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IMPACT OF COVID-19 PANDEMIC AND MACROECONOMICS ON LONG-TERM GOVERNMENT BOND YIELDS INTEREST RATE IN EMERGING MARKETS: ARDL APPROACH⁴

This study examines the effect of the COVID-19 pandemic and macroeconomic variables on the Long-term Government Bond Yields Interest Rate. The data in this study was sourced from OECD statistical data and the World Bank with the quarterly period Q1 2016 – Q4 2023. This study used the Pooled Mean Group Autoregressive Distributed Lag (ARDL) analysis method of the data panel. The analysis results show that the COVID-19 pandemic has had a negative and significant impact on interest rates on long-term government bonds in Emerging Markets countries in the long term, indicating downward pressure in response to economic uncertainty. However, in the short term, the impact is insignificant, raising questions about other factors affecting interest rates. Rising inflation in the short run tends to increase interest rates, while the relationship between inflation and interest rates in the long run becomes more complex. Exchange rate depreciation can increase demand for long-term government bonds and interest rates in the long run, but it does not have a significant impact in the short term. The implications of these findings emphasize the need for Emerging Markets countries to take proactive action in formulating economic policies that are adaptive and responsive to rapidly changing market conditions.

Keywords: Long-term Government Bond Yields Interest Rate; COVID-19; Autoregressive Distributed Lag

JEL: E43; E44; E52

1. Introduction

The impact of the COVID-19 pandemic on the global economy has been the focus of deep attention, resulting in significant changes in various sectors of financial markets (Quandt & Wahl-Jorgensen, 2021). One of the most striking aspects affected is the interest rates on long-term government bonds in the Emerging Markets. Before the pandemic, global financial markets showed relatively stable interest rates on government bonds, but the situation

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changed dramatically with the outbreak of COVID-19 (Britchenko *et al.*, 2023). Sharp fluctuations in interest rates, mainly triggered by economic uncertainty caused by the pandemic, have been a major concern. The COVID-19 pandemic has created unexpected instability in financial markets, raising serious concerns about the long-term implications for economic growth, fiscal stability and overall financial integrity (Miranda-Agrippino *et al.*, 2015).

Emerging market countries and developing countries with lower incomes in general are particularly vulnerable to the COVID-19 pandemic. Many of these developing countries have underdeveloped public health systems, poor and financially vulnerable populations, and inadequate social safety nets. Most of them also have limited monetary and fiscal policies, and are exposed to high risks of fluctuations in global trade and commodity prices. Emerging Markets, which refers to countries with rapid economic growth rates and characteristics of dynamic financial markets, are the main subjects in research on fluctuations in interest rates on long-term government bonds during the COVID-19 pandemic period (Liu, Liu and Yan, 2020). During the pandemic, Emerging Markets are faced with more challenging challenges, as they have to deal with two aspects that have a direct impact: first, the direct impact of the pandemic on the public health sector, and second, the economic uncertainty associated with the spread of the virus. Moreover, the unique characteristics of Emerging Markets financial markets, including varying levels of liquidity, underdeveloped regulatory frameworks, and significant reliance on foreign capital, further complicate understanding and handling the dynamics of government bond interest rate fluctuations in the context at hand today (Tobal & Menna, 2020; Avino *et al.*, 2021; Koepke, 2019).

During the COVID-19 pandemic, economic shutdown policies such as lockdowns and reduced business activities have posed serious challenges to the global economy (Naseer *et al.*, 2020). These measures, although necessary to control the spread of the virus, have led to widespread disruptions in supply chains, decreased production, and decreased consumption in various countries (Yu *et al.*, 2021). The impact is felt across the board, with many sectors of the economy experiencing negative impacts, while communities face financial hardship due to job and income losses. In the midst of this situation, financial markets are also inseparable from the impact (Kot, 2022). Fluctuations in asset prices, including long-term government bonds, are becoming more frequent, while investors are responding with varying reactions to growing government policies.

The COVID-19 pandemic has caused a wave of economic uncertainty that has hit all layers of global markets, including in Emerging Market countries. In response to this condition, most countries have implemented loose monetary policies in an effort to stimulate economic growth and reduce economic pressure caused by this outbreak (Benmelech and Tzur-Ilan, 2020). In addition, the pandemic has also triggered changes in investor risk perceptions and market expectations for future economic prospects (Huber, Huber and Kirchler, 2021). This dynamic is clearly reflected in interest rate fluctuations, where high levels of uncertainty and economic instability encourage financial markets to react dynamically to news and events related to COVID-19, such as the increase in new cases, the implementation of lockdown policies, and the discovery of new virus variants (Youssef, Mokni and Ajmi, 2021).

Historically, the linkage between long-term government bond interest rates and inflation rates has been a major focus in the economic literature (Kung, 2014). Conventionally, when there is an increase in inflation, interest rates tend to rise as a measure to overcome the risk of a decrease in currency purchasing power associated with inflation (Goodfriend, 2016). However, this dynamic does not always occur consistently in complex crisis situations, such as those experienced during the COVID-19 pandemic. Significant fluctuations in economic conditions and high levels of uncertainty can create deflationary pressures that have the potential to affect interest rate policy (De Santis & Der, 2022). Therefore, it is important to understand the changes in financial markets' response to the presence of this pandemic in great depth. A careful analysis of these dynamics will help formulate appropriate policy strategies to deal with the economic challenges faced.

During the COVID-19 pandemic, exchange rates have been a very influential factor in shaping long-term interest rates in Emerging Markets. When the pandemic broke out, many countries experienced significant pressure on their exchange rates due to the economic uncertainty brought about by the spread of the virus. These changes in exchange rates create an additional level of uncertainty in financial markets, as investors and other market participants become more cautious of exchange rate fluctuations and their impact on the domestic economic situation. Changes in exchange rates also have a direct impact on investor expectations regarding the direction of monetary policy and interest rates. If a country's exchange rate depreciates, central banks tend to respond by raising interest rates to strengthen their currency and control inflation (Egilsson, 2020). Conversely, if the exchange rate strengthens, the central bank may be inclined to lower interest rates as part of an effort to stimulate economic growth (Surico, 2015). Therefore, changes in exchange rates during the COVID-19 pandemic not only affected the dynamics of the foreign exchange market, but also had a significant impact on monetary policy and interest rates in Emerging Markets.

Studies examining the effects of the COVID-19 pandemic on interest rates on long-term government bonds interest rates are important given the complexity and far-reaching impact these changes have had on the global economic landscape. The research aims to reveal how macroeconomic variables and changes caused by the pandemic affect those interest rates. The ARDL panel data analysis method used is a significant innovation because it is able to capture complex relationships between variables in various countries in one analytical framework. The literature contribution of this study lies in updating knowledge about the interaction between the COVID-19 pandemic, macroeconomic variables, and interest rates on long-term government bonds in emerging markets. The results are expected to provide valuable insights for policymakers in facing economic challenges faced during and after the pandemic, as well as enrich an understanding of global financial market dynamics. The selection of Brazil, China, India, Indonesia, and Mexico as research objects was based on their position as important representatives of emerging markets. These five countries have large economies, large populations, high growth potential, significant economic and social diversity, and good data accessibility. Therefore, this study is expected to provide a more comprehensive picture of the effects of the COVID-19 pandemic on emerging markets.

The rest of the study will be outlined as follows. Section two discusses literature review. Section three examines the data, operational variables, and methods used. The fourth section

deals with the movement of variables, results, and discussion. The fifth section discusses conclusions and suggestions.

2. Literature Review

Long-term government bond yields have been the subject of extensive research due to their pivotal role in shaping economic conditions, investment decisions, and monetary policy formulation. Research shows that several factors influence the yield on long-term government bonds. Traditional determinants include inflation expectations, economic growth prospects, fiscal policy stance, and central bank policy actions (Akram and Das, 2015). Moreover, market sentiment, risk fear, and global economic trends have emerged as significant determinants, especially in the post-financial crisis era (Shahzad *et al.*, 2017). Moreover, unconventional monetary policy, such as quantitative easing, has confused the lines between traditional determinants, causing a complex interaction in yield dynamics (Cecioni, Ferrero and Secchi, 2019).

Long-term government bond yields exhibit dynamic behaviour influenced by both macroeconomic fundamentals and market expectations. Studies using time series econometrics techniques highlight the nature of persistence and return to mean results, showing a delicate balance between short-term fluctuations and long-term trends (Bauer and Rudebusch, 2014). In addition, the structure of the yield curve, the slope of the yield curve, and the dynamics of yield difference provide valuable insights into investor expectations regarding future economic conditions and policy actions (Leippold and Matthys, 2022).

The relationship between macroeconomic variables and bond interest rates has long been a subject of interest in economic research. Experts have explored how factors such as inflation, economic growth, monetary policy, and fiscal policy affect interest rates on long-term government bonds (Friedman, 1980; Kung, 2015). Most importantly, Mankiw & Goldfeld (1986) introduced the concept of "interest rate structure," highlighting the sensitivity of bond interest rates to expectations about future economic conditions.

The emergence of COVID-19 has triggered significant volatility and uncertainty in financial markets globally (Ali, Alam and Rizvi, 2020). Many studies have examined the direct and ongoing impact of the pandemic on a wide range of financial assets, including bonds. For example, Dia *et al.*, (2022) found that the pandemic caused asset hedging, resulting in lower long-term government bond interest rates in many countries as investors sought to hedge assets amid economic turmoil.

The COVID-19 pandemic has disrupted various macroeconomic indicators, including GDP growth, inflation, unemployment rate, and fiscal deficit (Jawad & Naz, 2023; Zubíková, 2022; Sarıışık & Usta, 2021). Researchers have investigated the transmission mechanisms by which the pandemic affected these variables and, consequently, bond interest rates. For example, Baldwin and Weder di Mauro (2020) emphasize the importance of supply chain disruptions, changes in consumer behaviour, and government responses in shaping macroeconomic outcomes during the pandemic (Barua, 2020; Ajmal *et al.*, 2021).

Several empirical studies have examined the relationship between COVID-19, macroeconomic variables, and bond interest rates, albeit with varying findings. For example, Yin et al., (2022) conducted a cross-border analysis and found that the impact of COVID-19 on long-term government bond rates varied depending on factors such as the severity of the outbreak, the effectiveness of policy responses, and previous economic conditions.

In conclusion, the literature on long-term government bond yields emphasizes the multifaceted nature of this crucial financial variable. Determinants such as inflation, economic growth, policy actions, and market sentiment interact dynamically to influence the movement of results. However, it is also important to note that external factors such as the COVID-19 pandemic have had a significant impact on the dynamics of long-term government bond yields. The pandemic has disrupted the global economy, triggered extraordinary monetary and fiscal policy actions, and changed market expectations for inflation, growth, and risks. Understanding the impact of the COVID-19 pandemic on government bond yields has become essential for policymakers, investors, and market participants in navigating these unforeseen economic challenges, formulating responsive policies, and managing the risks associated with interest rate fluctuations.

3. Research Method

This study examines the effects of the COVID-19 pandemic, inflation, and long-term government bond yields Interest Rate. The data used is in the form of panel data from five emerging market countries (India, Indonesia, Brazil, Mexico, and China) with a monthly period of 2017-2023. The period from January 2017 to December 2019 was chosen as the period before the COVID-19 pandemic to allow analysis of economic conditions before the significant impact of the pandemic. Next, the period from January 2020 to December 2023 is used to analyse the direct impact of the COVID-19 pandemic. The data used is sourced from OECD statistical data and the World Bank. Table 2 presents operational definitions for the variables used in the study.

In this study, two approaches are used, namely qualitative and quantitative approaches. The qualitative approach involves analysing the trend of movement of variables. This research uses the Autoregressive Distributed Lag (ARDL) estimation approach to estimate the short and long-term effects of the COVID-19 dummy, inflation rate, and exchange rate on long-term government bond interest rates. In panel data analysis using the ARDL method, the Pooled Mean Group (PMG) type has advantages in the efficient use of panel data, handling heterogeneity between units, estimation efficiency, and handling data stationarity problems. The study also integrated fixed effects in the ARDL model, which made it possible to consider fixed differences between units in the analysis. With this combination, a PMG approach with a fixed effect on ARDL can provide a more reliable and accurate estimation of the relationship between variables in panel data analysis.

Table 1. Variable Operational Definition

Variable	Definition	Unit	Data Sources
Long-term government bond yields Interest Rate (LTIR)	Long-term interest rates denote the yields of government bonds reaching maturity over a span of ten years. These rates are predominantly influenced by the lender's-imposed fees, the perceived risk associated with the borrower, and the depreciation of invested capital. Typically, long-term interest rates represent the mean of daily interest rates, quantified as a percentage.	Total, % per annum	OECD data
COVID-19 (DCOV)	The value 1 is used for situations during COVID-19, while 0 refers to conditions before the COVID-19 pandemic.	Dummy	Our world in data
Inflation (INF)	In this study, inflation is proxied using the Consumer Price Index (CPI). CPI is a price measurement tool that determines the average price of goods and services used by households.	Consumer Prices, Percentage change on the same period of the previous year	OECD data
Exchange Rate (EXR)	Comparison between the value of a country's currency (national currency) against the United States Dollar (USD).	National currency per US Dollar	OECD data

Source: Author Compilations, (2024).

Equation of function to see the influence of various variables that can affect Long-term government bond yields Interest Rate:

$$LTIR_{it} = \alpha_0 + \alpha_1 DCOV_{it} + \alpha_2 INF_{it} + \alpha_3 EXR_{it} + e_{it} \quad (1)$$

Where:

$LTIR_{it}$ is Long-term government bond yields Interest Rate; DCOV is dummy COVID-19; INF is inflationary; EXR is the exchange rate.

Meanwhile, the ARDL bound test model equation from equation 1 is reformulated in equation 2.

$$\Delta LTIR_{it} = \gamma_0 + \alpha_0 DCOV_{it-1} + \alpha_1 INF_{it} + \alpha_2 EXR_{it} + \sum_{i=1}^n \rho_0 \Delta LTIR_{it-1} + \sum_{i=1}^n \rho_1 \Delta DCOV_{it-1} + \sum_{i=1}^n \rho_2 \Delta INF_{it-1} + \sum_{i=1}^n \rho_3 \Delta EXR_{it-1} \quad (2)$$

In the ARDL model equation shown in equation 5 t is the period describing the long-term and short-term responses, α , e is the error, β_0 , β_1 , β_2 are the coefficients of the variable in the long run, α_0 , α_1 , α_2 is the coefficient of the variable in the short term, ECT is the residue obtained from the cointegration of estimates in which different equations are shown in equation (3).

$$\Delta LTIR_{it} = \vartheta_0 + \sum_{i=1}^n \gamma_{0i} \Delta DCOV_{it-1} + \sum_{i=1}^n \gamma_{1i} \Delta INF_{it-1} + \sum_{i=1}^n \gamma_{2i} \Delta EXR_{it-1} + \sum_{i=1}^n \gamma_{3i} \Delta LTIR_{it-1} + \delta ect_{it-1} \quad (3)$$

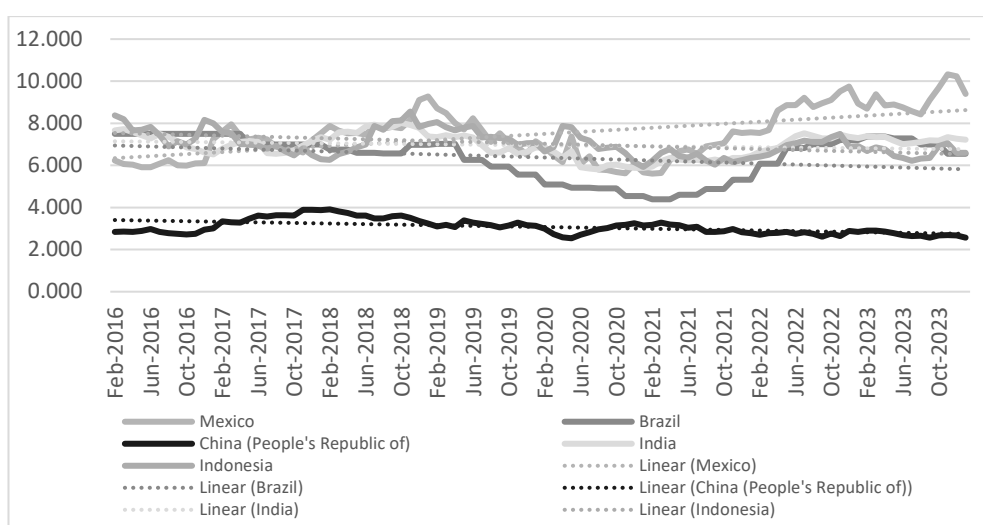
Where ϑ_0 represents the parameter coefficients, with γ_{0i} , γ_{1i} , ..., γ_{4i} , is the effect in the short term. The coefficient for the term error correction is described by a δ notation that will show a measure of how quickly the imbalance is corrected in the next period to reach an equilibrium point, the value of this coefficient is theoretically significant and negative. ECT-1 is a measure of the imbalance in period $t-1$ listed in equation 3.

4. Research Method

4.1. Analysis of Long-term Government Bond Yields Interest Rate Variable Movements

From Figure 2, it can be seen that Mexico tends to have the highest Long-term Government Bond Yields Interest Rate among China, Brazil, India, and Indonesia. This signals that investors may demand higher yields to invest their funds in long-term government bonds from Mexico compared to other countries in the same group. Meanwhile, China showed the lowest Long-term Government Bond Yield Interest Rate, suggesting that investors may be more satisfied with lower yields for China's long-term government bonds.

Figure 2. Long-term Government Bond Yields Interest Rate in Emerging Markets



Source: OECD, (2024).

COVID-19 roiled financial markets in early 2020. Investors are shifting from riskier assets to safer assets due to economic uncertainty. This leads to an increase in market interest rates, especially long-term rates, which affects the valuation of domestic assets and becomes important for market participants and policymakers. The impact of COVID-19 on sovereign bonds in developing countries varies, creating variations in domestic asset evaluations (Janus, 2021). During the COVID-19 period, especially in early 2021, there was an increase in interest rates in almost all countries, except China. This fact is interesting because China has a different monetary policy than most other countries. China has implemented aggressive monetary policies, including direct intervention from its central bank, to maintain economic stability in the face of the impact of COVID-19. In 2020, China adjusted its monetary policy in response to the COVID-19 pandemic. Such measures include a reduction in the policy rate, the implementation of new long-term refinancing operations, quantitative easing, and a reduction in the reserve requirement ratio. This action was taken to stimulate the economy affected by the pandemic (Wei and Han, 2021).

During the COVID-19 pandemic, many countries, including Mexico, Brazil, China, India, and Indonesia, implemented monetary and fiscal policies to address the economic impact generated by the global health crisis (Sarker, 2020). The Central Bank of Mexico, Banco de México, uses monetary policy instruments to maintain financial market stability, such as interest rate cuts to stimulate economic activity (Battilossi, 2019). The government is also involved in implementing fiscal stimulus measures to support economic growth. Something similar happened in Brazil, where Banco Central do Brasil regulates monetary policy while the government carries out fiscal stimulus measures to cope with the impact of the pandemic on the economy. In China, the People's Bank of China sets monetary policies that support economic growth and financial market stability, while the government takes fiscal measures to promote economic recovery (Wang *et al.*, 2023). In India, the Reserve Bank of India takes a role in monetary policy, while the government uses fiscal measures to maintain economic stability (Two, 2020). In Indonesia, Bank Indonesia regulates interest rates with monetary policy, while the government implements fiscal and other policy stimuli to overcome the impact of the COVID-19 pandemic and maintain economic stability. During the COVID-19 pandemic, Mexico experienced an increase in interest rates on long-term government bond yields. In fact, bond portfolio outflows from emerging market countries such as Mexico are often linked to the depreciation of the domestic currency. This increase in interest rates was also influenced by significant uncertainty in global financial markets, where emerging economies such as Mexico are considered to have higher risks, prompting investors to ask for higher yields to compensate for the risks taken. The Central Bank of Mexico can also influence interest rates with monetary policy measures, such as adjustments to benchmark interest rates in response to inflation or currency instability.

4.2. Analysis of Inflation Variable Movements

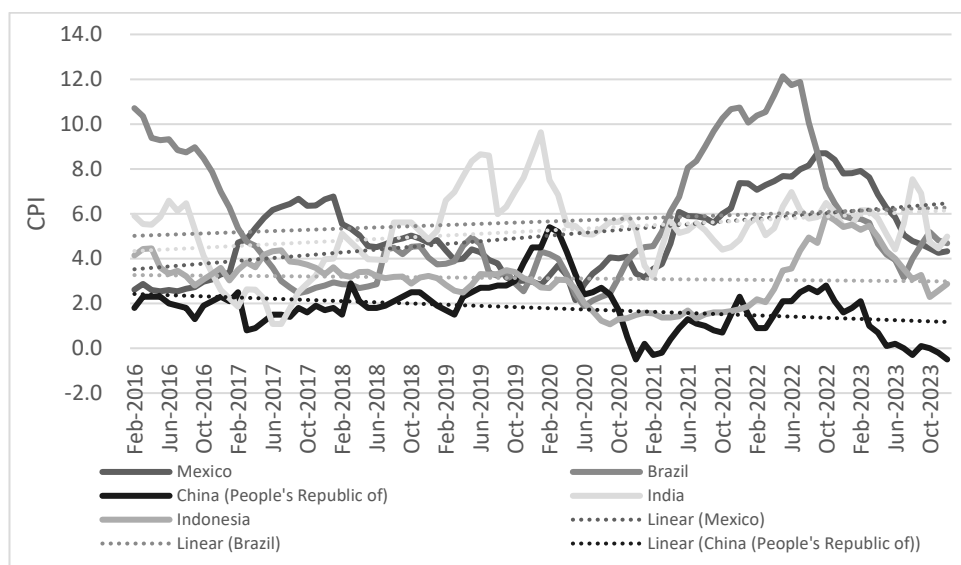
During the COVID-19 pandemic, emerging market countries have faced mixed inflation challenges. During the COVID-19 pandemic, Brazil faced the challenge of high inflation, peaking at around 12.1 per cent in May 2021. The Central Bank of Brazil, known as Banco Central do Brasil, responded by taking measures to control inflation while responding to the economic slowdown that occurred due to the pandemic. Measures taken include interest rate adjustments, in which central banks increase interest rates to reduce demand for credit and investment, which in turn can help curb inflation. In addition, fiscal intervention is also carried out by the Brazilian government to maintain price stability and stimulate economic growth (Araujo, Araujo and Ferrari-filho, 2022).

In China, which had a relatively low inflation rate before the pandemic, efforts were made to maintain a stable inflation rate during COVID-19. China's Central Bank, known as the People's Bank of China (PBOC), is focused on economic stimulus and policy reforms to drive stronger growth in the face of the impact of COVID-19 (Funke and Tsang, 2020). Measures such as the provision of additional liquidity to financial markets and support to key sectors of the economy have been taken to maintain price stability and support growth.

In India, fluctuations in inflation during the COVID-19 pandemic have posed a challenge for the Reserve Bank of India in keeping inflation under control while stimulating economic growth. The RBI adjusts interest rates and provides additional liquidity to financial markets

to ensure adequate credit availability, but also to prevent runaway spikes in inflation. Loose monetary policy has been implemented to stimulate investment and consumption, while taking into account price stability (Two, 2020).

Figure 3. Inflation in Emerging Markets



Source: OECD, 2024.

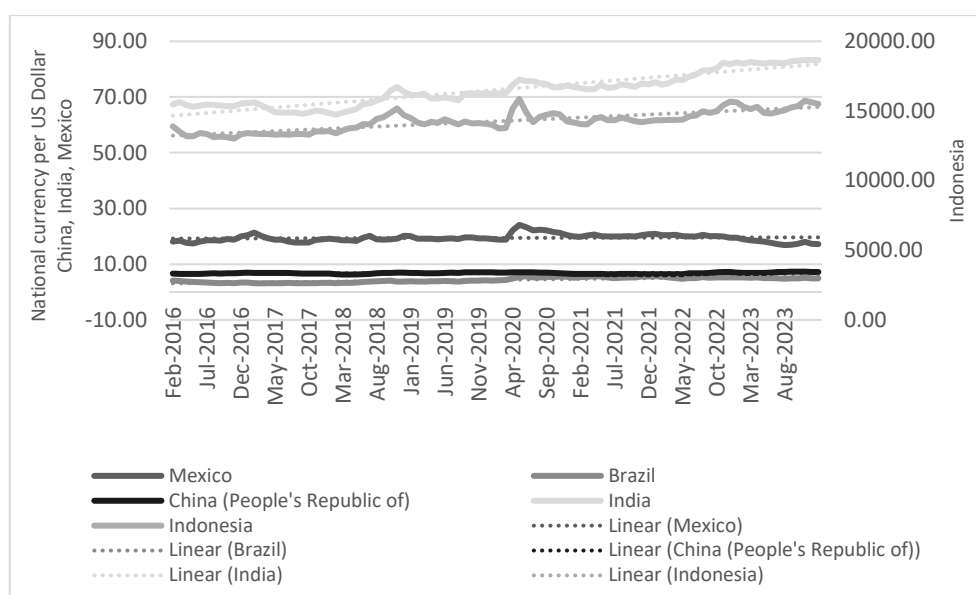
Bank Indonesia strives to keep inflation under control during the COVID-19 pandemic by adopting a monetary policy that supports economic growth. Interest rate cuts have been made to stimulate investment and consumption, as well as to reduce the burden of interest payments for entrepreneurs and society (Siregar, Gunawan and Saputro, 2021). Bank Indonesia also continues to monitor price stability and intervene if necessary to prevent a significant spike in inflation. In Mexico, the Central Bank of Mexico is facing the challenge of rising inflation during the COVID-19 pandemic. Banxico has set strict policies, including raising interest rates, to curb inflation and maintain price stability. In addition, Banxico also pays attention to external factors such as currency exchange rates and commodity prices that can affect inflation in the country (Mbah, Hultquist and Repp, 2023).

4.3. Analysis of Exchange Rate Variable Movements

Exchange rate movements against the United States dollar (USD) in emerging markets show significant variations, as illustrated in Figure 4. In the Figure, it can be seen that exchange rates in emerging markets tend to depreciate against the USD. It can be seen that in April 2020 emerging market countries experienced significant fluctuations in exchange rates. In particular, countries such as Indonesia and India showed the highest depreciation rates, illustrating a stronger dynamic in the decline in the value of their currencies against the US

dollar. According to research by Aimer, (2021), India's exchange rate during the COVID-19 pandemic was affected by economic policy uncertainty (EPU) and market volatility (VIX). During the pandemic, there was a positive relationship between the EPU and the Indian rupee exchange rate. The impact of market volatility is more significant than policy uncertainty. In addition, India's exchange rate tends to depreciate, which shows a rapid response to changing market conditions during the pandemic. The Indonesian rupiah exchange rate during the COVID-19 pandemic experienced pressure due to economic uncertainty and public concern. The measures taken in response to this pandemic have weakened the economic sector, which is reflected in the decline in the inflation rate. Social distancing and work-from-home policies have also reduced demand for goods and services as well as purchasing power, production and income. Bank Indonesia lowered interest rates as part of efforts to support the national economic recovery. In addition, the money supply also has an important role in the stability of the rupiah exchange rate against the US dollar (Rahayu, 2023). All of this shows that economic factors and pandemic-related policies significantly affect the Indonesian rupiah exchange rate.

Figure 4. Exchange Rate Emerging Markets



Source: OECD, 2024.

On the other hand, China and Brazil show different patterns, where they tend to experience more stable depreciation and flatter trends. Despite the depreciation, exchange rate movements in China and Brazil were not as strong as those seen in Indonesia and India. This indicates variations in market responses to economic and policy factors that affect exchange rates in each of these developing countries. The RMB (Chinese yuan) exchange rate during the COVID-19 pandemic showed relatively higher stability compared to other currencies. Research by Feng et al., (2021) shows that, although the pandemic has caused significant

fluctuations in global currency exchange rates, the RMB has experienced lower fluctuations compared to other major currencies such as EUR, GBP, and JPY. This is due to the strong early control measures of the Chinese government to prevent the spread of the pandemic, which helped maintain the stability of the RMB exchange rate. During the COVID-19 pandemic, Brazil's exchange rate movements showed stability despite fluctuations in the stock market. Despite the stock market decline at the beginning of the panic, the Brazilian real exchange rate remained stable, hovering around \$1 = 5.2 in May 2021. Although the ten-year bond yield fell from 9.84% in March 2020 to 6.8% in August 2020, it rose again to around 9% in May 2021 as Brazil reduced its stimulus. Thus, despite the turmoil in the stock market, Brazil's exchange rate remained relatively stable during the period of the COVID-19 pandemic (Yilanci, 2023).

4.4. Unit Root Test

Tests regarding variable stationarity in this study were carried out using the Augmented Dickey-Fuller test (ADF test) and the Phillips-Perron test, and the results are recorded in Table 3. It can be seen that the test results using both methods consistently show that the dependent variable, namely Long-term government bond yields Interest Rate, shows stationary properties in the first order I (1). Meanwhile, independent variables such as DCOV, INF, and EXR also exhibit stationary properties in the first order or first difference I (1). The results show that all these variables are relevant and have met the initial stage in the ARDL model estimation procedure.

Table 3. Unit Root Test

Variable	Augmented Dickey Fuller		Phillips-Perron		Decision
	level	1st difference	level	1st difference	
LTIR	10.4375	97.9248	13.1206	160.149	I (1)
	0.4030	0.0000	0.2170	0.0000	
INF	14.7309	97.8268	13.4591	165.115	I (1)
	0.1422	0.0000	0.1991	0.0000	
EXR	8.9252	126.117	7.3871	151.713	I (1)
	0.5392	0.0000	0.6885	0.0000	

Source: Author, data processed (2024).

4.5. Cointegration Test

The results of cointegration testing using the Johansen-Fisher Panel method show significant evidence to reject the hypothesis that there is no cointegration between the variables tested (Table 4). The trace test shows that at a significance level of 0.05, Fisher's statistical value is 27.23 for the hypothesis that there is no cointegration (None), with a probability of 0.0024. This shows strong evidence to refute the hypothesis that there is no cointegration. In addition, the maximum eigenvalue test gave similar results, albeit with a slightly higher level of significance, with a Fisher statistical value of 16.39 and a probability of 0.0889. However, when considering the hypothesis that there is a maximum of one cointegration relation (At most 1), the probability values associated with both tests are above the significance level of 0.05.

Table 4. Cointegration Test

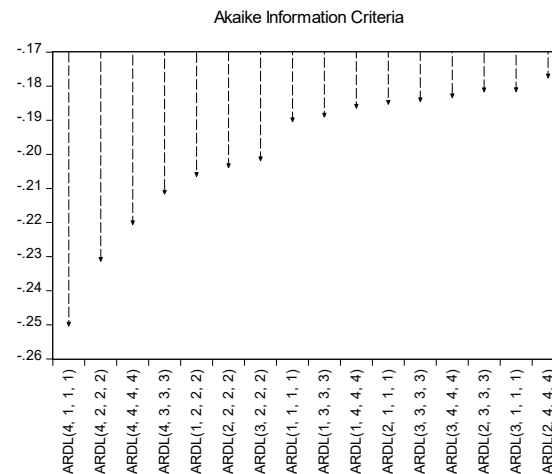
Hypothesized	Fisher Stat.*		Fisher Stat.*	
No. of CE(s)	(from trace test)	Prob.	(from max-eigen test)	Prob.
None	27.23	0.0024	16.39	0.0889
At most 1	16.87	0.0774	15.24	0.1235
At most 2	7.893	0.6393	7.527	0.6750
At most 3	9.358	0.4985	9.358	0.4985

Source: Author, data processed (2024).

4.6. Lag Optimum Selection

The most optimal lag length for the variables in this study was determined using the Akaike Information Criteria (AIC), described in detail in Figure 5. The maximum lag length selected is 4, 1, 1, 1 for various variables.

Figure 5. Lag Optimum Selection



Source: Author, data processed (2024).

4.7. Short and Long-Run Estimation Results

This analysis reflects the results of the Autoregressive Distributed Lag (ARDL) model used to analyse the relationship between short-term and long-term interest rates with several economic factors that may influence them. In this result, there are two parts: analysis for the short term and analysis for the long run.

In the ARDL Panel model with cointegrated lag, the main assumption is that the coefficient of the cointegrating variable has a significant negative slope at a confidence level of 5%. Based on Table 5, showing that the COINTEQ01 value is -0.10192 with a negative and significant slope at alpha below 5 per cent, indicating that the accepted ARDL panel model is a cointegrated lag model.

Table 5. Short and Long-Run ARDL Estimation

Short Run			
Variable	Coef.	Std. Error	t-Stat.
COINTEQ01	-0.101922***	0.029958	-3.402148
Δ (LTIR)	0.144171**	0.126584	1.138941
Δ (DCOV)	0.186364*	0.106495	1.749985
Δ (INF)	0.010818*	0.023570	0.458970
Δ (EXR)	-0.025170	0.065620	-0.383576
C	0.578958***	0.154604	3.744786
Long Run			
DCOV	-0.574392***	0.145060	-3.959678
INF	-0.014752	0.054944	-0.268488
EXR	0.000103**	0.000217	0.476632
Diagnostic Tests			
	F-stat.		Prob.
Normality Test	213.3391		0.5564
Multicollinearity	INF	EXR	DCOV
INF	0.00301	-1.02739	0.00144
EXR	-1.02739	4.69258	-1.18842
DCOV	0.00144	-1.18842	0.02104

Note: *, **, and *** indicate the level of significance at the level of 10%, 5% and 1%

Source: Author, data processed (2024).

In the long run, the variables DCOV (dummy COVID-19) and INF (inflation rate) affect long-term interest rates (GDP) in the long run. The DCOV coefficient of -0.574392 indicates that the COVID-19 pandemic has had a significant negative impact on long-term interest rates. This indicates that with the COVID-19 pandemic, long-term interest rates tend to be lower compared to situations without the pandemic. In other words, financial markets and the economy reacted to the uncertainty and instability caused by the pandemic, leading to a reduction in long-term interest rates. On the other hand, the INF coefficient (inflation rate) is -0.014752 and is insignificant in the long run. This suggests that the inflation rate does not have a significant influence on long-run interest rates in the context of this model. Although inflation in general is an important factor in determining interest rates, in the context of the Covid-19 pandemic, it seems that other factors such as economic uncertainty caused by the pandemic have a more significant impact on long-term interest rate movements.

Based on Table 6, it can be seen that the results of the cross-section show the impact of several variables on interest rates on long-term government bond yields in several countries. Changes in inflation three periods ago had a positive impact on interest rates on government bonds. This suggests that rising inflation is prompting central banks to raise interest rates to contain inflation, which then increases interest rates on government bonds. Inflation in Brazil, Indonesia, and Mexico has a positive and significant effect on interest rates on long-term government bond yields, while inflation in China and India has a negative effect. The appreciation of the country's currency against the US dollar also led to a decrease in interest rates on government bonds. This may be because foreign investors' purchasing power of government bonds increases with currency appreciation, lowering demand and interest rates. Exchange rates in Brazil, India and Mexico have a negative and significant effect on government bond yields, while Indonesia has a positive and significant effect. In addition,

the presence of the COVID-19 pandemic increased interest rates on government bonds, possibly due to increased demand for assets considered safer in uncertainty. The dummy variable COVID-19 only has a significant effect in Brazil in a positive direction.

Table 6. Cross Section Short-Run Coefficients

Variable	Coefficient (t- statistic)				
	Brazil	China	Indonesia	India	Mexico
COINTEQ01	-0.0588 (-171.6233)***	-0.1222 (-46.7543)***	-0.0798 (-77.6203)***	-0.0692 (-32.4447)***	-0.0383 (-82.5730)***
D(INF(-3))	0.0366 (3.7495)**	-0.0416 (-3.6856)**	0.3658 (40.7386)***	-0.1583 (-15.8432)***	0.0842 (8.1915)***
D(EXR)	-0.6505 (-6.8496)***	-0.1625 (-4567)	0.0001 (80.1472)***	-0.0760 (-10.2801)***	-0.0665 (-13.4112)***
D(DCOV)	0.5692 (2.4464)*	0.2529 (0.9371)	-0.1732 (-1.7473)	1.1096 (2.1545)	-0.1671 (-1.0041)
D(LTIR)	0.51954 (7.1701)***	0.1173 (0.5458)	0.0751 (5.1500)**	0.9449 (5.4712)**	-0.0901 (-8.2939)***
C	0.5567 (7.6591)***	0.4720 (4.0723)**	0.6715 (1.1990)	0.6642 (2.4784)*	0.4007 (9.6675)***

Note: *, **, and *** indicate the level of significance at the level of 10%, 5% and 1%

Source: Eviews, data processed, (2024).

4.8. Discussion

4.8.1. The Effect of COVID-19 on Long-term Government Bond Yield Interest Rate in Emerging Markets

Analysis of the estimation results revealed interesting findings related to the impact of the COVID-19 dummy variable on Long-term government bond yield Interest Rates in Emerging Markets. In the short term, COVID-19 has had a positive and significant effect, which means that the presence of this pandemic increases interest rates on long-term government bonds in emerging markets. These results are in line with Yilanci, (2023) which concluded COVID-19 did not cause any change in the exchange rate, but showed a slight increase in government bond yields starting in 2021 onwards. However, in the long run, the impact has been negative and significant, suggesting that over time, markets began to respond counterintuitively to this pandemic, with long-term government bond rates falling in those markets. These findings indicate that the short- and long-term effects of COVID-19 on government bond rates in emerging markets have different dynamics, which could influence future investment decisions and economic policies.

The COVID-19 pandemic situation has had a significant impact on financial markets in developing countries, including China, India, Indonesia, Brazil and Mexico. Business closures and social distancing restrictions implemented by the government in response to the pandemic have caused widespread economic disruption, including in the financial sector. At the start of the pandemic, there was significant uncertainty in emerging market financial markets. The global economic downturn and anticipated recession triggered tensions in the long-term government bond market. Countries such as China, India, Indonesia, Brazil, and Mexico, which were sampled in the study, experienced significant volatility in interest rates

on their long-term government bonds. Business closures and social distancing restrictions imposed by those countries to control the spread of the virus have created economic uncertainty. In China, for example, lockdowns in several key regions have slowed economic activity, resulting in pressure on financial markets and raised interest rates on long-term government bonds. Meanwhile, India, experiencing a severe wave of COVID-19 cases, was forced to impose tighter restrictions, causing a significant decline in economic performance and increasing interest rates on long-term government bonds. In Indonesia, restrictive policies implemented in an effort to suppress the spread of the virus have also had an impact on financial markets. Although Bank Indonesia has taken monetary policy measures to maintain stability, economic uncertainty resulting from the pandemic has affected interest rates on long-term government bonds. Brazil and Mexico have also not escaped the impact of the pandemic on their financial markets. Both countries face similar challenges in coping with economic uncertainty caused by the pandemic, which affects interest rates on their long-term government bonds. These results are in line with findings by Amstad et al., (2020); Jawad & Naz, 2023).

The response of government bond markets in developing countries to the COVID-19 pandemic is due to several factors. When the pandemic began to take hold in early 2020, global financial markets experienced turmoil, with investors shifting from riskier assets to safer assets. This led to an increase in market interest rates, particularly long-term interest rates, which are considered an important indicator by market participants and policymakers. However, bond market responses in emerging economies are not uniform, and this may be influenced by specific factors applicable in each country. Moreover, since before, bond markets in emerging economies have been seen as vulnerable to the influence of outside factors, as happened with the taper tantrum in 2013, where the Federal Reserve's actions triggered a sell-off in important bond markets. Recent studies have also shown that developing countries tend to be more vulnerable to capital outflows and sovereign bond yields are more affected than stock or foreign exchange markets. However, there is no clear pattern in the relationship between pre-crisis interest rates and changes in interest rates after the COVID-19 pandemic, suggesting that there are other factors influencing bond market responses in emerging economies to the pandemic.

4.8.2. Effects of Inflation on Long-term Government Bond Yield Interest Rate in Emerging Markets

In the short run, variable inflation shows a positive and significant influence on interest rates on long-term government bonds, while in the long run, it shows a negative but not significant influence. During the period before and during the COVID-19 pandemic, the relationship between inflation and interest rates on long-term government bonds in Emerging Markets became highly relevant and complex. Before the pandemic, this relationship could be understood in the context of traditional macroeconomic factors such as monetary policy, economic growth, and inflation expectations. However, when the pandemic hit, market dynamics changed dramatically, affecting the way these relationships were interpreted and impacting monetary policy and investment decisions. During the early days of the pandemic, there was a sharp decline in economic growth, which triggered an overwhelming fiscal and monetary policy response from central banks and governments. This massive stimulus aims

to cushion the negative impact of the pandemic on the economy, but often raises concerns about the potential for higher inflation in the future. In this situation, investors may demand higher yields on government bonds in lieu of rising inflation risks, leading to an increase in interest rates on long-term government bonds in the short term. However, as the pandemic continues, the effects of that stimulus and structural changes in the economy could affect the relationship between inflation and interest rates in the long run. For example, stimulus-induced increases in economic growth and increased productivity could bring inflation expectations back to more stable levels, easing pressure on interest rates on long-term government bonds.

Inflation conditions in emerging markets affect the Long-term government bond yield Interest Rate through several channels. First, the COVID-19 pandemic has caused significant uncertainty in the global economy. This uncertainty has weakened monetary policy transmission to inflation, so central banks in many emerging market countries have responded with loose monetary policies to stimulate economic growth and stabilize credit and output. This rapid response, coloured by extraordinary gatherings and unconventional measures, is often taken within a short time after the first COVID-19 case is recorded in a country. Second, structural changes in central bank institutional settings in emerging markets over the past few decades have reduced the risk of large and persistent monetary easing that could lead to a significant increase in inflation. Many emerging market countries have adopted inflation-targeting frameworks and strengthened the independence of their central banks, which has helped strengthen inflation expectations. As a result, central banks in emerging markets no longer need to keep policy rates high during crises like COVID-19. In addition, the nature of the COVID-19 crisis and policy responses from advanced economies have given central banks in emerging markets greater scope to ease policy. The pandemic has reduced economic activity abruptly and synchronized in both developed and developing countries, leading to a significant decline in inflation in 2020 in many emerging market countries. The decline was due to a decline in consumer spending and because many emerging market countries entered the crisis with output below its potential. Therefore, the COVID-19 pandemic has created conditions where central banks in EM have greater scope to lower interest rates on long-term government bonds in an effort to stimulate economic growth and stabilize financial markets. This result is supported by arguments by (Pordeli, Schofer and Sutton, 2021); (Niedźwiedzińska, 2021); (Prabheesh and Indonesia, 2021).

4.8.3. Exchange Rate Effect on Long-term Government Bond Yield Interest Rate in Emerging Markets

The ARDL results show that in the period before and during COVID-19, exchange rate variables affected the Long-term government bond yield Interest Rate in Emerging Markets in different ways according to the time period. In the long run, the exchange rate has a positive influence on the Long-term government bond yield Interest Rate. This suggests that currency depreciation could fuel higher inflation expectations, which in turn drives up interest rates on long-term government bonds. However, in the short term, the effect of exchange rates on long-term government bond rates becomes negative and insignificant. This suggests that in the short term, other factors, such as central bank monetary policy or rapid changes in global

economic conditions triggered by COVID-19, may dominate financial markets. These results are supported by research by Turner, (2014); Engel, (2016); and Jotikasthira et al., (2015).

Uncertainty stemming from the COVID-19 pandemic has induced sudden fluctuations in the exchange rates of emerging market countries (Xu and Lien, 2022). Unlike developed countries that do not experience significant changes in their currency exchange rates, developing countries feel a greater impact (Zhou *et al.*, 2021). Policy responses from governments and central banks are key factors in responding to these exchange rate changes. Expansionary fiscal policy or unconventional monetary policy can reduce the pressure of exchange rate decline due to COVID-19. However, conventional expansionary monetary policy may actually exacerbate the depreciation of the local currency. Therefore, exchange rate conditions in emerging market countries are strongly influenced by policy responses taken as well as complex domestic and global economic conditions.

Currency exchange rates in China, Brazil and India are influenced by unique factors. In China, events such as oil price discount offers from Saudi authorities affect the Yuan exchange rate. In Brazil, fluctuations in crude oil prices and factors such as interest rates have an impact on the Brazilian Real exchange rate. While in India, factors such as macroeconomic uncertainty also play an important role in determining the value of the Indian Rupee (Lin and Su, 2020). However, although currency exchange rates can fluctuate significantly, their effect on interest rates on long-term government bonds may not be significant. This is due to the presence of other factors that are more dominant in determining interest rates, such as central bank monetary policy or overall domestic economic conditions. In addition, the effect of exchange rates on interest rates on long-term government bonds can also be muted by government or central bank intervention in financial markets to maintain the country's economic and financial stability.

5. Conclusion

The conclusions of this analysis suggest that the impact of COVID-19 on long-term government bond rates in emerging markets, as seen in countries such as China, India, Indonesia, Brazil and Mexico, is a complex and dynamically evolving phenomenon. In the short term, the pandemic led to an increase in interest rates, which was in response to emerging economic uncertainty across the country. For example, in India, a severe increase in COVID-19 cases forced the government to impose strict restrictions, resulting in a significant decline in economic performance and increasing interest rates on long-term government bonds. In Mexico, business closures and social distancing restrictions have led to widespread economic uncertainty, which is reflected in rising interest rates on long-term government bonds. However, in the long run, there was a reduction in interest rates, indicating that the market began to adjust to the dynamics of the pandemic, by lowering interest rates as a form of adaptation to changing global economic conditions. This is reflected in the policy responses carried out by central banks and governments in each country, such as interest rate adjustments and fiscal stimuli implemented to stimulate economic growth and stabilize financial markets. The policy implications of these findings underscore the need for responsive, collaborative, and adaptive policy responses among

emerging market countries. In facing these challenges, strong economic policy coordination is needed, both at the regional and global levels, to mitigate the negative impact of the COVID-19 pandemic on global financial markets and strengthen economic resilience in developing countries.

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