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Article

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Causality between Green Stock Market with Monetary Policy, Global Uncertainty, and Environmental Damage in Indonesia

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ABSTRACT

The study examines the effect of monetary policy, global uncertainty and environmental damage on the green stock market in Indonesia in the long and short term, using the Autoregressive Distributed Lag (ARDL) bound test method. The ARDL bound test results show that there is cointegration in the long term between the green stock market and monetary policy, global uncertainty and environmental damage. Empirical evidence finds that in the long term, the variables that affect the green stock market in Indonesia are monetary policy from interest rates, global uncertainty and environmental damage from carbon emissions. While in the short term the variables that affect the green stock market are interest rates without lag, lag 1, lag 2 and lag 3; global uncertainty in lag 1 and lag 2; and carbon emissions without lag and lag 1; while forest damage without lag shows a very weak effect at the 10% significance level. Coefficient Ect_{t-1} also shows significant and negative sign. A deeper analysis found that there is a bidirectional causality from monetary policy to green stock markets and vice versa, and from carbon emissions to green stock markets and vice versa.

Keywords: Green Stocks, Interest Rates, Global Uncertainty, Environmental Damage, ARDL
JEL Classifications: E7, G410

1. INTRODUCTION

The transition to a world of low casualties requires the cooperation of governments around the world including Indonesia to protect and preserve the earth from the impacts of disasters caused by climate change. This commitment is contained in the Paris agreement in December 2015. Transformation of the low-carbon economy can be achieved through a green economy. The development of the green economy cannot be separated from green finance. Green finance is the key to a low-carbon economy (Chen, 2013). Green finance can be achieved through a green stock market. In the 2021 Green Summit, the Indonesian government has planned to achieve carbon neutrality by 2060. For Indonesia, the transition to a green industry is not easy due to the high cost of green investment. To overcome these obstacles, the government can use the capital market as a place for companies to obtain additional funds from investors who want to invest in green assets. According to the World Bank, the capital market can be a means to mobilize funds in order to meet investment needs and assist countries by utilizing funding from the private sector so that they can achieve sustainable development goals. The empirical study of Pham (2021) explains that the capital market is a potential channel to increase investor interest in environmentally friendly financial markets.

On the Indonesia Stock Exchange, one of the indexes that can be used as a benchmark for green investment which consists of a group of listed companies that are included in the selection criteria for sustainable responsibility investment (SRI) and environmental, social and good governance (ESG) is the SRI KEHATI Index. This index is the first green stock index in Indonesia. Since its launch in June 2009, this index has historically performed better than some other conventional index. During the period from December 30, 2009 to December 30, 2019, the SRI KEHATI index generated a return of 173.66%, while the JCI and LQ45 were 148.57% and 103.59%, respectively. However, fluctuations in the SRI KEHATI index also indicate high volatility. High volatility indicates that the

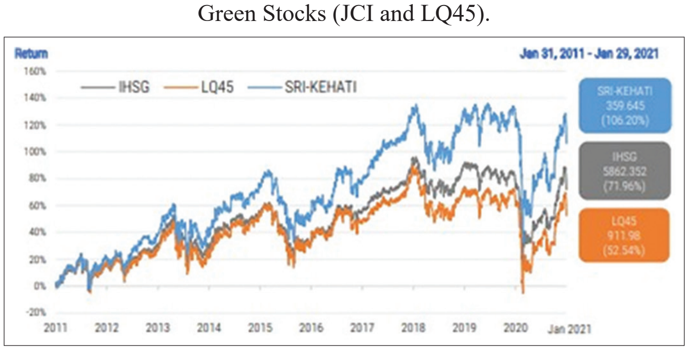
SRI KEHATI index is also sensitive to shocks. Empirical literature studies from Abugri (2008) and Bekhet and Matar (2013) provide an explanation that stock index volatility in emerging markets is higher than in more developed markets. In Figure 1 it can be seen that in 2013, 2015, and 2020 there was a sharp decline in index performance, but the worst occurred in 2020, where there was an economic crisis due to the COVID-19 Pandemic which shook the economy of the whole world, including Indonesia. Globally, companies and individuals are experiencing liquidity pressures. The stock market also experienced shocks from both the supply and demand sides.

Since the advent of capital markets in the world, economists have been burdened with the daunting task of making these financial intermediaries work efficiently and effectively. This is because asset prices are very sensitive to economic fluctuations, so supervision from the government is needed to maintain stability in the stock market. The capital market will always show a fluctuating trend so that if it is hit by a shock it will be very easy for bubbles to form which can trigger a financial crisis.

Empirical studies that analyze the factors that influence fluctuations in stock markets in several countries have been carried out by previous economists, such as monetary policy factors (Mishkin, 1978; Majid and Yusof, 2009; Gregoriou et al., 2009; Laopodis, 2010; Hojat and Sharifzadeh, 2017; Suriani et al., 2021; Tomar and Kesharwani, 2022). In addition to monetary policy, the source of economic fluctuations that is considered important is uncertainty (Bloom, 2009; Christiano et al., 2014; Gilchrist et al., 2014; Dery and Serletis, 2021). Another factor is environmental problems. Environmental problems arise as a result of increased economic activity. Environmental damage has become the concern of many parties, including investors in the stock market.

Furthermore, the empirical literature related to the determinants of the green stock market, we find that it is still limited in only a few countries. We identify green stock markets based on stock index criteria that fall into the SRI and ESG categories. Determinants from The green index on the American stock exchange are oil factor (Rehman et al., 2022), environmental issues of climate change and pollution (El Ouadghiri et al., 2021), exchange rate factors, gold prices, and oil (Kocaarslan and Soytas, 2021), oil prices (Sadorsky, 2012; Bondia et al., 2016; Ahmad, 2017; Dawar et al., 2021; Tan et al., 2021), financial fundamentals (Tzouvanas and Mamatzakis, 2021), environmental factors and bonds (Hammoudeh et al., 2020), interest rates (Bondia et al., 2016). The green index on the Chinese stock exchange is a risk factor for company characteristics, institutional risk, and economic factors (Fang et al., 2021). Green index related to Indonesian stock market: disclosure of sustainability that includes environmental, social and growth factors (Purwanto et al., 2021), green stock market performance (Zulkafli et al., 2017; Qoyum et al., 2021), and the effect of listing announcements and delisting SRI shares in Indonesia-Malaysia (Targanski and Murhadi, 2021).

Figure 1: YoY Return Trend of Green Stock Index (SRI) and Non-Green Stocks (JCI and LQ45).



Source: IDX *Fact Sheet* January (2021)

In summary, from the empirical literature that discusses the determinants of the green stock market, it can be identified, among others: first, empirical studies of the green stock market are mostly carried out for the green stock market which is classified as non-agnostic sector (there are specializations in certain industries). This is clearly different from the condition of the green stock market in Indonesia, which is classified as sector agnostic. Second, empirical studies are mostly conducted on green stocks in the United States and China stock exchanges, while the case for other countries' stock markets is still limited. Third, as far as we are concerned, empirical studies that analyze the effect of environmental damage from forest destruction on the green stock market for the case in Indonesia have never been conducted.

To overcome this limitation, this research needs to be done. Thus, this study aims to empirically analyze the effect of monetary policy, global uncertainty and environmental damage on the green stock market in Indonesia in the long and short term and examine the causality between these variables. With the findings of this study, it is hoped that it can provide input for policy makers to formulate effective policy strategies to promote a green stock market so that green economic development in Indonesia can be achieved. Besides, it can provide an overview for investors to design the right green investment trading strategy.

The outline of this paper is as follows: Section 2 provides an overview of the green stock market; section 3 highlights model specifications and estimation techniques; section 4 discusses the estimation results; and finally section 5 concludes the research.

2. GREEN STOCK MARKET OVERVIEW

Globally there are different terminology used to describe green investment (sustainable responsible investment (SRI)).The lack of a standard definition is seen in some literature related to SRI (Yesuf and Aassouli, 2020). Differences of opinion regarding the definition of SRI reflect the fact that on the one hand, the scope and practice that covers SRI changes from time to time, on the other hand SRI ethics are considered general depending on the context (society) in which it is applied (Martini, 2021).

SRI (sustainable responsible investment) is defined as a long-term oriented investment approach that integrates environmental, social and governance (ESG) factors in the process of research, analysis and selection of securities in investment portfolios. It combines fundamental analysis and engagement with evaluation of ESG factors to better capture long-term returns for investors, and to benefit society by influencing corporate behavior (Eurosif, 2021).

In the 2015–2019 Indonesia Sustainable Finance Roadmap guidebook, green stocks (SRI) can be said to be shares of companies go public environmentally friendly. The green stock index was formed to increase funding in the context of the capital market as a form of sustainable financial support. Environmentally friendly stock indexes will also increase the reputation or good name of a company so that it will make it easier to obtain funding as well as encourage improvements in environmental management in its business (OJK, 2014).

In Indonesia, there are 3 types of green stocks that are included in the SRI index category. The explanation of each index can be seen in Table 1. In the selection of SRI KEHATI index constituents, there are criteria core business screening (not including negative list), in addition to criteria for financial and liquidity aspects, as well as company ESG aspects.

3. MODEL SPECIFICATIONS AND ESTIMATION TECHNIQUES

The theoretical basis for the link between the stock market and macroeconomic risk factors can be seen from the Efficient Market Hypothesis (EMH) theory (Fama, 1965a, 1965b, 1970) and Arbitrage Pricing Theory (APT) (Ross, 1976). According to EMH, stock market prices include the most relevant and up-to-date information, so that past information is less predictive of future stock prices. That is why only relevant and new information is used to explain the volatility of stock market prices. While the APT is a development of the average variance model of the Capital Asset Pricing Model (CAPM) introduced by Treynor, 1961; Sharpe, 1964; Lintner, 1965, which includes the influence of macroeconomic variables to capture systematic risk in predicting stock prices (Yusof and Majid, 2007). In summary, if the market is efficient, then any changes in macroeconomic variables will directly or indirectly affect the expected cash flows of companies and their funding and investment decisions (Abbas and Wang, 2020).

The data used is a time series with a quarter period starting from July 2009 to December 2020. The determination of the initial period of analysis is based on the SRI KEHATI index data which was just launched in June 2009. The variable in this study is the SRI-KEHATI green stock index (SRI) from the Indonesia Stock Exchange (IDX) website, monetary policy as measured by the policy interest rate (PR) with data obtained from the Bank Indonesia (BI) website, global uncertainty is measured by the World Uncertainty Index (WUI) (Ahir et al., 2022) from the FRED economic data St. Louis FED, it's using a weighted average GDP unit, environmental damage are measured by the amount of territorial CO2 emissions (ECO2) and forest deforestation in Indonesia (DF) with ECO2 data sources from the Global Carbon Atlas (Andrew and Peters, 2021; Friedlingstein et al., 2021) in million tonne carbon (MtC) and Indonesia's deforestation data is obtained from the Indonesian Deforestation Report published by the Ministry of Environment and Forestry (KLHK), in thousand ha/yr.

Table 1: Types of Green Stock Index in Indonesia

SRI-KEHATI	ESG Quality 45 IDX KEHATI	ESG Sector Leader IDX KEHATI
• Comprising 25 top stocks with the best ESG score according to KEHATI evaluation. • Agnostic sector	• Comprising 45 best stocks based on the ESG performance evaluation, firm's financial quality, and good liquidity. • Financial ratios: Profitability (ROE), Earning risk (EPS Volume), and financial risk (leverage).	• Comprising stocks that have performance above their sectoral stocks' performance and have a good liquidity according to the ESG performance evaluation. • Industry classification based on IDX Industrial Classification (IDX-IC). • Having a variety number of constituent.

Source: KEHATI Foundation (2022).

For indicators of carbon emissions and deforestation, data are available in annual form. So this data needs to be converted into quarter form which will use the quadratic match sum interpolation technique. In Zhou (2001), it is explained that in order to get a strong statistical test result, it is necessary to use more observations so that with these data limitations, the interpolation technique can be used as a way to overcome the problem of data limitations. The interpolation technique has been widely accepted, and applied in several empirical studies (Baxter and King, 1995; Dees et al., 2005; Romero, 2005; Liu et al., 2012; Tang and Chuab, 2012; Shahbaz et al., 2014).

The reasons for choosing indicators as representatives of the analyzed variables include: policy interest rates are considered as the main instrument of monetary policy whose role is to maintain and maintain exchange rate stability and low inflation. The global uncertainty index is a report by the Economist Intelligence Unit (EIU) of an intelligence company that provides reports on the economic and political situation, on a quarterly basis an index that captures uncertainty from economic and political events originating from 143 countries with a population of at least 2 million. For indicators of environmental damage from carbon emissions and deforestation because these two indicators are still important issues related to environmental damage.

Thus, we explore the long-term and short-term relationship between green stock markets and monetary policy, global uncertainty and environmental damage by considering the multiple linear model in Equation (1):

$$SRI_t = \beta_0 + \beta_1 PR_t + \beta_2 lnWUI_t + \beta_3 ln\, ECO2_t + \beta_4 \ln DF_t + \varepsilon_t \quad (1)$$

Where the relationship of variables in equation (1) can be explained as follows:

$$\frac{\partial SRI_t}{\partial Pr_t} < 0, \frac{\partial SRI_t}{\partial lnWUI_t} < 0, \frac{\partial SRI_t}{\partial lnECO2_t} < 0, \frac{\partial SRI_t}{\partial \ln DF_t} < 0$$

β_0 is a constant term, β_1 up to β_6 is the estimated coefficient of the regression, ε_t is error term, variable SRI is the return from the SRI KEHATI index, PR is the Indonesian policy interest rate (percent), lnWUI is the natural log of the global uncertainty index (weighted average of GDP in dollars), $\ln ECO_2$ is the natural log of emissions Indonesia's territorial carbon in million tons of carbon per year (MtC), lnDF is the natural log of Indonesia's deforestation in thousand hectares/year (ha/year).

Data time series often experience stationarity problems, therefore the selection of econometric techniques to be used in this study refers to the results of the unit root test. The stationarity test carried out in this study used the Augmented Dickey-Fuller (ADF) test (Said and Dickey, 1984) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) with trend and intercept.

Table 2 shows the stationarity results from the ADF and KPSS tests which explain the stationarity of all variables. For the ADF test, the null hypothesis is rejected at first difference I(1) for all variables except ECO2 and DF. The null hypothesis cannot be rejected for the variables ECO2 and DF at both the level I(0) and first difference I(1) levels. This explains that ECO2 and DF are not stationary. So the ADF test cannot be applied and a second stationarity test is carried out using KPSS test which explains that the null hypothesis is rejected at the first difference level I (1) for all variables except SRI, where the null hypothesis is rejected for SRI at level I (0). This KPSS result shows that all variables are stationary at level I(0) and I(1). The results of the stationarity test in Table 2. Show that the appropriate method to be applied in analyzing this research is the ARDL (Autoregressive Distributed Lag) cointegration bound test approach from (Pesaran et al., 2001). This model has advantages compared to other cointegration techniques, including: (1) it can use a small number of samples (Ghatak and Siddiki, 2001), (2) it does not need to check for non-stationary properties and order of integration (Bekhet and Matar, 2013), (3) allows variables have different optimal lags, which is not possible with conventional cointegration procedures (Ozturk and Acaravci, 2011), (4) estimate the components of the long-term and short-run models simultaneously, eliminating problems associated with omitted variables and autocorrelation (Narayan, 2004).

To analyze the relationship between variables by testing the cointegration between variables, equation (1) can be converted into an equation that represents the ECM of the ARDL approach (p, q1, q2, q3, q4) which can be formulated in equation (2) to equation (6), that is:

$$\Delta SRI_t = \beta_0 + \sum_{i=1}^{p}\beta_{11}\Delta SRI_{t-i} + \sum_{i=0}^{q1}\beta_{12}\Delta PR_{t-i} + \sum_{i=0}^{q2}\beta_{13}\Delta \ln WUI_{t-i} + \sum_{i=0}^{q3}\beta_{14}\Delta lnECO2_{t-i} + \sum_{i=0}^{q4}\beta_{15}\Delta lnDF_{t-i} + \alpha_{11}SRI_{t-1} + \alpha_{12}PR_{t-1} + \alpha_{13}lnWUI_{t-1} + \alpha_{14}lnECO2_{t-1} +_{15} lnDF_{t-1} + e_{t1} \quad (2)$$

$$\Delta PR_t = \beta_0 + \sum_{i=1}^{p}\beta_{21}\Delta PR_{t-i} + \sum_{i=0}^{q1}\beta_{22}\Delta SRI_{t-i} + \sum_{i=0}^{q2}\beta_{23}\Delta \ln WUI_{t-i} + \sum_{i=0}^{q3}\beta_{24}\Delta lnECO2_{t-i} + \sum_{i=0}^{q4}\beta_{25}\Delta lnDF_{t-i} + \alpha_{21}PR_{t-1} + \alpha_{22}SRI_{t-1} + \alpha_{23}lnWUI_{t-1} + \alpha_{24}lnECO2_{t-1} +_{25} lnDF_{t-1} + e_{t1} \quad (3)$$

$$\Delta \ln WUI_t = \beta_0 + \sum_{i=1}^{p}\beta_{31}\Delta \ln WUI_{t-i} + \sum_{i=0}^{q1}\beta_{32}\Delta SRI_{t-i} + \sum_{i=0}^{q2}\beta_{33}\Delta PR_{t-i} + \sum_{i=0}^{q3}\beta_{34}\Delta lnECO2_{t-i} + \sum_{i=0}^{q4}\beta_{35}\Delta lnDF_{t-i} + \alpha_{31}WUI_{t-1} + \alpha_{32}SRI_{t-1} + \alpha_{33}PR_{t-1} + \alpha_{34}lnECO2_{t-1} +_{35} lnDF_{t-1} + e_{t1} \quad (4)$$

$$\Delta \ln ECO2_t = \beta_0 + \sum_{i=1}^{p}\beta_{41}\Delta \ln ECO2_{t-i} + \sum_{i=0}^{q1}\beta_{42}\Delta SRI_{t-i} + \sum_{i=0}^{q2}\beta_{43}\Delta PR_{t-i} + \sum_{i=0}^{q3}\beta_{44}\Delta lnWUI_{t-i} + \sum_{i=0}^{q4}\beta_{45}\Delta lnDF_{t-i} + \alpha_{41}lnECO2_{t-1} + \alpha_{42}SRI_{t-1} + \alpha_{43}PR_{t-1} + \alpha_{44}lnWUI_{t-1} +_{45} lnDF_{t-1} + e_{t1} \quad (5)$$

$$\Delta \ln DF_t = \beta_0 + \sum_{i=1}^{p}\beta_{51}\Delta \ln DF_{t-i} + \sum_{i=0}^{q1}\beta_{52}\Delta SRI_{t-i} + \sum_{i=0}^{q2}\beta_{53}\Delta PR_{t-i} + \sum_{i=0}^{q3}\beta_{54}\Delta lnWUI_{t-i} + \sum_{i=0}^{q4}\beta_{55}\Delta lnECO2_{t-i} + \alpha_{51}lnDF_{t-1} + \alpha_{52}SRI_{t-1} + \alpha_{53}PR_{t-1} + \alpha_{54}lnWUI_{t-1} +_{55} lnECO2_{t-1} + e_{t1} \quad (6)$$

Table 2: ADF and KPSS unit root test

Variable	ADF		KPSS	
	Level I (0)	1st difference I (1)	Level I (0)	1st difference I (1)
SRI	–9.392465***	–16.22999***	0.134688***	0.5000000
PR	–1.974797	–4.649456***	0.115518***	0.054480***
lnWUI	–3.879746***	–7.824084***	0.070151***	0.032125***
lnECO2	–2.760532	–1.266114	0.060190***	0.103063***
lnDF	2.684270	4.652045	0.160442	0.145637***

***, **, *indicate statistical significance at the 1%, 5%, and 10% levels. Data processing output with Eviews (2022) where Δ-is operator first difference, β_0 is constant term, $\beta_{11},\ldots\beta_{55}$ represents the short run coefficient, $q1,\ldots,q4$ is the lag length, e_{t1} is white noise error term. Sign summation (sum) in the equation represents the dynamics of error correction while the second part (sign with α_j) describes a long-term relationship. Furthermore, to examine the long-term and short-term relationship, the hypothesis can be formulated as follows:

No long term relationship	There is a long term relationship
H_0: $\alpha_{11}=\alpha_{12}=\alpha_{13}=\alpha_{14}=\alpha_{15}=0$	H_1: $\alpha_{11}\neq\alpha_{12}\neq\alpha_{13}\neq\alpha_{14}\neq\alpha_{15}\neq 0$
H_0: $\alpha_{21}=\alpha_{22}=\alpha_{23}=\alpha_{24}=\alpha_{25}=0$	H_1: $\alpha_{21}\neq\alpha_{22}\neq\alpha_{23}\neq\alpha_{24}\neq\alpha_{25}\neq 0$
H_0: $\alpha_{31}=\alpha_{32}=\alpha_{33}=\alpha_{34}=\alpha_{35}=0$	H_1: $\alpha_{31}\neq\alpha_{32}\neq\alpha_{33}\neq\alpha_{34}\neq\alpha_{35}\neq 0$
H_0: $\alpha_{41}=\alpha_{42}=\alpha_{43}=\alpha_{44}=\alpha_{45}=0$	H_1: $\alpha_{41}\neq\alpha_{42}\neq\alpha_{43}\neq\alpha_{44}\neq\alpha_{45}\neq 0$
H_0: $\alpha_{51}=\alpha_{52}=\alpha_{53}=\alpha_{54}=\alpha_{55}=0$	H_1: $\alpha_{51}\neq\alpha_{52}\neq\alpha_{53}\neq\alpha_{54}\neq\alpha_{55}\neq 0$

No short term relationship	There is a short term relationship
H_0: $\beta_{11}=\beta_{12}=\beta_{13}=\beta_{14}=\beta_{15}=0$	$H1$: $\beta_{11}\neq\beta_{12}\neq\beta_{13}\neq\beta_{14}\neq\beta_{15}\neq 0$
H_0: $\beta_{21}=\beta_{22}=\beta_{23}=\beta_{24}=\beta_{25}=0$	$H1$: $\beta_{21}\neq\beta_{22}\neq\beta_{23}\neq\beta_{24}\neq\beta_{25}\neq 0$
H_0: $\beta_{31}=\beta_{32}=\beta_{33}=\beta_{34}=\beta_{35}=0$	$H1$: $\beta_{31}\neq\beta_{32}\neq\beta_{33}\neq\beta_{34}\neq\beta_{35}\neq 0$
H_0: $\beta_{41}=\beta_{42}=\beta_{43}=\beta_{44}=\beta_{45}=0$	$H1$: $\beta_{41}\neq\beta_{42}\neq\beta_{43}\neq\beta_{44}\neq\beta_{45}\neq 0$
H_0: $\beta_{51}=\beta_{52}=\beta_{53}=\beta_{54}=\beta_{55}=0$	$H1$: $\beta_{51}\neq\beta_{52}\neq\beta_{53}\neq\beta_{54}\neq\beta_{55}\neq 0$

This hypothesis can be checked using standard F-statistics (Fs) which is compared to the critical value. Decision to reject or accept H_0 based on the following procedure:

If Fs> upper bound critical value, then reject H_0, there is a cointegration;

If Fs< lower bound critical value, then cannot reject H_0, no cointegration;

If Fs lower bound and-upper bound then there is no decision.

Once cointegration is confirmed, long-term relationships between variables using the selected ARDL model can be estimated. Furthermore the ECM ARDL can be estimated.

4. ESTIMATED RESULTS

In the process of testing cointegration in the ARDL model, it is important to determine the optimal lag on the variables for long-term level relationships based on the assumption of uncorrelated residuals. If the lag is entered too little then the residual from the regression will not display the process white noise so the model cannot estimate actual error correctly or result in estimation bias. On the other hand, if you include too many lags, it can reduce the ability to reject the hypothesis because too many additional parameters will reduce degrees of freedom or it can increase the standard error of coefficient estimation. So this will lead to a specification error (Gujarati, 2003). Determination of the optimal lag length is useful to avoid the problem of misspecification (Pesaran and Shin, 1999). The selected lag is based on minimum score criteria Akaike Information Criterion (AIC) (Akaike, 1981).

Table 3 shows the results of testing the long-term relationship between variables. From Table 3 it can be concluded that the null hypothesis can be rejected when the F-statistic is above the upper limit of the critical value according to the criteria of Pesaran et al. (2001) and Narayan (2004), which means that there is a long-term relationship between the dependent variable and the independent variables. Long-term coefficient estimates show that there is a relationship between interest rates and green stock markets and vice versa, there is a relationship between carbon emissions and green stock markets and vice versa, there is a relationship between green stock markets and global uncertainty but the relationship is weak, and there is no relationship between green stock markets and deforestation.

The conclusion from Table 4 shows that all variables in the long term have a significant effect on the green stock market, except for the deforestation variable which is not significant. The sign of the coefficients in Table 4 is also in accordance with the previous empirical results described in the analysis model of this study except for the global uncertainty variable.

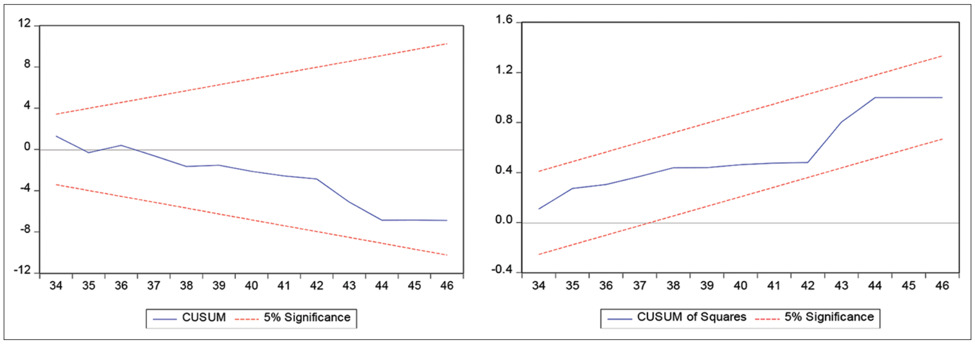
Furthermore, the short-term balance between the green stock market and regressors can be seen in Table 5. When the coefficient Error correction terms (Ect_{t-1}) significant and negative sign confirms the existence of a long-term equilibrium relationship between variables (Narayan and Smyth, 2005). Coefficient (Ect_{t-1}) shows the speed of adjustment in correcting imbalance, so that the economy can return to its balance (Pesaran and Pesaran, 2009). Coefficient (Ect_{t-1}) was found to be –5.2092 with high significance at the 1% (0.0000) level. This implies that the high speed adjustment returns to balance, where 520.92% of the previous quarter's imbalance may return to long-term equilibrium in the current quarter. In addition, the regressions for the underlying ARDL for all models passed the diagnostic tests of normality,

Table 3: Long-term relationship

Model	F-statistic	Level of Significance	Critical bound	
			Lower	Upper
F_{SRI} (SRI/PR, lnWUI, lnECO2, lnDF)	5.8615***		Asymptotic: n=1000	
F_{PR} (PR/SRI, lnWUI, lnECO2, lnDF	4.9946***	10%	2.2	3.09
F_{lnWUI} (lnWUI/SRI, PR, lnECO2, lnDF	3.8173**	5%	2.56	3.49
F_{lnECO2} (lnECO2/SRI, PR, lnWUI, lnDF	12.8356***	1%	3.29	4.37
F_{lnDEF} (lnDF/SRI, PR, lnWUI, lnECO2	1.6809			
			Finite sample: n=40	
		10%	2.402	3.395
		5%	2.893	4
		1%	3.967	5.455

Source: Data processing output with Eviews (2022)

Figure 2: CUSUM and CUSUMQ plots of the Green Stock Market.



Source: Data processing output from Eviews (2022)

Table 4: Estimation of the Long-Term Coefficient Model

SRI=–	–0.01606	+0.04195	0.00224	–0.00718
0.00964	PR	lnWUI	lnDF	lnECO2
t-value	–6.2705***	2.2213**	–0.3923	–6.2721***
P-value	0.0000	0.0447	0.7012	0.0000

The specification is restricted constant and no trend. The ** and *** signs indicate significance at the 5% and 1% levels. data processing output with Eviews (2022)

Table 5: Short-term coefficient estimation

Regressor	Coefficient	t-statistic	
ΔSRI_{t-1}	3.8541	5.9888***	
ΔSRI_{t-2}	3.0531	5.6623***	
ΔSRI_{t-3}	2.5499	5.5711***	
ΔSRI_{t-4}	1.7101	4.9474***	
ΔSRI_{t-5}	0.9016	4.0196***	
ΔSRI_{t-6}	0.3326	3.2661***	
ΔPR	–0.0824	–4.5838***	
ΔPR_{t-1}	0.0755	–3.6573***	
ΔPR_{t-2}	0.0538	–2.1885**	
ΔPR_{t-3}	0.0668	–2.7973**	
ΔlnWUI	–0.0099	–0.4005	
$\Delta lnWUI_{t-1}$	–0.1810	–4.2408***	
$\Delta lnWUI_{t-2}$	–0.1404	–4.2082***	
$\Delta lnWUI_{t-3}$	–0.0411	–1.6345	
$\Delta lnDF$	0.0060	–1.7758*	
$\Delta lnDF_{t-1}$	–0.0607	–1.4667	
$\Delta lnECO2$	0.0353	–2.7331**	
$\Delta \text{lnECO2}_{t-1}$	0.0608	–2.8757**	
$\Delta \text{lnECO2}_{t-2}$	0.0228	–1.1714	
$\Delta \text{lnECO2}_{t-3}$	0.0422	–2.8603**	
Ect_{t-1}	–5.2092	–6.9782***	
Adjusted R^2	0.8269	DW-statistic	1.9678
Normality	0.5781	Serial correlation X^2 (2)	0.8228
Heteroskedasticity X^2 (25)	0.1945		

Specifications are unrestricted constant and no trend. The ***sign indicates significance at the 1% level. data processing output from Eviews (2022)

serial correlation, and heteroscedasticity. These results reveal that there is no specification error.

A causality test between variables was also carried out. Table 6 explains that there is a bidirectional causality from the monetary policy variable to the green stock market and vice versa and from carbon emissions to the green stock market and vice versa. However, no causality was found in the other variables. The final test of the

Table 6: Checking causality with wald test

Dependent variable		Chi-square
SRI	PR	34,19758***
	LnWUI	9.716344
	LnECO2	26.68011***
	LnDF	2.411220
PR	SRI	15,91127***
LnWUI	SRI	2.174560
LnECO2	SRI	8.311050**
LnDF	SRI	0.137994

Data processing output from Eviews (2022)

stability of the ARDL model is needed to examine the stability of the long-term coefficient with short-term dynamics using CUSUM and CUSUMQ (Pesaran and Pesaran, 1997; Bahmani-Oskooee and Bohl, 2000) between the green stock market and the variables that influence it. We apply cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares (CUSUMQ) introduced by Brown et al. (1975). If the CUSUM and CUSUMQ plots remain within the critical limit (between two straight lines) implying a 5% significance level, then the graphical representation of the CUSUM and CUSUMSQ plots applied to the error-correction model is stable and the null hypothesis cannot be rejected (Bahmani-Oskooee and Ng, 2002). The CUSUM and CUSUMSQ graphs presented in Figure 2 of the recursive estimates of both sets of models reveal that there is stability and no detectable systematic change in the coefficients at the 5% significant level over the sample period. Thus, both CUSUM and CUSUMSQ of the coefficients of the error correction model show structural stability for the two models tested.

5. CONCLUSION

This study investigates the relationship between green stock markets and monetary policy, global uncertainty, and environmental damage in Indonesia by testing the cointegration between variables. This article contributes to knowledge in the empirical literature using the ARDL-bounds test in examining cointegration. The estimation results show strong evidence for the null hypothesis of the unit root in the investigated data series. The results of the ARDL-bound test show that there is a long-term equilibrium relationship between the variables investigated. Stable error correction model from test results with CUSUM and CUSUMQ. Monetary policy shocks through policy interest rates have a negative and significant effect on the green stock market both in the long and short term with lag and without lag. These results are in agreement with previous studies (eg. Bissoon et al., 2016; Sahu and Pandey, 2020; Zhang and Zheng, 2020; Tchereni and Mpini, 2020). These results also explain that monetary policy is also effective for emerging market stock markets. The monetary policy mechanism in influencing the stock market is through a decrease in interest rates which results in a shift in consumer and household decisions as investors, where investors who usually invest part of their funds in bonds, with low interest rates, make bonds less attractive so that investors shift their funds to stocks. So that the demand for stocks increases and causes stock prices to also increase (Rozeff, 1974; Mishkin, 1996). Interestingly we find that global uncertainty affects green stock markets positively. Increased global uncertainty stemming from global political and economic uncertainty has benefited Indonesia's green stock market. It seems that increasing global uncertainty is changing the behavior of investors who tend to choose safe risks by diverting their funds to the green stock market in Indonesia. This also strengthens the real result that the performance of the green stock index is better than the performance of other indices.

These empirical results are also in line with Yang et al. (2020) who found that uncertainty had a positive effect on the stock market in China. Furthermore, we also find that environmental damage stemming from carbon emissions has a negative effect on the green stock market. These results are in agreement with previous empirical evidence from Wen et al. (2020). The increase in carbon emissions causes stock prices to decrease due to the shifting attention of investors who consider green companies to be responsible for increasing carbon that can damage the environment. Meanwhile, global uncertainty and deforestation have not shown their effect on the green stock market in Indonesia. Coefficient of Ect_{t-1} which gives a negative and significant sign indicates the speed of adjustment from short-term imbalance to long-term balance. Therefore, it can be said that green stock price variability is basically related to monetary policy variables, global uncertainty and environmental damage from carbon emissions, through changes in stock returns that lag behind economic activities.

The findings and implications of this study are limited to the green stock market in Indonesia with the characteristics of a developing country stock market. Incorporating a longer sample period, covering more green stock markets worldwide and including other macroeconomic variables that have the potential to influence green stock markets could enhance further analysis and implications of studies in this issue.

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