

Macroeconomic Analysis On Indonesia Green Sukuk: Co-Integration And Vector Error Correction Mechanism (Vecm) Model Approach

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ABSTRACT

The performance of Indonesia Islamic green bonds or green Sukuk can be influenced by many factors such as internal and external. External variables will be used in this study, namely macroeconomic influenced. This study aims to analyze the long and short-term influence of macroeconomic variables such as inflation, BI rate (benchmark interest rate), exchange rate, and stock price exchange on the performance of Indonesia green bonds and green Sukuk for the periods from 2018 to 2020. This quantitative study applied the method of the co-integration approach of Vector Error Correction Mechanism (VECM) to examine the short-term and long-term impacts among macroeconomic variables through EViews software. The authors carried out a long-term correlation analysis on these variables using the co-integration test. The Vector Error Correction Model (VECM) was used in the analysis because the results of the stationary test obtained stationary data at first difference and have long-term co-integration. The results showed that the macroeconomics variables are based on the empirical findings that the inflation rate, exchange rate, and stock exchange have a co-integration in the short-term and long run with the green Sukuk performance. It is different from the Bank Indonesia rate variables of co-integration in the long-term period to green Sukuk performance. The investors should pay attention to the exchange rate and stock exchange movements because both variables have short and long-term effects on green Sukuk. Hence, the investors also need to pay attention to changes in the inflation because it influences green Sukuk return in the long run.

Keywords: *Macroeconomic, Green Sukuk, Islamic Green Bonds, Sukuk, VECM.*

INTRODUCTION

Globally, Indonesia ranks as the fourth largest Sukuk market after Malaysia, Saudi Arabia, and the UAE. To date, Malaysia is the largest market for green Islamic securities in South East Asian countries. Indonesia represents a relatively small share of the market, but it has been a global pioneer with the first sovereign green Sukuk. Based on the data from the Climate Change Initiative, for the first half of 2019, Indonesia has been the world's fifteenth largest green bond issuer and the only Islamic economy in the world's top 15. The Indonesian government since 2018 has regularly issued the Islamic financial instruments in the global market, namely the State Shariah Securities or Surat Berharga Syariah Negara (SBSN).

Based on data from the Ministry of Finance of the Republic of Indonesia, up to 2020, the Indonesia government has issued three times sovereign green sukuk so far. In June 2019, the total green bonds issued by the Indonesian government amounted to US\$ 3.12 billion. Overall, it reached USD 750 million within 6 months of which was 5.5 years sovereign Sukuk *Wakala* issued in February 2019. The first sovereign green Sukuk issued was worth USD 1.25 billion in 2018.

The performance of green Sukuk can be influenced by many factors. Several previous researches have been conducted to link green Sukuk with microeconomic and macroeconomic factors. This study only focuses more on linking the influence of macroeconomic variables on changes in the performance of green Sukuk in Indonesia. Green Sukuk are Shariah-compliant Government Securities (SUN) issued in order to fund climate change projects in line with climate change commitments. Further, issuing of green Sukuk aims to fulfill the Indonesia government's goal for the Nationally Determined Contribution's (NDC) 29% emission

reduction target by 2030 has been identified as IDR 3,461 trillion for a five year period or an average of IDR 266.2 trillion per year. According to Murniati Mukhlisin, a Syariah Financial Planner, the issuance of green sukuk aims to protect the environment, which is a priority. This is consistent with the objectives of the Maqasid Syariah, namely Hifdzul bi'ah (environmental protection), as well as the goal of SDG No. 13, namely Climate Action. Green Sukuk can also contribute to increasing economic growth as well as to reduce climate change and other macroeconomic problems (unemployment and poverty). Therefore, in this study, the macroeconomic factors that will be analyzed are the inflation rate, BI rate (benchmark interest rate), exchange rate, and stock price exchange.

Table 1.1 Indonesian Macroeconomic Indicators for 2016 to 2020

Macroeconomic Indicators	2016	2017	2018	2019	2020
Inflation	3.0%	3.6%	3.1%	2.7%	1.50%
BI Rate	4.75%	4.25%	6.00%	5.00%	4.00%
Exchange Rate (IDR/USD)	13,309	13,381	14,250	14,250	14,750
Stock Price Exchange	15.3%	20.0%	-2.5%	1.7%	5.97%

Source: <https://www.indonesia-investments.com/finance/macroeconomic-indicators/item16>

Based on Table 1, it can be seen that the macroeconomic indicators in Indonesia periods from 2016 to 2020 experienced a fairly volatile change both in terms of inflation rate, BI rate and stock price exchange. However, the exchange rate (in Rupiah against Dollar) has experienced consistent increase. Changes in various macroeconomic indicators have an impact on changes in green Sukuk performance in Indonesia, which is an interesting to analyze that phenomenon. The research by Elkarim (2012) showed that inflation has a significant inverse and relationship on Sukuk performance. Besides, Ahmad, Daud and Kefeli's (2012) findings are consistent with Elkarim's (2012) that the higher inflation rate will lead to a lesser number of Sukuk issued by the financial institution due to the decrease of demand for Sukuk. Nevertheless, the results from Said and Grassa's (2013) study showed that inflation does not have a strong influence on the performance of the Sukuk market. While the research by Saad (2009) found out that an increasing in inflation will lead to a better performance of Sukuk in the market while decreasing in inflation will reduce the performance of Sukuk. On the other hand, research by Syamni, Ghazali and Sulaiman (2010) and Said and Grassa (2013) proved that the interest rate does not significantly influence the Islamic bonds (green Sukuk) as Islam prohibited interest.

According to Suciningtias (2019) showed that Bank Indonesia's rate, inflation rate, changes in foreign exchange, changes in gold prices, and world oil prices have co-integration in the long run with Sukuk performance. Another study by Wibisono (2010) showed that the exchange rate has a positive influence on the yield of government bonds within one, five, and ten years. Ahmad and Mat Radzi (2011) also found that Sukuk issuers place a premium on economic factors such as GDP, foreign exchange rate, and international liquidity in issuing Sukuk. by Zhou (2019) is stock prices exchange. This study showed that the green bond issuance have a positive effect on stock prices exchange. Green bonds also attract some investors, although the interest stimulated by the prospect of increased environmental protection is not particularly sustainable. Besides, the green bond issuance plays an active role in improving companies' profitability, operational performance, and innovation capacity. In line with this study, Tandelilin (2010) stated that the stock price exchange can be used to forecast the interest rate and bond prices.

Based on above background and previous literature, this study is interested in examining the macroeconomic influences of inflation rate, BI rate, exchange rate and stock price exchange on the performance of green Sukuk in Indonesia for the period 2018 to 2020. The green Sukuk performance was measured based on the Indonesia Composite Sukuk Index (ISIXC) as issued by the Indonesia Bond Pricing Agency (IBPA). ISIXC is a performance benchmark for Sukuk in the Indonesian capital market. The testing is carried out using the co-integration approach of Vector Error Correction Mechanism (VECM) to examine the short-term and long-term impacts.

METHODOLOGY

The purpose of this study is to assess the performance of green Sukuk by analyzing secondary data from the Indonesia Composite Sukuk Index - Total Return (ISIXC-TR). This performance measurement used the change of value from period t to the period $t-1$ of ISIXC-TR. Other data are inflation rates obtained from the Indonesian Central Statistics Agency (BPS), interest rate and exchange rate obtained from Bank Indonesia website, while stock price exchange obtained from Indonesia Stock Exchange (IDX). The data are in the monthly-time series starting from March 2018 to August 2020. The changes (Δ) on variables used is formulated as follows following Haron and Ayojimi (2018):

$$\Delta_x = \frac{(X_t - X_{t-1})}{X_{t-1}} \times 100$$

Where X-value represent ISIX-TR, inflation, interest rate, exchange rate and stock exchange. In this study, the inflation data is the inflation rates of every month from March 2018 to August 2020 taken from the Indonesian Central Statistics Agency (BPS) website <https://www.bps.go.id/subject/3/inflasi.html#subjekViewTab6> and Bank Indonesia website <https://www.bi.go.id/id/moneter/inflasi/data/Default.aspx>. The interest rate for the data processing in this research is used by Bank Indonesia BI 7-day (Reverse) Repo Rate due to the use of the BI7-Day Repo Rate as the reference interest rate effective from 19 August 2016 which taken from <https://www.bi.go.id/id/moneter/bi-7day-RR/data/Contents/Default.aspx>. Previously, the reference of interest rate uses the BI Rate. The exchange rate is an exchange rate of the rupiah against USD (closing month end rate), sourced from the website <https://id.investing.com/currencies/usd-idr-historical-data>. Furthermore, the data stock price exchange was obtained from the Indonesia Stock Exchange (IDX) and also by investigating the website <https://id.investing.com/indices/idx-composite-historical-data> (monthly closing). In the econometrics, variables that are co-integrated are said be in the long-term equilibrium condition (Nachrowi, 2006). Besides, if the data is stationary in the level process, the ordinary VAR (unrestricted VAR) model can be obtained.

On the other hand, if the data is stationary in the differentiation process and co-integrated between the variables, then VECM testing is needed to prove it. The VECM model is a restricted VAR model due to co-integration or long-term relationships between variables in VAR estimation. The use of VECM model to quantify the long-run relationship has been established in the past studies (Valadkhani, 2013; Haron & Ayojimi, 2018). The stages of the research methodology can be described as follows:

1. Descriptive statistics from the research data.
2. Stationary ADF Test

In the time-series statistical model, time series variables need to be tested first for its stationary, namely examining whether there is a root unit in the model (called integrated data) or otherwise. To examine the stationary data, this study employed the ADF Augmented Dickey and Fuller test. Non-stationary data will cause spurious regression.

3. Johansen Co-integration Test

Co-integration theory was proposed by Engle and Granger (1987), namely non-stationary variables because they contain trends (variables have co-integration relationships). It means that there is a stable long-term relationship between variables. This study adopted the maximum co-integration likelihood estimation proposed by Johansen to test whether there is co-integration between variables and to examine the numbers of vector of co-integration group (Widarjono, 2017). The statistical method used by Wang et al. (2010) are as follows:

a) The diagonal elements and trace test with statistical test is as follows:

$$\lambda_{trace}(r) = -T \sum_{t=r+1}^n \ln(1 - \lambda_1)$$

H1: rank (P) > r, is the number of independent vector matrix groups, namely the number of Eigen values that are different from 0; T is the number of samples; r is the number of vector groups that are co-integrated; is the estimated value for the Eigen value i; n is the number generated from the Eigen value that meets the chi-square and under chi-square distributions.

b) The maximum Eigen value test with statistical test is as follows:

$$\lambda_{max}(r, r + 1) = -T \ln(1 - \lambda_{r+1})$$

H1: rank (P) = r+1; T is the number of samples; r is the number of vector groups that are co-integrated; is the estimated value for the Eigen value i that meets the chi-square distribution.

4. Estimation of Vector Correction Mechanism (VECM)

Based on the Granger Representation Theorem, between the co-integrated variables, the nature of short-term relationships between variables is expressed in the form of error correction model (ECM) or VECM. This model is a time series data analysis that is used for variables that have dependencies which are often referred to as co-integration. The VECM method is used to balance the short-term economic relations of variables that have long-term economic balance. The VECM model of this study can be described as follows:

$$\Delta ISIXC_{TR} = \alpha_0 + \alpha_1 \Delta INFL + \alpha_2 \Delta ITRrate + \alpha_3 \Delta ECXrate + \alpha_4 \Delta STOCKPRCexchange + \alpha_4 u_{t-1} + e_t$$

u_{t-1} is lag 1 co-integration error, or mathematically written as:

$$u_{t-1} = \Delta ISIXC_{TR}_{t-1} - \alpha_0 - \alpha_1 \Delta INFL(t-1) - \alpha_2 \Delta ITRrate(t-1) - \alpha_3 \Delta ECXrate(t-1) - \alpha_4 \Delta STOCKPRCexchange(t-1)$$

Where; $\Delta ISIXCTR$ is total return from the green bond and green Sukuk index; $\Delta INFL$ is inflation rate; ΔITR rate is interest rate set by Bank Indonesia; ΔECX rate is exchange rate or forex exchange; $\Delta STOCKPRC$ exchange is stock price exchange by Indonesia Stock Exchange (IDX).

RESULTS AND DISCUSSION

Augmented Dickey Fuller Test (ADF) Stationary Test

The Augmented Dickey Fuller Test (ADF) Stationary Test is commonly a statistical test used to test whether a given time series is stationary or not and also important for forecasting. ADF stationary test results are as follows:

Table ADF Stationary Test

VARIABLES	RETURN_GSUKUK	INFL	BI RATE	EX_RATE	STOCK_EXCH
Intercept Prob.	-5.853579 (0.0000)	-5.309215 (0.0002)	-3.262643 (0.0267)	-6.127423 (0.0000)	-4.344137 (0.0020)
Trend & Intercept prob.	-4.047294 (0.0202)	-3.939190 (0.0241)	-3.898734 (0.0257)	-6.015726 (0.0002)	-4.324191 (0.0100)

From Table, all variables are stationary at 1% and 5% significance based on the ADF test (first difference). It means that the model does not contain the unit root.

Johansen Co-integration Test

The Johansen co-integration test is to find out the long-term relationship between variables using the lags length 2. This co-integration test is used to test the relationship between variables in the time series data. Following is the co-integration test results:

Table Co-integration Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.849748	119.4431	69.81889	0.0000
At most 1 *	0.737017	70.16161	47.85613	0.0001
At most 2 *	0.576063	35.43427	29.79707	0.0101
At most 3	0.340400	13.12181	15.49471	0.1104
At most 4	0.084755	2.302655	3.841466	0.1292
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **Mackinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.849748	49.28146	33.87687	0.0004
At most 1 *	0.737017	34.72734	27.58434	0.0051
At most 2 *	0.576063	22.31246	21.13162	0.0340
At most 3	0.340400	10.81916	14.26460	0.1635
At most 4	0.084755	2.302655	3.841466	0.1292
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **Mackinnon-Haug-Michelis (1999) p-values				

Table shows the statistical trace value of 119.4431, which is greater than the critical value of 69.81889, while Max-Eigen value is 49.28146 also greater than the critical value of 33.87 (p = 5%). Thus, it can be concluded that the variables inflation, BI rate and exchange rate, changes in stock exchange to green Sukuk return changes are co-integrated (p=5%).

Results of VECM Estimates: Macroeconomic Influence on the Performance of Green Sukuk Return

The VECM estimation results obtained a short-term and long-term relationship between green Sukuk return changes, inflation, BI rate, changes in exchange rates, and changes in stock exchange. In this estimation, the exogenous variable is the green Sukuk return change

(ISIXC_TR), while other variables are endogenous variable. The results of the VECM equation of the variables with lag 2 are shown in the following Table:

Table VECM Estimation Results for Indonesian Green Sukuk Index Performance

Variables	Coefficient	T-Statistic	Result
Long Term Model			
RETURN_GSUKUK(-1)	1.000000		
INFL(-1))	-0.354126	[-0.411047]	Significant at 1%
BI_RATE(-1))	0.139115	[0.133282]	No Significant
EX_RATE(-1))	-0.000953	[-0.735049]	Significant at 1%
STOCK_EXCH(-1))	0.000945	[0.545840]	Significant at 1%
C	13.48188	[13.48188]	
Short Term Model			
CointEq1	0.168463	[1.572871]	Significant at 10%
D(RETURN_GSUKUK(-1))	-0.517299	[-2.059291]	Significant at 10%
D(RETURN_GSUKUK(-2))	-0.488316	[-1.893418]	Significant at 10%
D(INFL(-1))	-1.718556	[-1.735759]	Significant at 10%
D(INFL(-2))	-0.086172	[-0.100340]	Significant at 10%
D(BI_RATE(-1))	-4.141742	[-1.861870]	No Significant
D(BI_RATE(-2))	4.810818	[1.919899]	No Significant
D(EX_RATE(-1))	-2.870316	[-0.727952]	Significant at 10%
D(EX_RATE(-2))	-3.134553	[-0.718418]	Significant at 10%
D(STOCK_EXCH(-1))	0.301857	[0.094019]	Significant at 10%
D(STOCK_EXCH(-2))	-1.302885	[-0.340811]	Significant at 10%
C	-0.058825	[-0.596326]	
R-squared	0.520029		
Adj. R-squared	0.168050		
Sum sq. resids	2.760819		

Notes: The t-table obtained with the number n sample = 30 and the total number of variables= 6, with df value is 24. The t-table value at 1%, 5% and 10% are 2.492, 2.063 and 1.710, respectively

The coefficient of determination test results show that the macroeconomic indicators have a significant contribution to changes in the return of green Sukuk in Indonesia by 16.80%.

Performance Analysis of Green Sukuk Return in the Long Term

Based on the VECM estimation results, in the long run, the variable exchange rate and stock exchange has a positive effect at 1% on the coefficient value is -0.000953 and 0.000945. While changes in inflation rates also have a significant effects at 1% on changes in the green Sukuk Index return. The coefficient of change in the inflation is -0.354126. This means that if there is an increase in the IDR / USD exchange rate at the first lag of 1% it will cause an increase in the long-term green Sukuk Index return by 0.46%.The pattern of changes in the green Sukuk index return, changes in exchange rates and stock exchange can be described in Figure.

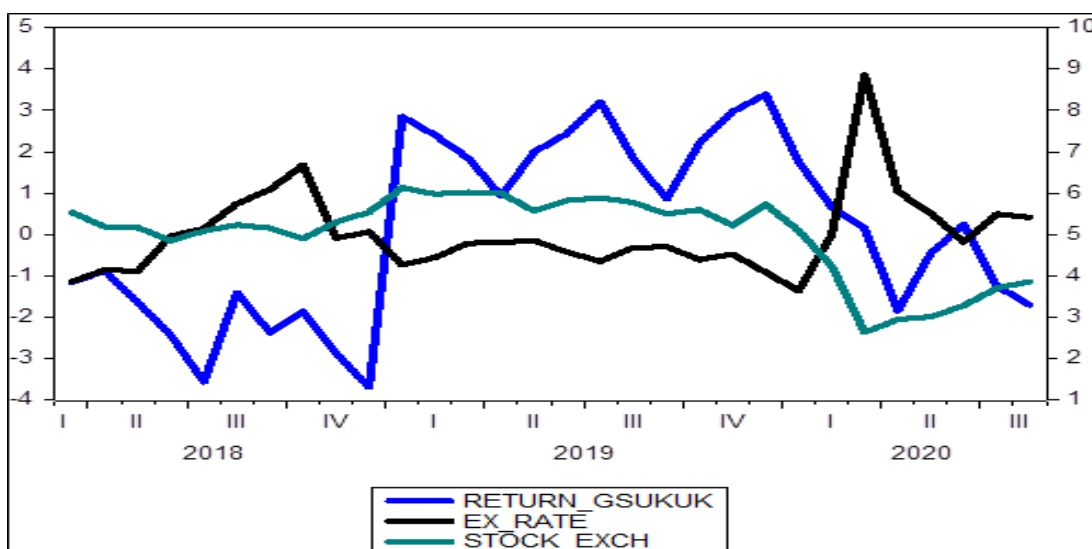


Figure Changes of the Green Sukuk Return to Exchange Rate and Stock Exchange

The above graph illustrates the change in green Sukuk return, exchange rates and stock exchange tend to fluctuate, although in some period there is opposite movement bit in many other periods changes in exchange rates and stock exchange are in line with changes in green Sukuk return. Furthermore, changes in the exchange rates and stock exchange become an important instrument that investors will pay attention to in investing because the environment of investing in Indonesia adheres to the floating exchange rate system. Therefore, the stability of the exchange rate needs to be one of the concerns of the Financial Services Authority (OJK) in Indonesia. While stock market supervision by the Financial Services Authority (OJK) as well and the authorized the application of the rules (regulator) by BEJ and KPEI (Kliring Penjamin Emisi Indonesia).

Meanwhile, the increase in inflation by 1% caused a decrease in green Sukuk return 3, 54% in the long run. The inflation is the tendency of rising prices of goods and services. The price increase has caused a decline in purchasing power and reduced the allocation of funds placed on securities including green Sukuk. The pattern of green Sukuk return, BI rate and inflation rates can be described in Figure;

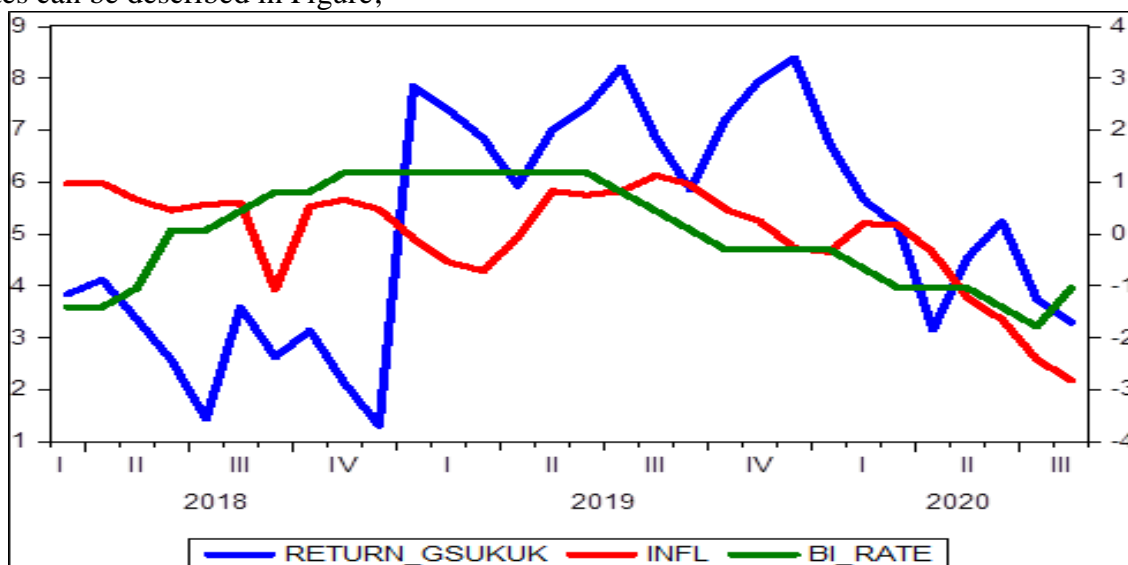


Figure Changes Return of Green Sukuk, BI Rate and Rate of Inflation in Indonesia

Figure illustrates that the volatility of changes in BI rate is smaller compared to changes in the green Sukuk return and inflation rate. Change in inflation rate looks more stable, but both have the same negative effects in changes in green Sukuk return. BI rate changes do not affect

the performance of green Sukuk return in the long term period. Furthermore, the signals issued by the Central Bank of Indonesia through interest rate policies that usually serve as a reference for banks and other financial institutions did not affect the changes in the performance of the green Sukuk index. Green Sukuk in Indonesia is dominated by sovereign (state) green Sukuk and the contract structure used is dominated by *ijarah*, *mudharabah* and *wakalah* contracts not affected by changes in the interest rate.

Performance Analysis of Green Sukuk Return in the Short Term

The results from Eviews software of the Johansen co-integration test showed that there is co-integration between variables. Nevertheless, in the short-term, the conditions that occur are not necessarily the same. Furthermore, a VECM test was conducted to observe the condition in the short-term. From the VECM estimation results (Table 4.14), it shows that the change in the green Sukuk return at lag 1 and lag 2 has a significant negative effect ($p=10\%$). In the first lag, the increase in the change in return of green Sukuk by 1% in the previous month will cause a decrease in the return of green Sukuk by 0.51% in the following month. While in the second lag, the increase in the change in return of 1% at $t-2$ months will decrease the return of green Sukuk by 0.48% on month t . The BI rate indicator does not significantly affect the change in green Sukuk performance on lag 1 but has a positive effect on the second lag ($p=10\%$). Similarly, the increase in the BI rate at $t-2$ months will increase green Sukuk return by 4.81% on month t .

Nevertheless, changes in the inflation rate in the first lag have a significant positive impact than in the second lag ($t-2$ month), namely 1.71% and 0.08%. That means in the short-term, the effect of inflation rate on changes in the green Sukuk return in the lag 1 have a positive influence, differently in the lag 2 have a negatively influence on the performance green Sukuk return. Changes in the exchange rate have also a significant positive effect on lag 2 ($p=10\%$). The increase in the exchange rate at $t-2$ months will increase the return of green Sukuk by 3.13% on month t . Changes in the stock exchange in the short-term have a positive influence on the changes in green Sukuk return both in lag 1 and lag 2 ($p=10\%$). In the first lag, the stock exchange increase by 1% will increase green Sukuk return by 0.30% in the following month, while a 1% increase at $t-2$ months will increase green Sukuk return by 1.30% on month t .

CLOSING

Discussion

1. Several macroeconomic variables affect the return of green Sukuk index. The first one is inflation. Changes in the inflation rates have a significant effect at 1% on changes in the green Sukuk Index return. The coefficient of change in the inflation is -0.354126. This means that if there is an increase in the IDR / USD exchange rate at the first lag of 1% it will cause an increase in the long-term green Sukuk Index return by 0.46%. It indicates that inflation has a relationship on the performance of green Sukuk return in Indonesia.
2. Another macroeconomic variable is interest (BI) rate. BI rate changes do not affect the performance of green Sukuk return in the long term period. The coefficient of change in BI rate is 0.139115 that means if there is a decrease in the interest rate in the long term period did not cause impact on performance of green Sukuk return. Furthermore, the signals issued by the Central Bank of Indonesia through interest rate policies that usually serve as a reference for banks and other financial institutions also did not affect the changes in the performance of the green Sukuk index. It means that the BI rate does not affect the performance of green Sukuk return in Indonesia.

3. This study also analysed the effect exchange rate on performance of green Sukuk return. The increase in the exchange rate in lag 1% will increase the return of green Sukuk by 0.73% in the long-term period. Changes in the exchange rates become an important instrument that investors will pay attention to because the environment of investing in Indonesia adheres to the floating exchange rate system, therefore, the stability of the exchange rate needs to be one of the concerns of the Financial Services Authority (OJK) in Indonesia. Hence, the variables exchange rate has an influence on performance of green Sukuk return in Indonesia.
4. The last independent variable examined for its effect on performance of green Sukuk return is stock exchange. Here, changes in stock price exchange in the long-term have a positive influence on changes in green Sukuk return both in lag 1 ($p=10\%$). In the first lag, the stock exchange increase by 1% will increase green Sukuk return by 0.54%, so stock price exchange is accepted.
5. Overall, the results of this study indicated that partially, the macroeconomic variable, namely interest (BI) rate cannot affect the performance of green Sukuk and bonds. But simultaneously, the three macroeconomic variables are significantly influence the performance of green Sukuk return in Indonesia. The results of this study are in line with the conclusion of previous studies in term of performance of green Sukuk. The result of the study conducted by Suciningtias (2019), who found that Bank Indonesia rate, inflation rate, changes in foreign exchange, changes in gold prices and world oil prices have co-integration in the long run with the Sukuk performance.

CONLUSSION

Simultantly, for the short and long term period, the effect of macroeconomic variables on the performance of green Sukuk is also are significant influence. Only variables interest (BI) rate did not effect on the performance of the green Sukuk return. This study has a policy implication. Based on the empirical findings, it can be concluded that the performance of Indonesian green Sukuk has distinctive characteristics compared with other countries that has issuance of green bonds. Generally, Indonesia green Sukuk uses the US dollar currency. The macroeconomics variables on performance of Indonesia green Sukuk are based on the empirical findings that the inflation rate, exchange rate, and stock exchange have a co-integration in the short-term and long run with the green Sukuk performance. Differently, the BI rate variable has no co-integration in the long-term period to green Sukuk performance. Investors should pay attention to exchange rate and stock exchange movements because both variables have short and long-term effects on green Sukuk. Furthermore, investors also need to pay attention to changes in the inflation because of its influence on green Sukuk return in the long run.

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