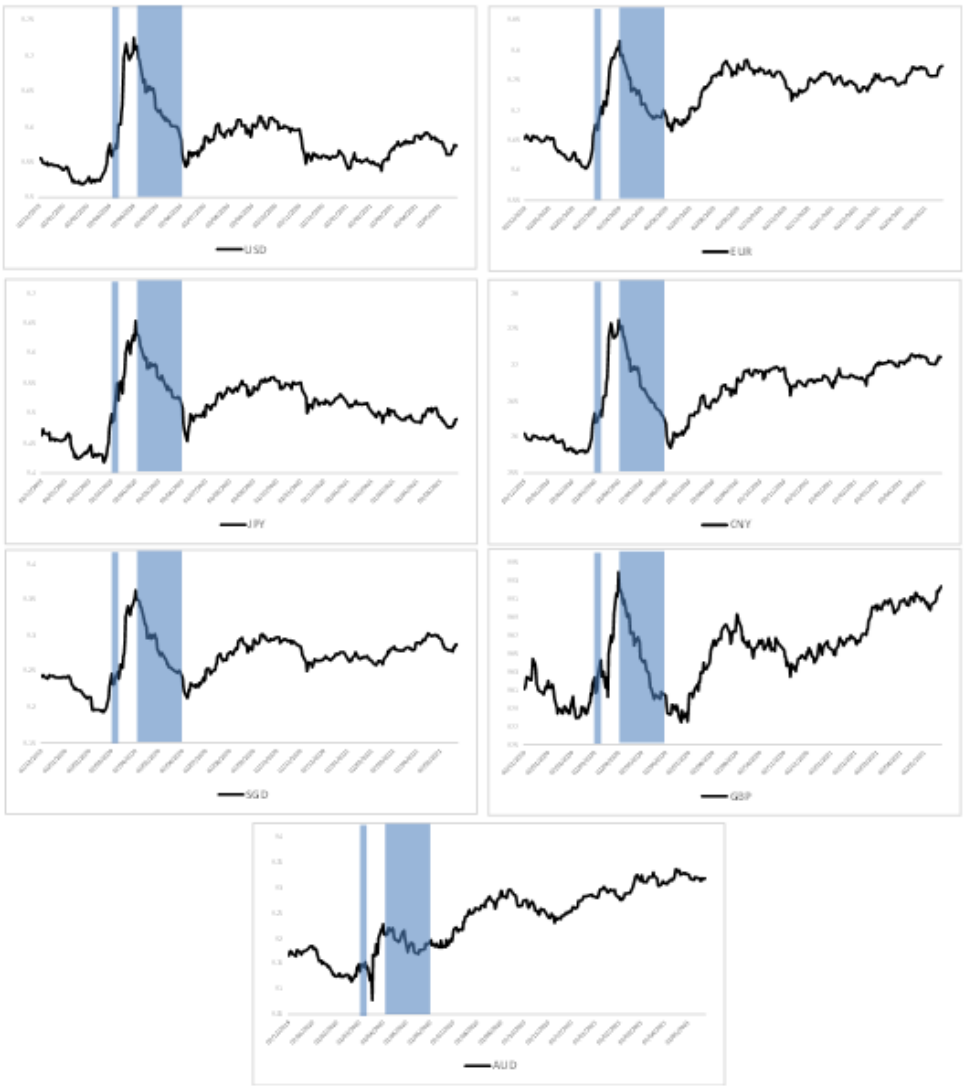

Figure 1. Series of Exchange Rates, the Moments of Outbreak News, and LSRR Policy
Source: Bank Indonesia (2021) and various reports, calculated by the author

lowing form:

$$\ln(\sigma_{i,t}^2) = \omega + \sum_{j=1}^{M} \rho_{i,j} \left| \frac{\varepsilon_{i,t-j}}{\sigma_{i,t-j}} \right| + \sum_{j=1}^{N} \tau_{i,j} \ln(\sigma_{i,t-j}^2) + \sum_{j=1}^{P} \gamma_{i,j} \frac{\varepsilon_{i,t-j}}{\sigma_{i,t-j}} + \sum_{k=1}^{3} \varphi_{k,t} X_{k,t} \quad (3)$$

where σ_t^2 denotes the conditional variance while ω, $\rho_{i,j}$, $\tau_{i,j}$, $\gamma_{i,j}$, and $\varphi_{k,t}$ are estimated parameters. To be stationary, $0<\tau_{ij}<1$ should hold. Volatility spillovers in this study refer to Diebold & Yilmaz (2009). This study generates a series of volatility from EGARCH(M,N) and then applies the series in forecast error decomposition to identify volatility spillovers. To a certain extent, a *P-variable* Vector Autoregressive (VAR) model by Diebold & Yilmaz (2009) is applied to capture a forecast error variance decomposition. Considering the moving average representation denoted as B, the spillover index can be defined in a matrix form by using the

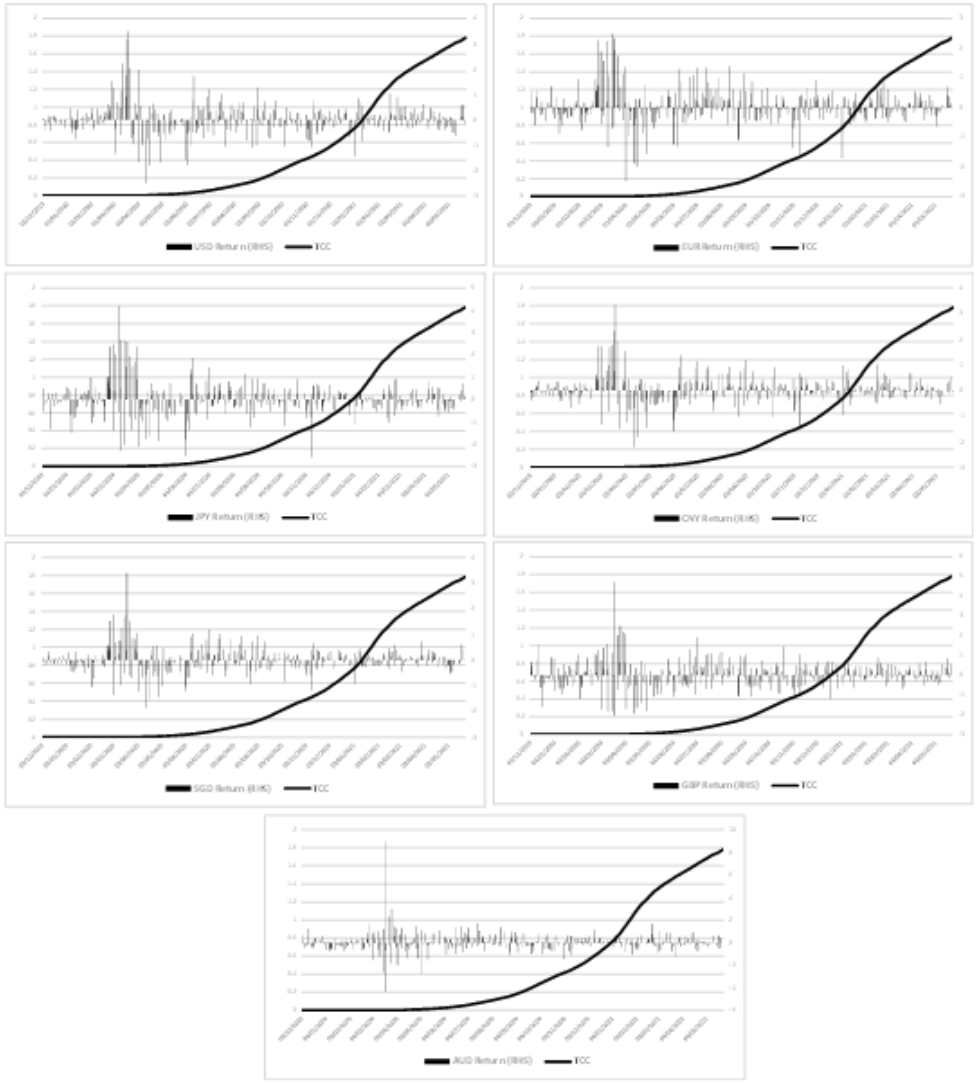

Figure 2. Brief Patterns of Exchange Rate Returns and Confirmed Cases
Note: TCC is confirmed cases in a logarithmic form
Source: Bank Indonesia (2021) and WHO (2021) report, calculated by the author models

h-step ahead forecast as follows:

$$\mathrm{SI} = 100 * \frac{\sum_{\mathrm{h}}^{\mathrm{H}-1} \sum_{\mathrm{i}\neq\mathrm{j}}^{\mathrm{P}} \mathrm{b}_{\mathrm{ij}}^{2}}{\sum_{\mathrm{h}}^{\mathrm{H}-1} \mathrm{trace}(\mathrm{B_h B_h^{'}})} \qquad (4)$$

Where $\mathrm{trace}(\mathrm{B_h B_h^{'}})$ is a total forecast error variation represented as the sum of $\mathrm{b}_{\mathrm{h,ii}}^{2}$; $\mathrm{b}_{\mathrm{h,ij}}^{2}$; $\mathrm{b}_{\mathrm{h,ji}}^{2}$, and $\mathrm{b}_{\mathrm{h,jj}}^{2}$. $\mathrm{b}_{\mathrm{h,i=j}}^{2}$ denotes inherent volatility shares and $\mathrm{b}_{\mathrm{h,i\neq j}}^{2}$ symbolizes a cross volatility share or a spillover value.

4. Results and Analysis

4.1. Summary Statistics

This section focuses on several important features. The summary statistics verify the observations in Figure 1 and 2. Based on the results, the EGARCH and variance decomposition models were then employed to understand the effect of the COVID-19 pandemic on the bilateral exchange rate returns, volatility, and spillover effects in Indonesia.

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DOI: 10.47291/efi.2023.06

Table 1. Summary Statistics of Variables

	Mean	Standard Deviation	Skewness	Kurtosis	JB (P-Values)	ADF	AR	ARCH
USD	0.005	0.605	0.853	9.660	0.000	-0.529***	0.255***	0.469***
EUR	0.034	0.600	0.392	6.618	0.000	-0.493***	0.137***	0.228***
JPY	0.008	0.743	0.703	8.108	0.000	-0.631***	0.088***	0.306***
CNY	0.030	0.546	0.765	9.304	0.000	-0.476***	0.239***	0.424***
SGD	0.013	0.495	0.993	10.591	0.000	-0.520***	0.243***	0.351***
GBP	0.032	0.696	0.875	9.291	0.000	-0.886***	0.035	0.281***
AUD	0.043	0.836	2.998	41.536	0.000	-1.220***	-0.220***	0.218***
TCC	0.469	0.580	1.008	2.504	0.000	-0.002	-0.531***	1.016***

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively.

Table 1 presents the summary statistics of the variables, confirming observational findings. All returns tend to depreciate. AUD reaches the highest depreciation while the smallest depreciated return is demonstrated by USD over the periods of data availability. Furthermore, AUD exhibits the most volatile return, followed by JPY and GBP. As displayed in the table, advanced economies and powerful currencies in the world, represented by USD and JPY, contribute less effects on Indonesian exchange rate returns compared to other emerging countries. This fact may be attributed to the technical perspective wherein currency comparison is based on the direct quote of Indonesian currency against other currencies.

The average daily returns of the exchange rates are not normally distributed. The distribution of returns is right asymmetric and leptokurtic with a fat tail. Tests using the Augmented Dickey-Fuller (ADF), Autoregressive (AR) (1) and Autoregressive Conditional Heteroskedasticity (ARCH) (1) indicate that exchange rate returns display stationarity, predictive abilities, and the ARCH effect. Since the returns of exchange rate have the ARCH effect with an asymmetric distribution and heavy tail, the variable is sufficient to be estimated using the EGARCH (M,N) model. Following Sharma et al. (2019) and summary statistics, the selection of Akaike, Schwarz and Hannan-Quinn Information Criterion specifies the model in the application of EGARCH (1,1).

4.2. Descriptive Analysis and Results

Responses to direct quote exchange rates in relation to the effects of the pandemic in Indonesia are varied. Table 2 block A suggests that the news of COVID-19 cases has negatively significant effects on only two pairs, IDR-JPY and IDR-CNY. Meanwhile, EUR responds positively to the outbreak announcement. Furthermore, the information on LSSR affects IDR-USD, IDR-EUR, IDR-JPY, IDR-CNY, IDR-SGD, and IDR-GBP, but excluding IDR-AUD. It implies that the COVID-19 pandemic delivers a transitory depreciation of IDR relative to foreign currencies. This pattern of returns reverses immediately as the Indonesian exchange rate market incorporates LSSR. As a result, the behavior of returns in Indonesia tends to be more responsive to pandemic-physical policy measures compared to the news of the crisis.

The heat wave effect was evident during the pandemic. Bad news in early March 2020 contributed to the increasing volatility of IDR-AUD, IDR-EUR, IDR-USD, IDR-SGD, and IDR-GBP as depicted in Table 2 block B. However, only the IDR-GBP exchange rate experiences decreasing volatile movements affected by social measures. Consistent with Figure 2, the announcement of confirmed cases leads to a declining impact on volatility for IDR-AUD, IDR-EUR, IDR-USD, IDR-SGD, and IDR-GBP. The different sign between TCC and OBA occurs due to the variation in the order of regularity over time. It results in temporary effects on great volatility. The impact of TCC in reversing the OBA event indicates that additional measures beyond distancing policies have been successfully assimilated with TCC during the period. As more information becomes available, governments are better equipped to mitigate the pandemic, hence investors will also

respond with correcting reactions in the exchange rate market.

A different pattern of cumulative effect between returns and volatility is also observed. The cumulative effect encompasses all crisis variables simultaneously to determine exchange rate movements. The result reveals that exchange rate volatility in Indonesia is relatively more affected by the unexpected event of the pandemic than exchange rate returns. No effect on returns is detected on the seven pairs of exchange rates. Meanwhile, all direct quotes except IDR-CNY experience increasing volatility. However, the crisis news has no predictive ability on the volatility of IDR-CNY. Thus, it is imperative to investigate the underlying factors contributing to the volatility pattern.

Next, behavior between currencies was taken into account. This section presents an analysis of volatility spillovers on bilateral exchange returns with Indonesian currency. Prior to discussing Table 3, a row-column decomposition was adopted as an input-output table in which the sum of rows should be equal to the sum of columns. Moreover, $\mathrm{b_{ij}}$ represents the estimated results elucidating the contribution of innovations from return i to return j.

Table 3 illustrates the spillover effects of exchange rate volatility during the pandemic. The most independent exchange rate is CNY, accounting for 74.25 percent of the innovations to its own return series. It is consistent with Table 2 that IDR-CNY exhibits an insignificant impact on the volatility from the crisis in Indonesia. On the other hand, USD is the most dependent exchange rate at 3.54 percent.

It is revealed that the gross volatility spillovers from the seven markets, when considered as directional to others (TOD), are relatively large. Meanwhile, when considered as directional from others (DFO), the column exposes that USD has the highest contribution compared to six exchange rate markets at 13.78 percent, followed by SGD (13.64 percent), EUR (10.37 percent), GBP (10.32 percent), JPY (5.36 percent), AUD (4.33 percent), and CNY (3.68 percent). Table 3 also addresses net directional volatility spillovers. Notably, the largest and smallest are AUD (28.16 percent) and USD (-13.26 percent) among others.

Interestingly, in the Indonesian market, AUD (28.16 percent) and JPY (14.47 percent) have greater influence in shaping the volatility of other currencies. In addition, the most to least affected currencies are USD, SGD, EUR, GBP, and CNY, respectively. It suggests that those five currencies are perceived as a safe-haven for investors during COVID-19.

Considering the total inter-connectedness of exchange rate volatility as the sum of varied directional spillovers, the total spillover effect reaches 61.48 percent. It indicates that throughout the sample, on average, spillovers dominate the forecast error variance of volatility. The high degree of volatility spillover also confirms the existence of the meteor shower hypothesis in the course of the COVID-19 pandemic.

The presence of a spillover effect arises from the considerable integration of the exchange rate market in Indonesia. The percentage is relatively high compared to its behavior, suggesting that the volatility on six pairs most likely is driven by spillovers. It implies that the effect of the pandemic has less magnitude in directly affecting exchange rate volatility compared to the spillovers within the market. Therefore, spillovers play an important role in the volatility of exchange rates during the pandemic crisis, unlike during the Asian financial crisis where volatility originated from financial shocks. They potentially strengthen the unpredictability of exchange rate returns which can harm macroeconomic conditions as well as trade and investment.

4.3. Robustness Test

To conduct robustness checks to examine the results in this section, the estimates were reproduced by excluding physical distancing policies (LSSR). The estimated results are presented in Table 4. The results are robust after eliminating LSSR. All signs and significance of TCC and OBA on the returns of

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DOI: 10.47291/efi.2023.06

Table 2. Coexistent Effect of the COVID-19 Pandemic on Returns and Volatility

Block A	Mean Equation							
	TCC		OBA		LSSR		Cumulative Effect	
	β_1	t-stat	β_2	t-stat	β_2	t-stat	$\sum\beta$	t-stat
USD	-3.500	-1.195	0.133	0.593	-0.312**	-2.088	-0.179	-0.671
EUR	-5.284	-1.593	0.403*	1.778	-0.232*	-1.727	0.171	0.655
JPY	-10.619***	-3.893	0.739	1.140	-0.426***	-3.309	0.314	0.476
CNY	-4.601**	-2.209	0.095	0.293	-0.371***	-4.189	-0.275	-0.821
SGD	-3.817	-1.531	0.254	1.124	-0.275**	-2.446	-0.021	-0.083
GBP	-1.467	-0.438	0.064	0.164	-0.345**	-2.141	-0.280	-0.660
AUD	-0.512	-0.116	0.285	0.848	0.007	0.043	0.292	0.780

Block B	Variance Equation							
	ϕ_1	t-stat	ϕ_2	t-stat	ϕ_3	t-stat	$\sum\phi$	t-stat
USD	-1.392*	-1.770	0.381***	6.356	-0.010	-0.706	0.372***	5.920
EUR	-2.496***	-3.990	0.410***	6.573	-0.002	-0.146	0.408***	6.303
JPY	-8.733	-1.596	0.554	1.603	0.094	1.157	0.649*	1.696
CNY	-12.974	-1.595	0.229	0.628	0.075	0.632	0.305	0.756
SGD	-3.735***	-5.028	0.365***	6.305	0.004	0.218	0.368***	5.874
GBP	-3.791***	-5.144	0.240***	3.954	-0.041***	-3.118	0.200***	3.055
AUD	-1.324*	-1.695	0.461***	8.030	-0.010	-0.586	0.451***	7.353

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively.

Table 3. Spillover Effects of Exchange Rate Volatility from EGARCH

	AUD	CNY	EUR	GBP	JPY	SGD	USD	DFO
	Spillover of OBA and LSSR							
AUD	69.72	0.86	0.04	0.80	27.49	1.08	0.02	4.33%
CNY	11.47	74.25	0.13	2.59	3.18	8.07	0.30	3.68%
EUR	45.54	0.78	27.42	0.02	24.06	0.47	1.71	10.37%
GBP	42.68	0.30	1.47	27.78	26.19	1.59	0.00	10.32%
JPY	12.69	20.40	2.42	0.72	62.46	0.42	0.90	5.36%
SGD	61.22	1.59	4.18	0.17	27.62	4.50	0.72	13.64%
USD	53.80	1.36	9.86	0.17	30.31	0.96	3.54	13.78%
TOD	32.48%	3.61%	2.59%	0.64%	19.84%	1.80%	0.52%	61.48%
Net Spillover	28.16%	-0.07%	-7.78%	-9.68%	14.47%	-11.84%	-13.26%	

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively.
DFO and TOD stand for Direction from Others and To Others' Direction

IDR-USD, IDR-EUR, IDR-JPY, IDR-CNY, IDR-SGD, IDR-GBP, and IDR-AUD remain relatively consistent with the main results. Furthermore, the predictability of volatility remains unchanged. Both TCC and the outbreak news continue to exhibit sensitivity to the volatility of returns in terms of sign and significance.

5. Conclusion

This study attempts to investigate the responses of returns and volatility spillovers across IDR-USD, IDR-EUR, IDR-JPY, IDR-CNY, IDR-SGD, IDR-GBP, and IDR-AUD during the COVID-19 pandemic by considering the number of cases, outbreak news, and periods of LSSR policies. The responses of returns vary depending on the sources of the effects of the pandemic. The unexpected event of the pandemic induced a momentary depreciation of IDR relative to seven pairs. The significant responses reverse immediately as the event of LSSR becomes assimilated with information.

Both heat wave and meteor shower hypotheses were observed respectively during the crisis in Indonesia. The decreasing pattern follows a rapid increase in volatility for IDR-AUD, IDR-EUR, IDR-USD, IDR-SGD, and IDR-GBP subsequent to the dissemination of the crisis news in the market. Compared to returns, exchange rate volatility in general is more sensitive to the crisis event. The greater

Table 4. The Impact of Confirmed Cases and News of Outbreak

Block A	Mean Equation			
	TCC		OBA	
	β_1	t-stat	β_2	t-stat
USD	-2.253	-0.801	0.165	0.710
EUR	-4.330	-1.316	0.402	1.639
JPY	-8.228***	-3.147	0.715	1.215
CNY	-3.332	-1.641	0.129	0.363
SGD	-3.029	-1.217	0.287	1.205
GBP	0.913	0.285	0.111	0.309
AUD	-0.480	-0.110	0.291	0.855

Block B	Variance Equation			
	ϕ_1	t-stat	ϕ_2	t-stat
USD	-1.301*	-1.722	0.406***	6.736
EUR	-2.511***	-4.514	0.429***	7.086
JPY	-9.250*	-1.675	0.494	1.576
CNY	-10.151	-1.583	0.240	0.864
SGD	-3.819***	-5.387	0.378***	6.306
GBP	-3.646***	-4.254	0.278***	4.412
AUD	-1.286**	-2.427	0.479***	8.480

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively.

proportion of volatility stems from the spillover effect in the Indonesian exchange rate market. It is reasonable because five out of seven currencies are perceived as a safe haven for investors. Thus, this study reveals that spillovers play a more essential part in propagating volatility since exchange rate volatility is more reactive to the effects of the pandemic compared to exchange rate returns. Since this paper has limited independent variables to non-economic factors, it is pivotal for further research to include economic policy measures of the government, as the measures can impact both exchange rate returns and volatility.

This study contributes to policy considerations regarding the exchange rate behavior of Indonesia amidst the effects caused by the COVID-19 pandemic as well as the literature on empirical studies of the COVID-19. The efficient market hypothesis in Indonesia during the global health crisis indicates the necessity to exercise caution when using the exchange rate channel to manage macroeconomic conditions in the event of a global shock in the future. Learning from the case of COVID-19, volatility spillover effects dominate the behavior of direct quotes of Indonesian exchange rates. It contributes to further less predictable returns, harming the trade and investment in Indonesia.

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