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DETERMINANTS OF INDONESIAN GOVERNMENT BOND YIELD

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Abstract:

Background: The COVID-19 pandemic significantly impacted the bond market in early 2020. As the pandemic unfolded, there was a surge in uncertainty and risk aversion among investors. One of the important factors used by investors when buying or investing in government bond instruments is the yield. Although considered a relatively risk-free alternative due to government guarantees, government bonds have other risks influenced by factors outside the bonds themselves. These factors include domestic and international economic conditions such as exchange rate risk, domestic and international interest rate risk, and other global events like the COVID-19 pandemic.
Purpose: This research aims to analyze the factors affecting the yield of Indonesian government bonds with maturities of 5, 10, and 30 This research was conducted to identify factors that influence government bond yields using a symmetric approach with the ARDL model.
Design/methodology/approach: This research was conducted to identify factors that influence government bond yields using a symmetric approach using the Autoregressive Distributed Lag (ARDL) model. These factors included the short-term interest rate, consumer price index, industrial production index, exchange rate, BI rate, stock price index, foreign exchange reserves, the Fed rate, the world oil price and US bond yields.
Findings/Result: The industrial production index was found to have a significant negative effect on yields, while the stock price index was found to have a significant positive effect. There was no significant long-term effect of world oil prices on yields; the effect was only present in the short term. The COVID-19 pandemic significantly impacted yields in the short term. The impact of the COVID-19 pandemic on bond yields is related to the perception of risk regarding a country's economic uncertainty.
Conclusion: Indonesian government bond yields in the long term were influenced by almost all observed variables, except for world oil prices. The impact of world oil prices and the COVID-19 pandemic was found to occur only in the short term. Foreign exchange reserves were the main factor affecting 5-year bond yields, while the exchange rate was the primary factor influencing the yields of 10- and 30-year bonds. The BI rate and the Fed rate significantly impacted all three bond yields in the long term. Investors needed to be responsive to yield fluctuations and conduct thorough risk analyses to make informed investment decisions regarding government bonds.
Originality/value (State of the art): This study contributes significantly to the understanding of the dynamic and complex interactions between domestic and global economic factors that affect Indonesian government bond yields. By using the Autoregressive Distributed Lag (ARDL) methodology, this research integrates both short-term and long-term factors, focusing on multiple bond maturities (5, 10, and 30 years).

Keywords: ARDL, domestic economics, global risk, government bonds, yield

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INTRODUCTION

Bonds are one of the investment instruments sold to the public, issued by the government or companies to raise long-term funds to finance government spending in the public sector for a country and develop business for a company (Saenong et al. 2020). The purpose of issuing and selling bonds for the government of a country is to finance government expenditure in the development field, especially public sector development (Rosnawintang et al. 2021). According to Law of the Republic of Indonesia No. 24 of 2002 concerning state debt securities, government bonds are defined as securities in the form of debt recognition letters with a guarantee of interest and principal payments by a country, issued to meet funding needs for development in various sectors that support the economy. Countries can use funding through the government bond market as alternative funding to reduce potentially damaging monetary financing budget deficits and avoid increasing the amount of debt in foreign currency (Bank and Fund, 2001). Liestiowaty et al. (2011) state that bonds are a relatively safe investment option with a low risk of default because the government can pay when due by increasing tax revenues or printing money.

Investors consider bond yield an essential factor when purchasing bonds (Qisthina et al. 2022). According to Rahardjo (2003), bond yield is an essential factor investor use when purchasing bonds as an investment instrument. Bond investors can calculate investment income on the funds invested in these bonds using a yield measurement tool. This allows investors to minimize risk. Even though they are considered safe, government bonds have other risks influenced by factors outside of the bonds themselves, namely domestic economic conditions (internal) and international/global economic conditions (external). Domestic economic conditions and global external factors are forms of information that can be used to assess their impact on the yield of Indonesian government bonds. Bond yields are used by investors and market participants as benchmarks to understand the development of their bond portfolio value by observing the movement of these bond yields. COVID-19 is a disease outbreak caused by the Coronavirus that occurred in 2019. The World Health Organization (WHO) declared the Coronavirus disease a global pandemic on March 11, 2020. A few days later, on March 14, 2020, the Indonesian government declared the COVID-19 outbreak a national disaster. This unprecedented pandemic has caused chaos in countries around the world. COVID-19 has led to economic instability. The rapid spread of the pandemic triggered economic weaknesses in developed countries, disrupting all major economic sectors (Mulyono, 2023). In addition to affecting the stock market, the COVID-19 pandemic significantly impacted the bond market (Zaremba et al. 2022). The pandemic has created massive systematic risks, making it difficult for investors to find safe havens (Wei and Han, 2021).

In early 2020, as the pandemic unfolded, there was a surge in uncertainty and risk aversion among investors. This drove investors to seek safer havens, such as government bonds, which are considered low-risk investments. The increased demand for government bonds caused bond prices to rise and yields to fall (Mulyono, 2023). According to Zhou et al. (2022), the impact of the COVID-19 pandemic on government bond yields varied depending on the country and the period of assessment. The long-term response of German bond yields appeared more negative (indicating a decline in yields), while the response of U.S. yields seemed more positive (indicating an increase in yields). The short-term responses varied in direction, magnitude, and duration. Paule-Vianez et al. (2022) found that the fear induced by COVID-19 was associated with an increased perception of country risk. Their findings suggest that during periods of heightened fear of the coronavirus, investors could achieve higher returns by investing in safe assets, such as government bonds.

Some previous studies on yield still provide different findings between one study and another, such as the industrial production index is significantly positively related to bond yields in Akram and Li (2019) and Zhou (2021) research but did not have a significant relationship in the study Muharam (2013). US Treasuries had a positive and significant effect on yields in Muktiyanto and Aulia (2019); Yusuf and Prasetyo (2019); and Zhou (2021) research. Unlike the results of these three studies, Permanasari and Kurniasih (2021) stated that there was no significant relationship between the 10-year US yield and the yield on Indonesian government bonds with a tenor of 10 years. The existence of differences in research results regarding the relationship between the analyzed factors and yields, as well as the COVID-19 pandemic as a global event, are considerations for the necessity of research on the determinants of government bond yields.

Several previous empirical studies have been conducted to investigate the relationship between Indonesian government bond yields and various factors using different methodologies and factors. Zhou (2021) conducted a study on South African government bond yields using both linear and non-linear ARDL methods. Zhou examined the impact of independent variables used in the research by Akram and Das (2014), which included short-term interest rates, inflation, IPI, and the government debt ratio. The impact of exchange rates, stock price indexes, US bond yields, and bank credit was also analyzed. Short-term interest rates were found to be the main factors influencing long-term yields in both the short and long term. US long-term yields had a positive impact on bond yields in both the short and long term. Inflation rates, economic growth, effective exchange rates, and bank credit had negative effects on bond yields in the long term.

Muharam (2013) analyzed the determinants and volatility of Indonesian government bonds using US bond yields, foreign exchange reserves, BI interest rates, Fed interest rates, stock price indexes, world oil prices, and real sector performance. The factors influencing government bond yields were: BI interest rates, stock price indexes, Fed interest rates, foreign exchange reserves and world oil prices. Sundoro (2018) conducted research on the impact of macroeconomic factors, liquidity factors, and external factors on the yields of Indonesian government bonds with maturities of 2, 5, and 10 years using VECM. The research concluded that all variables caused Indonesian government bond yields to move fluctuatively. Besides Sundoro (2018), Akram and Li (2019) also investigated yield determinants using various maturity periods, namely 2, 5, 7, 10, and 30 years.

In this paper, we investigate the relationship between the movements in Indonesian government bond yields and several internal and external factors. The factors used in the study are a combination of those utilized in the research by Zhou (2021) and Muharam (2013). More specifically, we focus on the monthly yield movements of bonds with maturities of 5, 10, and 30 years referring to the research by Akram and Li (2019) over the period 2016–2022. For this purpose, we examine the relationship between these factors and bond yields using the autoregressive distributed lag (ARDL) approach. The ARDL model introduced by Pesaran and Shin (1997), this model will allow us to see the impact of both current and past data of the dependent and independent variables. According to Magnus and Fosu (2006), the advantage of this method is the simpler cointegration testing with the bound test, it can be applied to models where all variables are stationary at I(0), I(1), or a combination of both. Furthermore, this method is relatively more efficient for small and limited sample data.

Based on the background, the purpose of this study is to analyze the factors influencing government bond yields using a symmetric approach with the ARDL model. To the best of our knowledge, studies that analyze domestic macroeconomic factors and external factors simultaneously to understand the complex dynamics affecting bond yields using the ARDL methodology are still rare. Therefore, this study offers significant policy implications by providing additional insights for investors, policymakers, and financial institutions when anticipating yield movements.

METHODS

The data used in this research is secondary data obtained from several sources such as investing.com, Bank Indonesia, Central Statistics Agency, and FRED. The data used is monthly data starting from April 2016 to December 2022. The dependent variable used in this research is the yield of Indonesian government bonds with maturities of 5, 10 and 30 years. The independent variables used are short-term interest rate using 3-month short-term returns or 3-month T-Bill (T3M), Consumer Price Index (CPI), Industrial Production Index (IPI), exchange rate (KUR), interest rates BI (BIR), Composite Stock Price Index (JCI), foreign exchange reserves (CD), Fed interest rates (FFR), world oil prices (OIL), US Long-term Yield 10 Year (USY) and Covid-19 (COV).

Bond yields with maturities of 5 years, 10 years and 30 years were chosen to see comparisons over short, medium, and long terms. The yield used is closing data in percent units (LTY). CPI indicates the increase in prices of goods and services to consumers, which is the basis for calculating inflation. IPI is an indicator that reflects economic activity and describes the economic growth rate. The exchange rate used is the Rupiah exchange rate against the US Dollar. The data uses the middle rate obtained from Bank Indonesia. BIR is the reference interest rate issued by Bank Indonesia, namely the BI-7 Day Reverse Repo Rate (BI7DRR).

JCI is an index of stock price movements that uses closing data. CD is foreign currency reserves managed by BI for international transaction purposes in billions of USD. OIL is the world's crude oil price, and this research uses West Texas Intermediate (WTI). FFR is the US interest rate, while the US bond yield is the yield on US bonds with a tenor of 10 years. The COVID-19 variable will be analyzed using a dummy variable with 0 describes conditions before and 1 during the pandemic. CPI, IPI, KUR, JCI, CD and OIL will be transformed into natural logarithm form.

This research uses descriptive data analysis to see a picture of existing facts and the relationship between phenomena that occur systematically and quantitative analysis to analyze the influence of factors on yield. Quantitative analysis was carried out using an econometric model approach, namely a symmetrical approach using the Autoregressive Distributed Lag (ARDL) model. Pesaran and Shin (1997) introduce ARDL analysis as a method to analyze long-term relationships through a cointegration approach between time series variables. This method is used to see the impact of data in the present and past from the dependent variable and independent variables. The advantage of this method compared to other methods, according to Magnus and Fosu (2006), is that it is a more straightforward cointegration test than the Johansen-Juselius cointegration test. Cointegration testing in ARDL is sufficient to estimate using Ordinary Least Square (OLS) when the lag of the model has been identified using the Bounding Testing Cointegration test. The test can be applied to models where all variables are stationary at I(0), I(1), or integrated between both. In addition, testing with this method is relatively more efficient when using small and limited sample data.

The model estimation stages using the ARDL approach start from a series of processes, namely the Data Generating process stage, model diagnostic testing and model estimation evaluation. The data-generating process is a series of stages used to obtain model estimation results: stationarity testing, determining the optimum lag, and cointegration testing. Model diagnostic testing consists of testing classical assumptions testing the validity and stability of the model. Classical assumption testing is carried out to determine whether the resulting model estimates are free from problems such as autocorrelation, heteroscedasticity, and normality. The expected model has residuals free from autocorrelation and heteroscedasticity problems with normally distributed residuals.

This research will look at the determinants of government bonds that will mature in 5-year, 10-year and 30-year using a symmetrical approach using ARDL. Therefore, there will be three equations with different dependent variables. The determinant equation for government bond yields using the ARDL symmetric approach is as follows:

$$\Delta LTY_t = \alpha + \partial_1 LTY_{t-1} + \partial_2 T3M_{t-1} + \partial_3 IPI_{t-1} + \partial_4 CPI_{t-1} + \partial_5 KURS_{t-1} + \partial_6 BIR_{t-1} + \partial_7 JCI_{t-1} + \partial_8 CD_{t-1} + \partial_9 FFR_{t-1} + \partial_{10} OIL_{t-1} + \partial_{11} USLTY_{t-1} + \sum_{a=0}^{m-1} \beta_{1a} LTY_{t-a} + \sum_{a=0}^{n-1} \beta_{2a} SR_{t-a} + \sum_{a=0}^{o-1} \beta_{3a} IIPI_{t-a} + \sum_{a=0}^{p-1} \beta_{4a} CPI_{t-a} + \sum_{a=0}^{q-1} \beta_{5a} KURS_{t-a} + \sum_{a=0}^{r-1} \beta_{6a} BIR_{t-a} + \sum_{a=0}^{s-1} \beta_{7a} JCI_{t-a} + \sum_{a=0}^{x-1} \beta_{8a} CD_{t-a} + \sum_{a=0}^{u-1} \beta_{9a} FFR_{t-a} + \sum_{a=0}^{v-1} \beta_{10a} OIL_{t-a} + \sum_{a=0}^{w-1} \beta_{11a} USLTY_{t-a} + COV + \varepsilon_t$$

Description: α is the intercept coefficient; with ∂_i, β_{ia} = 1,2,…,n are coefficients in long-term, and short-term; ε is residual, t indicates the time; m, n, o, …, w are optimum lags; LTY is long-term yield as dependent variable; T3M is short-term interest; IPI is Industrial Production Index; CPI is the Consumer Price Index; KURS is the exchange rate; BIR is BI Rate; JCI is the Composite Stock Price Index; CDs are foreign exchange reserves; FFR is the Fed's interest rate; OIL is world oil prices, USY is US Long Term Yield and COV is a dummy variable of COVID-19.

Akram and Das (2014) research stated that The long-term government bond yield can be seen as being influenced by short-term interest rates and forward interest rates. The low short-term interest rates (T-Bill 3 months), which are essentially determined by the monetary policy are the main drivers of the relatively low nominal yields of long-term. The increase in the the industrial production index as a proxy for domestic economic activity indicates an improvement in the government's ability to pay its obligations. Akram and Li (2019) found that as the pace of economic activity increases, long-term interest rates on Treasury securities rise. They research also shows that inflation has a positive influence on Government Bond yield. It shows that when the consumer price index rises, it leads to higher inflation, indicating that investors will demand compensation for holding long-term bonds

during periods of increasing inflation. According to Samuelson and Nordhaus (1996), an excessively high exchange rate will lead to an increase in interest rates, thus slowing economic growth and reducing investment and leads to higher yield. Sihombing (2014) concludes that an increase in interest rates will encourage investors to sell bonds, leading to an increase in yield. In line with Sihombing, Qisthina et al. (2022) also found that interest rates have a significant positive relationship with government bond yields. Sundoro (2018) found that when the stock price index increase, the yields of government bonds across all tenors will decrease. The decrease in the stock price index occurs due to portfolio investment reallocation driven by increased bond yields (Ncube et al. 2012). Muharam (2013) stated that a country with good liquidity, indicated by an increase in foreign exchange reserves, has a low risk of default on its bonds, and vice versa. The higher the risk level of a country, the higher its bond yields.

Ncube et al. (2012) also stated that the South African economy is highly responsive to shocks, one of which is the US yield. Unexpected increases in medium-term US bond yields lead to depreciation of the exchange rate against the dollar and an increase in South African bond yields. Muharam (2013) found that foreign exchange reserves have a significant negative effect on bond yields. A country with good liquidity has a low risk of default on its bonds. The higher the risk level of a country, the higher its bond yields. According to Ncube et al. (2012), expansive monetary surprises from the US reduce the yields of South African government bonds. The increase in Fed interest rates prompts domestic investors to switch to holding foreign bonds with higher yields than domestic bonds. They also stated that the South African economy is highly responsive to shocks, one of which is the US yield. Unexpected increases in medium-term US bond yields lead to depreciation of the exchange rate against the dollar and an increase in South African bond yields. The results of Muharam (2013) study indicate that there is a relationship between oil prices and the yields of Indonesian government bonds. An increase in oil prices will affect domestic selling prices and other commodity prices (Sihombing, 2014). Paule-Vianez et al. (2022) discovered that fear induced by COVID-19 led to a rise in the perception of country risk, which in turn positively influenced the yield of 10-year sovereign bonds. Based on the above explanation, the hypothesis of this study is as follows:

H_1: T3M has a positive effect on Indonesian government bond yields.
H_2: IPI has a positive effect on Indonesian government bond yields.
H_3: CPI has a positive effect on Indonesian government bond yields.
H_4: KUR has a positive effect on Indonesian government bond yields.
H_5: BIR has a positive effect on Indonesian government bond yields.
H_6: JCI has a negative effect on Indonesian government bond yields.
H_7: CD have a negative effect on Indonesian government bond yields.
H_8: FFR has a negative effect on Indonesian government bond yields.
H_9: OIL has a positive effect on Indonesian government bond yields.
H_{10}: USY has a positive effect on Indonesian government bond yields.
H_{11}: COV has a a positive effect on Indonesian government bond yields.

This framework starts with the need for investors' information regarding factors influencing bond yields when investing in bonds. These factors consist of two categories: Internal economic conditions and External factors. The internal factors are T-Bill 3 months, the consumer price index, the industrial production index, exchange rates, BI interest rates, the stock price index, and foreign exchange reserves. External factors are the Fed's interest rates, oil prices, the yield of U.S. government bonds, and the impact of the COVID-19 pandemic. Furthermore, the influence of these factors will be analyzed using a symmetric approach with ARDL. The research framework is presented in Figure 1.

RESULTS

Data Stationarity Testing

The first step is testing the unit root (stationarity) of each variable used in modelling. Stationarity testing in this research uses the Phillips-Perron (PP) test with the null hypothesis that the data has a unit root. The stationarity test results for each research variable are presented in Table 1. Based on the test results, only the IPI variable is stationary at level, as indicated by the absolute value of T-stat (4.65263) > the absolute value of Critical Value

(2.89815). Therefore, the null hypothesis is rejected, meaning that the IPI variable is stationary or there is no unit root at the level. All variables in the modelling do not have unit root problems or are stationary in first differences. Based on the test results, data modelling using ARDL can be carried out because the variables are stationary at the first difference. There is no need to test the second difference.

Determination of Optimum Lag

The optimum lag in modelling is determined by considering the AIC value. The selected model is the model with the optimum lag, which has the smallest AIC value. Based on the results of data processing with ARDL modelling, the optimum lag for 5-year yield is (1, 0, 4, 0, 1, 0, 0, 1, 4, 2, 4), for 10-year yield is (3, 0, 0, 1, 0, 0, 2, 0, 1, 2, 2) and (1, 0, 4, 0, 1, 0, 0, 1, 2, 1, 0) for 30-year yield.

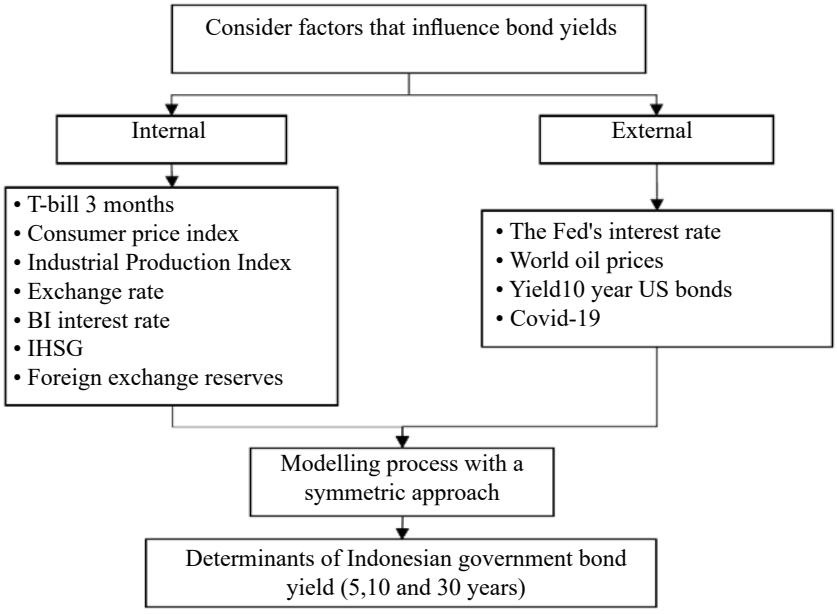

Figure 1. Framework of thought

Table 1. Variable stationarity test results

Variable	Levels			First difference		
	T-stat	Prob.	Critical Val.	T-stat	Prob.	Critical Val.
5LTY	-2.15861	0.223	-2.89815	7.972454	0.00	-2.89862
10LTY	-2.57286	0.103	-2.89815	-8.58825	0.00	-2.89862
30LTY	-1.97909	0.295	-2.89815	-7.80144	0.00	-2.89862
T3M	-1.63453	0.460	-2.89815	-12.1649	0.00	-2.89862
IPI	-4.65263	0.003	-2.89815	-14.8352	0.00	-2.89862
CPI	-1.31667	0.363	-2.89815	-8.90289	0.00	-2.89862
KUR	-1.90629	0.457	-2.89815	-13.2562	0.00	-2.89862
BIR	-1.64081	0.289	-2.89815	-4.23392	0.00	-2.89862
JCI	-1.85072	0.237	-2.89815	-7.36697	0.00	-2.89862
CD	-2.00618	0.928	-2.89815	-8.83569	0.00	-2.89862
FFR	-0.24038	0.363	-2.89815	-7.35634	0.00	-2.89862
OIL	-1.65964	0.448	-2.89815	-7.96303	0.00	-2.89862
USY	-0.66497	0.849	-2.89815	-7.43952	0.00	-2.89862

Cointegration Test

The long-term relationship between variables in ARDL modelling can be determined using the Bound test approach cointegration test developed by Pesaran et al. (2001). The test is carried out based on the F value. There are two critical F values: the lower bound or I(0) and the upper bound or I(1). If the calculated F value is greater than the upper bound value, there is cointegration; if the value is smaller than the lower bound, then there is no cointegration. However, if the calculated F value is between the lower and upper bound values, then there is no decision. Based on the test results with the bound test in Table 2, the F-calculated value for the LTY5, LTY10, and LTY30 models is greater than the upper bound value at the 5 percent real level of 3.04. It shows that the three models have cointegration or a long-term relationship between the independent and dependent variables in the modelling.

ARDL Model Estimation Results

The ARDL model is used to analyze the influence of several factors on the yield of 5-, 10- and 30-year Indonesian government bonds. The model presented is a model with the optimal lag selection that meets classical assumptions (normality, autocorrelation, and heteroscedasticity) and validity testing (reset test). Table 3 shows model feasibility tests for 5-, 10- and 30-year Indonesian government bond yields, and Table 4 shows the ARDL model estimation results. When the p-value > 0.05 (the significance level), the null hypothesis is accepted. This indicates that the residuals of the model do not contain autocorrelation, have constant variance (homoscedasticity), are normally distributed, and the model is valid for use. The CUSUM test represents the stability of the variables, while the CUSUMQ test indicates the stability of the model's errors.

Based on the model feasibility test results (Table 3), the estimation results for the three models have met the criteria for model feasibility, as the p-values for the normality, autocorrelation, and heteroscedasticity tests are all greater than 0.05. All models meet the criteria for the best model: the residuals are normally distributed, homogeneous, and uncorrelated. Additionally, the CUSUM and CUSUMQ test results indicate that the estimated parameters in the research models are stable. The RESET test results show that the LTY5 and LTY10 models are valid or suitable, as their p-values are greater than 0.05. However, the LTY30 model did not meet the validity test, as its p-value is smaller than 0.05. Despite this, the RESET test results for the LTY30 model do not meet the criteria at the 5% significance level, but the model is still suitable for use as it already meet the criteria for the best model (the residuals are normally distributed, homogeneous, and uncorrelated). The variation explained by the independent variables in the research on 5-, 10-, and 30-year bond yields is 80%, 73%, and 75%, respectively, while the remaining variation is explained by other factors outside the model.

Table 2. Bound test results on 5-, 10- and 30-year bond yields

Model	Lower bound			Upper bound			F Count	Information
	1%	5%	10%	1%	5%	10%		
5LTY	2.41	1.98	1.76	3.61	3.04	2.77	3.450	There is cointegration
10LTY	2.41	1.98	1.76	3.61	3.04	2.77	5.740	There is cointegration
30LTY	2.41	1.98	1.76	3.61	3.04	2.77	3.745	There is cointegration

Table 3. Model feasibility tests for 5-, 10- and 30-year Indonesian government bond yields

LTY5		LTY10		LTY30	
Adjusted R-sq	0.80	Adjusted R-sq	0.73	Adjusted R-sq	0.751
Normality	0.88	Normality	0.55	Normality	0.611
Autocorrelation	0.07	Autocorrelation	0.69	Autocorrelation	0.138
Heteroscedasticity	0.23	Heteroscedasticity	0.16	Heteroscedasticity	0.854
Reset	0.20	Reset	0.56	Reset	0.003
CUSUM	stable	CUSUM	stable	CUSUM	stable
CUSUM-Q	stable	CUSUM-Q	stable	CUSUM-Q	stable

Table 4. ARDL model estimation results for 5-, 10- and 30-year yields

Panel A: LTY5			Panel B: LTY10			Panel B: LTY30		
Variables	Coeff	T-Stat	Variables	Coeff	T-Stat	Variables	Coeff	T-Stat
T3M	0.102	0.69	T3M	-0.041	-0.28	T3M	0.38	2.23**
CPI	0.148	2.56*	CPI	-0.001	-0.05	CPI	0.08	1.56
IPI	0.001	0.15	IPI	-0.029	-1.97***	IPI	0	0.19
KUR	-0.284	-0.07	KUR	16.64	2.90*	KUR	10.63	2.37**
BIR	0.621	2.70*	BIR	0.431	1.76***	BIR	0.51	2.16**
JCI	-0.339	-0.20	JCI	5.274	1.82***	JCI	0.8	0.45
CD	-9.302	-4.02*	CD	-7.764	-2.86*	CD	-2.28	-1.03
FFR	-1.044	-3.31*	FFR	-0.747	-2.72*	FFR	-1.26	-4.26*
OIL	-0.009	-0.94	OIL	-0.005	-0.45	OIL	-0.01	-0.76
USY	0.938	3.38*	USY	0.127	0.67	USY	0.45	2.16**
C	98.14	1.94	C	-102.82	-1.73***	C	-87.73	-1.72***
				Short-term				
D(CPI)	0.002	0.47	D(LY2(-1))	-0.183	-2.31**	D(CPI)	-0.007	-2.13**
D(CPI(-1))	-0.067	-5.80*	D(LY2(-2))	-0.159	-2.48**	D(CPI(-1))	-0.028	-5.17*
D(CPI(-2))	0.001	0.11	D(IPI)	-0.002	-0.77	D(CPI(-2))	-0.010	-1.48
D(CPI(-3))	-0.058	-6.81*	D(JCI)	-1.430	-2.15**	D(CPI(-3))	-0.026	-4.83*
D(KUR)	7.753	5.48*	D(JCI(-1))	-1.975	-2.87*	D(KUR)	6.594	7.29*
D(CD)	-7.187	-6.69*	D(FFR)	-0.135	-1.75***	D(CD)	-3.770	-5.03*
D(FFR)	-0.168	-1.35	D(OIL)	0.002	0.51	D(FFR)	-0.031	-0.40
D(FFR(-1))	0.772	5.86*	D(OIL(-1))	-0.007	-2.14**	D(FFR(-1))	0.438	4.83*
D(FFR(-2))	-0.063	-0.69	D(USY)	0.386	4.33*	D(OIL)	0.005	1.90***
D(FFR(-3))	-0.343	-3.34*	D(USY(-1))	0.176	1.84***	COV	0.461	6.27*
D(OIL)	-0.002	-0.64	COV	-0.355	-7.35*	ECT (-1)	-0.324	-7.34*
D(OIL(-1))	-0.007	-1.78***	ECT(-1)	-0.424	-9.09*			
D(USY)	0.484	5.11*						
D(USY(-1))	-0.008	-0.08						
D(USY(-2))	-0.284	-2.98*						
D(USY(-3))	-0.173	-1.67						
COV	2.127	6.84*						
ECT (-1)	-0.496	-7.13*						

***,**, * represent p-values that are significant at the 1, 5, and 10 percent levels, respectively

The 5-year bond yield estimation results in panel A show that consumer price index, BI interest rates, foreign exchange reserves, the Fed interest rate, and US bond yields influence 5-year bond yields in the long term. The 3-month T-Bill, IPI, exchange rate, stock price index, and world oil prices do not significantly impact the 5-year bond yield changes in the long term. consumer price index, BI interest rates, and US bond yields have a significant positive effect, while foreign exchange reserves and the Fed interest rate have a negative effect.

An increase in the consumer price index of 1 unit will cause an increase in the 5-year bond yield of 0.148 units. An increase in the US bond yield by 1 unit will increase the 5-year bond yield by 0.938 units, while an increase in the BI interest rate will increase the 5-year bond yield by 0.621 units. A decrease in the Fed's foreign exchange reserves and interest rates by 1 unit will reduce the 5-year bond yield by 9,302 units and 1,044 units, respectively.

Changes influence short-term changes in the 5-year bond yield value in exchange rates, foreign exchange reserves, world oil prices last month, and the COVID-19 pandemic. Changes also influenced the 5-year bond yield in the consumer price index and Fed interest rates one and three months ago. Changes in US bond yields

this month and two months ago also influenced 5-year yields. Changes in the amount of foreign exchange reserves, changes in the consumer price index value (one and three months ago), the Fed's interest rate (three months ago), world oil prices last month and US bond yields two months ago had a significant negative effect on changes in 5-year bond yields in short-term. Changes in exchange rates, US bond yields this month, and the presence of the COVID-19 pandemic significantly influenced the 5-year yield in a positive direction.

Panel B shows that in the long term, the 10-year government bond yield is significantly influenced by the IPI, exchange rate, BI interest rates, JCI, foreign exchange reserves and the Fed interest rate. Apart from these factors, other factors had no significant influence on the 10-year bond yield. IPI, foreign exchange reserves and the Fed interest rate influence the 10-year bond yield in the opposite direction (negative). In contrast, the exchange rate, BI and JCI interest rates are in the same direction (positive). An increase in IPI, foreign exchange reserves and the Fed's interest rate by 1 unit will reduce bond yields by 0.029 units, 7.764 units and 0.747 units, respectively. An increase in the BI and IHSG interest rates by 1 unit will cause the 10-year bond yield to increase by 0.431 units and 5.274 units. An increase in the exchange rate of 1 unit will also cause an increase in the 10-year bond yield of 16.64 units.

Changes significantly influence the short-term influence on the 10-year bond yield in the value of the 10-year bond yield in the past one and two months, changes in JCI and US bond yields (this month and last month), changes in the Fed's interest rates, world oil prices this month ago, and the Covid-19 pandemic. Changes in the IPI and current oil prices did not significantly impact the 10-year bond yield in the short term. Almost all changes in these factors significantly influenced the 10-year bond yield negatively; only changes in the US bond yield this month and last month affected the 5-year bond yield positively.

The estimated results of the 30-year bond yield model are shown in panel C. The 3-month T-Bill, exchange rates, BI and The Fed interest rates, and long-term US bond yields significantly influence the 30-year bond yield. CPI, IPI, JCI, foreign exchange reserves, and world oil prices had no significant long-term influence on the 30-year bond yield. The 3-month T-Bill, exchange rate, BI interest rate, and US bond yield influence the 30-year bond yield in a positive direction, while the Fed interest rate is in a negative (opposite) direction. An increase of 1 unit in the three months T-Bill, exchange rate, BI interest rate, and US bond yield will increase the 30-year bond yield by 0.38 units, 10.63 units, 0.51 units, and 0.45 units. However, an increase in the Fed's interest rate by 1 unit will cause a decrease in the 30-year bond yield by 0.51 units.

Changes in exchange rates, foreign exchange reserves, world oil prices, the Fed's interest rate in the previous month, CPI (this month, the previous month, and the previous three months) as well as the Covid-19 pandemic have significantly influenced the 30-year bond yield in the short term. Changes in the exchange rate, the Fed's interest rate in the previous month, and world oil prices in the form of an increase will also cause an increase in the 30-year bond yield. The Covid-19 pandemic also significantly influenced the 30-year bond yield positively. Changes in foreign exchange reserves and CPI, both this month, the previous month, and the previous three months, significantly influenced the opposite direction of the 30-year bond yield in the short term.

Based on the research results above, the 3-month T-Bill has a significant impact and was found to have the same direction towards the yield. The consumer price index was found to have a significant impact with the same direction towards the yield. The industrial production index has a significant impact with a negative direction. The exchange rate, when its impact was found to be significant towards the yield, had a positive or direct impact. The BI interest rate significantly affects the yield in the same direction. The JCI (Jakarta Composite Index) has a significant positive impact on the yield. The significant impact of foreign exchange reserves was found to be in the opposite direction to the yield. The Fed interest rate significantly affects the yield in a negative (opposite) direction. No significant impact of global oil prices on yield was found. The yield of U.S. bonds significantly affects the yield in the same direction in the long term. In the short term, the presence of the COVID-19 pandemic had a significant positive and negative impact on yield changes. Based on these results, the industrial production index, the stock price index, and oil prices were found not to be in line with the research hypothesis.

The relationship between the 3-month T-Bill and bond yield is in line with Akram and Das (2014). Their relationship can be understood through the concept of short-term interest rates and their impact on the overall interest rate environment. According to Akram and Das (2014), when the short-term interest rate represented by the 3-month T-Bill changes, this change will affect long-term bond yields. An increase in the 3-month T-Bill will cause an increase in bond yields. This relationship also implies that when short-term borrowing costs rise, investors may demand higher yields for long-term investments as compensation for the increased opportunity cost of holding longer-term instruments.

The consumer price index was found to be in line with the findings of Akram and Li (2019), significantly affecting bond yields in a positive direction. According to Arslanalp and Poghosyan (2014), the consumer price index affects bond yields through inflation expectations. An increase in the consumer price index will exert upward pressure on government bond yields. Investors will demand higher yields as compensation for the reduced value of investments due to rising inflation. High inflation rates can increase risk perception and create uncertainty in the financial markets, thus causing yields to rise (Rosanti and Sihombing, 2021). This result is also in line with the research findings of Akram and Das (2014); Hsing (2015); Kurniasih and Restika (2015); Yusuf and Prasetyo (2019); Akram and Uddin (2021).

The industrial production index, as an indicator reflecting the economic activity of a country, was found to have a significant negative impact. This research result differs from the findings of Akram and Li (2019). Akram and Li (2019) found that the industrial production index significantly affects yields positively. This research is in line with the findings of Zhou (2021). Zhou (2021) found that the IPI significantly affects bond yields in the opposite direction in the long term and no significant impact was found in the short term. This shows that an increase in economic activity will increase confidence and reduce investor risk perception, thus lowering yields.

The exchange rate was found to significantly affect yields in a positive direction. This research result is consistent with the findings of Samuelson and Nordhaus (1996). When there is a significant increase in the exchange rate, it can cause an increase in interest rates. This can then cause a slowdown in economic growth and reduce investment levels. Simply put, if the domestic currency weakens against the U.S. dollar, it will push up interest rates, which in turn causes bond prices to fall and yields to rise. The significant impact of the exchange rate on yields in a positive direction is consistent with the research conducted by Pramana and Nachrowi (2016); Muktiyanto and Aulia (2019); Rosnawintang et al. 2021) and Qisthina et al. (2022).

The BI interest rate was found to have a significant impact on bond yields in a positive direction. This result is consistent with the hypothesis built based on the research by Sihombing (2014). Qisthina et al. (2022) also stated that interest rates have a significant positive impact on government bond yields. An increase in interest rates will prompt investors to sell bonds, thus causing yields to rise (Sihombing, 2014). Sundoro (2018) stated that investors might sell bonds to avoid a decline in bond prices in the long and short term due to an increase in interest rates. According to Muktiyanto and Aulia (2019), the connection between yields and interest rates is related to the risk investors receive from changes in interest rates. Movements in interest rates will cause an increase in the short-term money market, which will subsequently cause an increase in bond yields with longer tenors. The same results were also found in the research by Muharam (2013); Kurniasih and Restika (2015); Pramana and Nachrowi (2016); Korir and Wanyama 2017; Tjandrasa (2017); Rosanti and Sihombing (2021).

A significant impact of the stock price index on bond yields was found to be in a positive direction. This result contradicts the findings of Sundoro (2018), who found that when the stock price index increases, the government bond yields for all tenors decrease. This result aligns with the findings of Rosanti and Sihombing (2021), who found that the impact of stock price index shocks on bond yields with tenors of 1, 5, and 10 years shows a positive response. This response indicates that when the JCI increases, the bond yields for all tenors will rise. This can happen because government bonds are considered a safe asset or safe haven during economic uncertainty. Therefore, investors tend to switch to lower-risk assets. This finding is also supported by Baur and Mcdermott (2012), who found that bonds are considered a safe investment in the face of economic uncertainty. Additionally, research by Gulko (2002) also stated that stocks and bonds have a positive correlation due to the impact of general macroeconomic conditions.

Foreign exchange reserves were found to significantly impact yields in the opposite direction. This result is consistent with the research by Muharam (2013). Muharam (2013) stated that a country with good liquidity has a low risk of default on its bonds, and conversely, a country with poor liquidity has a high risk of default. The higher the risk level of a country, the higher its bond yields. Foreign exchange reserves can negatively impact yields because an increase in foreign exchange reserves can be interpreted as a sign of economic stability and strength of a country. Additionally, an increase in foreign exchange reserves can indicate a decrease in the risk perception of the country, which can cause government bond yields to decline as investors are willing to accept lower yields for safer assets (Santosa and Sihombing, 2015). According to Kumar and Baldacci (2010), the size of a country's foreign exchange reserves signals the country's ability to pay its debts and can act as a buffer when there are external shocks.

The significant impact of the Fed interest rate on yields was found to affect bond yields in a negative direction. This research result aligns with the findings of Ncube et al. (2012). Ncube et al. (2012) found that expansive monetary surprises from the U.S. reduce the yields of South African government bonds. Sihombing (2014) stated that an increase in the Fed interest rate indicates an improvement in the U.S. economy, leading to an increase in investment levels. An increase in investment levels also indicates an increase in capital flows from the U.S., leading to higher bond purchases. This will push up bond prices and lower yields.

No significant impact of global oil prices on bond yields in the long term was found; the impact was only found in the short term. This result does not align with the hypothesis built based on the research by Muharam (2013). Muharam (2013) found that global oil prices significantly affect yields in a positive direction. The significant impact of global oil prices is only found in the short term (Saenong et al. 2020). This result aligns with the findings of Saenong et al. (2020), who found that the significant impact of oil prices on bond yields is only found in the short term, where the impact may not directly affect yields but through other factors that subsequently affect yields.

The yield of U.S. government bonds was found to significantly positively affect yields. This result is consistent with the findings of Ncube et al. (2012), who found that the depreciation of the exchange rate against the dollar and the increase in South African bond yields were due to unexpected increases in U.S. medium-term bond yields. Zhou (2021) stated that an increase in U.S. bond yields would push up the exchange rate. An increase in the exchange rate will reduce investment levels, thus lowering bond demand, which causes yields to rise.

The presence of the COVID-19 pandemic had a short-term impact on changes in yield. The study found that the pandemic had a significant positive and negative effect. The yield changes in 10-year government bonds were significantly negatively affected. This result is consistent with the hypothesis that yield changes are significantly positively influenced by the COVID-19 pandemic, aligning with the findings of Paule-Vianez et al. (2022). Paule-Vianez et al. (2022) found that COVID-19 is associated with an increase in a country's risk perception. This is indicated by the fact that when fear of the coronavirus increases, investors can obtain higher returns by investing in safe assets, such as government bonds. The difference in the results, where the change in 10-year government bond yields is significantly negatively influenced, may be due to the different impacts of COVID-19 based on the different assessment periods of these impacts. This is reinforced by the findings of Zhou et al. (2022), which state that the short-term response to COVID-19 on yields can vary in direction, strength, and duration.

Managerial Implications

Governments as Bank Indonesia needs to cautiously set interest rates to maintain economic stability and minimize negative effects on bond yields. Investors need to be responsive to market fluctuations and conduct thorough risk analyses to make informed investment decisions regarding government bonds. Understanding how factors like BI and The Fed interest rates influence different bond maturities is crucial.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The main factor affecting the 5-year yield is foreign exchange reserves. The next factors are the Fed interest rate and the yield on US bonds. The primary drivers for the yields on 10-year and 30-year bonds are the

exchange rate, followed by foreign exchange reserves and the JCI for the 10-year yield, and the Fed interest rate and BI interest rate for the 30-year yield. Short-term interest rates, the consumer price index, the exchange rate, BI interest rates, the stock price index, and the yield on US government bonds were found to have a significant positive effect on the yields. Meanwhile, foreign exchange reserves and the Fed interest rate had a significant negative impact on the yields. Short-term changes were observed due to fluctuations in the Fed interest rate and oil prices in the current or previous month. Additionally, the COVID-19 pandemic also contributed to changes in the yields of Indonesian government bonds in short-term. Unlike previous research findings, the industrial production index was found to have a significant negative impact on the yields. Furthermore, a significant effect from crude oil prices was not found in this study, which might be due to the influence of COVID-19 on the industrial production index and global oil prices. Additionally, the lack of a significant impact from global oil prices may be because they affect the yield indirectly through other factors.

Recommendations

This research has several limitations, namely because the number of factors used is large. Hence, it is impossible to conduct testing with a maximum number of lags of 12 so that subsequent research can focus on specific factors or try to analyze using other analytical tools such as R, Stata, and others. This research uses monthly data, and it is hoped that future research can use daily data to look at the relationship between factors and yield more thoroughly and enrich yield information. Furthermore, further research needs to be carried out regarding crude oil prices on yields because no significant influence was found on 5-, 10- or 30-year bonds.

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