International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2025, 15(2), 360-369.

The Dynamic Response of the Green Stock Market to External Economic Policy Uncertainty: The Case of Indonesia

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Received: 10 October 2024 **Accepted:** 03 February 2025 **DOI:** https://doi.org/10.32479/ijeep.18254

ABSTRACT

This study analyzes the effects of economic policy uncertainty and external shocks on the Indonesian green stock market. This study uses secondary data from January 2010 to December 2023, covering a sample size of 168 months, and uses the ARDL model to estimate the research framework. The study findings reveal that, in the short term, the exchange rate has a significant effect on the green stock market, while economic policy uncertainty, including domestic economic policy uncertainty, does not affect the green stock market. This suggests that the green stock market is less susceptible to external market sentiment and tends to be more stable in the short term. In addition, there is a difference in the effects of the exchange rate and oil prices. Again, similar results are also revealed in the long term, which sees only the exchange rate affecting the green stock market. This suggests that investment in the Indonesian green stock market is based on a paradigm shift towards more sustainable economic practices where other external sentiments may not significantly affect investment decisions. The implications of these findings are important for policymakers and investors to consider green stocks, which tend to be more stable than conventional stocks.

Keywords: Green Stock Market, Economic Policy Uncertainty, ARDL, Exchange Rate, Oil Price
JEL Classifications: E31, E43, E52, F31, G18, G38

1. INTRODUCTION

Research on the influence of economic policy uncertainty on stock markets has been widely carried out in developed and developing countries. The research results show that economic policy uncertainty (EPU) harms the stock market except the US stock market (Tzika and Pantelidis, 2024). Stock markets in other countries, including developed countries, also experience negative effects from economic policy uncertainty, such as stock markets such as Canada (Batabyal and Killins, 2021), Japan (Keddad, 2024), and G7 countries (Kundu and Paul, 2022; Nusair and Al-Khasawneh, 2022).

Emerging market countries, such as India (Simran, 2024), Nigeria (Isah et al., 2024), several emerging market countries (Hong et al., 2024), and 25 countries (Liu et al., 2022), also experience negative effects from economic policy uncertainty. This research shows that economic policy uncertainty significantly influences developing countries because the stock market is relatively underdeveloped.

Research on the influence of economic policy uncertainty on the green stock market is still minimal, and there is no consensus on the results because there are green stock markets that do not experience negative effects due to economic policy uncertainty. Some experience negative effects. Mensi et al. (2023) found that the green stock market was relatively stable amid economic policy uncertainty. Specifically, regarding the influence of oil prices, the researcher obtained results that show that oil prices do not influence the stability of the green stock market. This means the green stock market is relatively stable if there are fluctuations in economic policy uncertainty and oil prices.

However, several other studies have proven different results, such as the green stock market experiencing negative effects due to fluctuations in oil prices, other external variables, and economic policy uncertainty. These results are almost the same for both stock markets in developed and developing countries. These studies include Shahbaz et al. (2021), Li et al. (2022), Pham and Nguyen (2022), Long et al. (2022), Hanif et al. (2023), Li et al. (2023) and Umar et al. (2024). The results of these two research groups were very different, and no two decisions were the same.

An analysis of the influence of economic policy uncertainty and several external variables has not been carried out in Indonesia, especially in the green stock market. The green stock market is a very important choice for investors; more and more companies are entering it because of the green stock market index. The green stock market is relatively stable compared to the overall index. This is under the development of the green stock market in Indonesia, which is relatively stable compared to the Indonesian stock market as a whole.

Figure 1 shows that the green stock market did not experience significant fluctuations from January 2010 to December 2023, despite large fluctuations in Federal and Indonesian interest rates (Federal Reserve, 2024). This suggests that, in general, the green stock market is relatively stable and unaffected by both external and internal economic policy uncertainty. However, this claim requires empirical verification, as the green stock market has increasingly gained attention.

The response of the green stock market to oil prices and exchange rates is quite distinct, as the green stock market tends to decline when the local currency depreciates, and oil prices rise. Figure 2 illustrates this dynamic, highlighting these differing conditions. Previous research suggests that the green stock market generally does not experience significant fluctuations in response to external shocks like oil prices and exchange rates (Mensi et al., 2022; Mensi et al., 2023). However, other studies present contrasting findings, including research by Shahbaz et al. (2021), Li et al. (2022), Pham and Nguyen (2022), Long et al. (2022), Li et al. (2023), Hanif et al. (2023), and Umar et al. (2024). These studies show a lack of consensus regarding the influence of external shocks on the green stock market across various markets.

Additionally, there has been limited analysis of the impact of external shocks on Indonesia's green stock market, which is one of the motivations for this research. The results will provide valuable insights for policymakers and investors in the Indonesian stock market. Moreover, this research is crucial in comparing the effects of external and domestic economic policy uncertainty. The influence of these two external variables has yet to be fully explored to determine whether their impacts on the green stock market are similar. Addressing these issues is essential for this study and will serve as an important reference for emerging markets with green stock indices.

2. LITERATURE REVIEW

In general, the analysis of the influence of economic policy uncertainty (EPU) on stock markets has been widely conducted in both developed and developing countries. Researchers have used various models, ranging from linear to nonlinear models. For example, Kundu and Paul (2022) examined the effects of EPU on stock markets in seven countries using Markov switching VAR models, concluding that EPU increases stock market volatility and reduces stock returns. Similarly, Nusair and Al-Khasawneh (2022) used the ARDL linear model to analyze EPU's impact on the stock markets of G7 countries, showing that EPU has a negative and significant effect on these markets. However, short- and long-term influences are only observed in the Canadian and Japanese stock markets. These studies demonstrate the impact of EPU on G7 countries' stock markets.

Meanwhile, Hong et al. (2024) applied the Granger causality test to analyze the influence of EPU on the Group of Seven and Emerging Market Seven nations from 1997 to 2022. They found that domestic and global economic policies influenced half of the stock market group and showed that global EPU has a more significant impact than domestic EPU.

In the case of the US, Li et al. (2023) found that the South Korean and Japanese stock markets were more resilient to global economic policy uncertainty compared to other Asian markets. Additionally, they observed that the US stock market remained more stable during periods of economic policy uncertainty, highlighting the strength of stock markets in developed countries compared to emerging ones. The stability of the US stock market, being the largest in the world, is further supported by Tzika and Pantelidis

Figure 1: Indonesia stock index, green stock index, federal interest rate, and Indonesia interest rate, 2010-2023 (Monthly data)

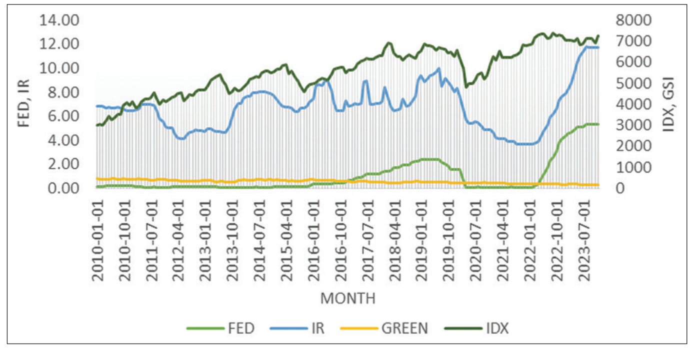
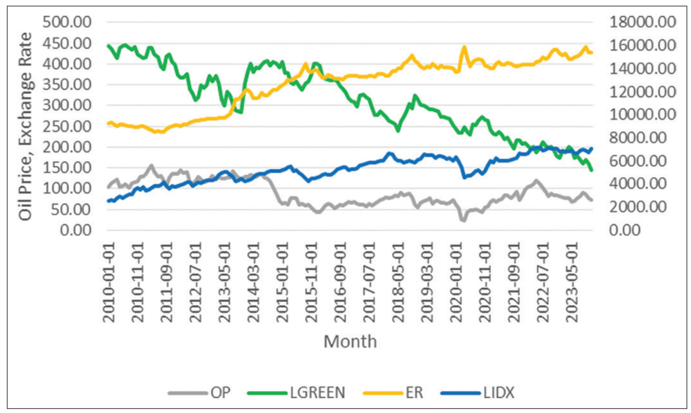


Figure 2: Oil price, exchange rate, Indonesia stock index, and green stock market, January 2010-December 2023



(2024). Their research, using monthly data, shows that the impact of economic policy uncertainty on the US market is minimal. This suggests that the sheer size of the US stock market helps buffer it from significant fluctuations due to policy-related sentiment.

The Canadian stock market, however, shows different behavior. Batabyal and Killins (2021) found that EPU has a negative and significant impact on Canadian stock returns, with asymmetric short- and long-term effects. This suggests that even stock markets in developed countries are susceptible to the adverse effects of EPU.

Similarly, Shi and Wang (2023) compared the influence of US and Chinese policies on 11 major stock markets using daily and monthly data. They found that the US EPU has a more significant impact on European stock markets, while China's EPU influences Asian markets, especially in terms of monthly data. This highlights the importance of developing countries remaining vigilant about the policies of larger economies.

The US's influence on developing countries is significant, as these countries often adjust their policies in response to US policy changes. Yang et al. (2023) conducted a comprehensive analysis of the global oil market and EPU's impact on the US and Chinese stock markets, confirming that the US stock market is more dominant in affecting global oil prices. Their research also found that rising EPU in both countries substantially impacts global oil prices and stock market volatility.

On the other hand, Keddad (2024) provides a comparative analysis of the impact of economic policy uncertainty from the United States, China, Japan, and the European Union on Asian stock markets. The study reveals that China significantly shapes Asian economic policies, exerting considerable influence over Japanese and American markets. In particular, China's monetary, fiscal, and exchange rate policies have a strong impact, especially on developed countries. The findings also indicate that China's policies significantly affect stock markets in neighboring countries, emphasizing China's critical role in the region's economic dynamics.

Similarly, research by Lean et al. (2024), which used a VAR model, examines the influence of US and Chinese economic policies on ASEAN stock markets. Their study shows that the impact of these policies varies across ASEAN countries, where some markets exhibit strength while others are highly vulnerable to global policy shifts.

Another researcher, such as Shao et al. (2022), also examined dynamic EPU and stock markets in China, the UK, and the US, showing that EPU drives the Chinese stock market while the UK and US markets lead. Using a time-varying parameter VAR model, Dai and Peng (2022) examined the impact of economic policy uncertainty on China's stock market and uncovered several key findings. Firstly, the consumption, industrial, public utility, and financial sectors play a crucial role in the Chinese stock market. Secondly, fiscal and trade policies significantly impact monetary policy, and exchange rates exert a relatively minor influence. In a related study, Zhang et al. (2023) used the GARCH model to assess the effect of global economic policy uncertainty on China's stock market, revealing that such uncertainty drives long-term volatility in China's equity market.

This was confirmed by Isah et al. (2024), who investigated the impact of global and domestic economic policy uncertainty on Nigeria's stock market using the GARCH-MIDAS model. Their study reveals that global and domestic policy uncertainty significantly affect future stock market investments, with global uncertainty having a more pronounced impact. This highlights the stronger influence of global policies, especially in developing markets, and emphasizes the need for government intervention to reduce the effects of global economic policy uncertainty, preventing large market fluctuations.

Similar research has been conducted in various countries. For instance, Mamman et al. (2023) utilized the GARCH panel model to assess the impact of global economic policy uncertainty on the BRICS countries (Brazil, Russia, India, China, and South Africa). The study showed that global policy uncertainty increases stock market volatility in these nations. The study suggests that coordinated policies could help mitigate the effects of global uncertainty.

By utilizing a different approach, Liu et al. (2022) explored the nonlinear effects of economic policy uncertainty and oil price volatility on stock markets in 25 countries using a panel smooth transition regression model. Their findings show that oil price volatility negatively affects stock markets, particularly during periods of economic policy uncertainty, further demonstrating how policy influences oil prices and stock markets. Adekoya et al. (2022) also examined the impact of economic policy uncertainty on 62 energy companies across various markets, revealing that companies unprotected by hedging strategies suffer more from uncertainty than those that hedge.

Other studies have used nonlinear models, such as Simran (2024), who applied the NARDL model to analyze the influence of global economic policy uncertainty on India's stock market. The research shows that global policy uncertainty has an asymmetric effect, with positive policies having a more significant impact than negative ones. Simran advises policymakers to proactively manage global economic policy uncertainty to minimize negative effects and enhance positive outcomes.

Earlier research by Li et al. (2023) using the GARCH-MIDAS model found that economic policy uncertainty could indicate stock market volatility, helping investors predict market movements. Benchimol et al. (2023) analyzed the effects of monetary policy on stock markets, discovering that the market responds more aggressively to monetary policy changes and exhibits asymmetric reactions to positive and negative policy shifts, further confirming monetary policy's influence on the stock market.

These studies demonstrate that economic policy uncertainty significantly impacts stock markets in developed and developing countries, using a mix of linear and nonlinear models. However, specific research on the effects of economic policy uncertainty on the green stock market remains limited. Shahbaz et al. (2021) conducted a causality study linking energy markets, stock markets, and green stock returns. They found that the clean energy market reacts asymmetrically to oil price shocks and stock market conditions, with larger fluctuations in oil prices and stock markets negatively affecting the clean energy sector.

Meanwhile, Mensi et al. (2022) examined the dynamic relationship between green bonds, WTI oil prices, and stock markets in G7 countries. Their research shows that green bonds reduce the impact of oil price changes on stock markets, suggesting that diversifying with green stocks can mitigate external risks. Similarly, Li et al. (2022) analyzed the interplay between oil prices, green bonds, carbon emissions, and efficiency indexes, finding that oil prices negatively impact green bonds and carbon prices while boosting short- and medium-term carbon efficiency.

Pham and Nguyen (2022) also studied the effects of oil prices, stock markets, and economic policy uncertainty on green bond returns, finding a time- and country-dependent relationship between green bonds and uncertainty. They concluded that green bonds offer a hedge against uncertainty. Similarly, Long et al. (2022) analyzed spillover effects between uncertainty and green bond markets in the US, Europe, and China, discovering significant impacts of oil price and stock market uncertainty on green bonds.

While green stock markets have received attention, research on their response to external factors, such as EPU, is still developing. Li et al. (2023) analyzed the influence of oil prices on seven Chinese green energy stock markets, showing that green energy stocks lead to oil price changes. Mensi et al. (2023) found that green stocks are net transmitters of risk in the short term but net receivers in the long term, with resilience akin to gold.

However, there are also several studies that yielded different results. For instance, Hanif et al. (2023) examined various factors affecting the green stock market and found that oil prices have a stronger impact on the green stock market than other variables. Additionally, they noted that the green stock market has not developed as much as the conventional stock market. Similarly, Umar et al. (2024) studied the effect of oil price shocks on green stock markets in 12 developed countries, concluding that the US and European green stock markets are the primary contributors to return volatility and spillover effects globally. Furthermore, they found that oil prices have a more significant impact on green stock markets.

These findings illustrate a lack of consensus regarding the influence of external variables on the green stock market. Moreover, limited research analyzes the effect of economic policy uncertainty on the green stock market. Specifically, in the context of Indonesia, no studies have investigated how economic policy uncertainty or other external factors affect its stock market. This presents an opportunity for new research to serve as a reference for policymakers and investors in addressing external shocks on the Indonesian green stock market, which is one of the world's emerging markets. The research is particularly important as it aims to address a key issue in the green stock market, which has not been fully explored and lacks consensus, especially in Indonesia.

3. RESEARCH METHOD AND DATA

3.1. Data

This study utilizes monthly data spanning from January 2010 to December 2023, covering 168 months. The starting point of the data was January 2010, when new green stock market data became available in June 2009. The variables included in the study are the Green Stock Index (GSI), Federal Interest Rate (FED), (Federal Reserve, 2024), Indonesia Interest Rate (IR), Industrial Production Index (IPI), Inflation (INF), Exchange Rate (ER), and Oil Price (OP). The GSI, ER, and OP variables are log-transformed, while the other variables are expressed as percentages. According to Lütkepohl and Xu (2012), applying logarithmic transformations helps stabilize the variance of the variables used in the estimation. The sources and definitions of the variables are presented in Table 1.

3.2. Model Analysis

Most macroeconomic and financial data exhibit trends, with many being stationary at different levels. Due to these varying stationarity levels, the most suitable model for analysis is the Autoregressive Distributed Lag (ARDL) model. Considering this, the study adopts the ARDL model, which is expressed as follows:

$$\begin{aligned} ln\Delta GSI_t = {} & \beta_1 + \sum_{i=1}^{j2} \beta_2 \Delta lnGSI_{t-i} + \sum_{i=0}^{j3} \beta_3 \Delta FED_{t-i} \\ & + \sum_{i=0}^{j4} \beta_4 \Delta IR_{t-i} + \sum_{i=0}^{j5} \beta_5 \Delta IPI_{t-i} \\ & + \sum_{i=0}^{j6} \beta_6 \Delta INF_{t-i} + \sum_{i=0}^{j7} \beta_7 \Delta LnER_{t-i} \\ & + \sum_{i=0}^{j7} \beta_7 \Delta lnOP_{t-i} + \theta_1 lnGSI_{t-1} \\ & + \theta_2 FED_{t-1} + \theta_3 IR_{t-1} + \theta_4 IPI_{t-1} \\ & + \theta_5 INF_{t-1} + \theta_6 lnER_{t-1} + \theta_7 lnOP_{t-1} + \grave{o}_t \end{aligned} \quad (1)$$

The first step in estimating equation (1) involves conducting a stationarity test. If the variables exhibit different levels of stationarity, equation (1) can be applied. However, if they share the same level of stationarity, a more suitable model based on the data distribution will be required. After confirming different stationarity levels, equation (1) is estimated, ensuring that certain conditions of the ARDL model are met. One key condition is that the error correction term coefficient must be negative and statistically significant. Additionally, the model must demonstrate stability, which can be confirmed by the Cusum and Cusum–Q graphs, with the plotted line falling within the upper and lower bounds.

Once these model criteria are satisfied, the estimated model is further tested against classical linear regression assumptions. If the results meet all these assumptions, such as normality, absence of serial correlation, and homoscedasticity, the model is deemed suitable for analysis. The ARDL model is chosen due to several advantages. First, it is more appropriate for small sample sizes compared to the Johansen–Juselius and Engle–Granger models, particularly for cointegration testing (Ghatak and Siddiki, 2001;

Hazman, 2016). Second, the ARDL model can handle data combinations of *I(0)* and *I(1)* without requiring the same order of cointegration, unlike other models (Pesaran et al., 2001). Third, it allows for different lags between variables (Ozturk and Agenvci, 2011). This model has been widely adopted in global economic and financial studies (Jayaraman and Choong, 2009).

3.3. Testing for Short-run Effects

This study employs monthly data, which allows for relatively long lag lengths in the short-term analysis. To account for all potential lag lengths, the Wald Test is applied in the analysis. Several tests are conducted to examine the short-term dynamic effects, as outlined in the earlier section. The variables under consideration include the Federal interest rate as a proxy for economic policy uncertainty (EPU), Indonesia's interest rate, income (IPI), inflation, exchange rate, and oil price. The null and alternative hypotheses for these tests are presented in Table 2.

3.4. Symmetric Effect Testing

A test for symmetry is conducted to assess whether the independent variables exert similar effects. This test examines whether specific variables have identical impacts. The symmetric effects are formulated as hypotheses as follows in Table 3:

4. FINDINGS AND DISCUSSION

4.1. Findings

The first step in developing a time series model is conducting a stationarity test, as the results will determine the most appropriate model to use. Table 4 presents the stationarity test outcomes for all variables used in the estimated model according to equation (1). The results indicate varying levels of stationarity: two variables—Industrial Production Index (IPI) and inflation (INF)—are stationary at the level, while five variables—the Green Stock Index (GSI), external monetary policy (FED) as a proxy for economic policy uncertainty, interest rate (IR), and exchange rate (ER)—are stationary after the first difference. Based on these findings, the Autoregressive Distributed Lag (ARDL) model is deemed the most appropriate for this research.

According to the stationarity test results (Table 4), the ARDL model is the best fit. The PP test results align closely with those of the ADF test, confirming the consistency of the stationarity level for each variable. Short-term estimation results, provided in Appendix 1, show that the model is suitable for analysis, as the error-correction term coefficient is negative and significant, fulfilling the necessary conditions for use in this study.

Lag length determination can be done either automatically or manually. In this study, a fixed lag model was chosen for two reasons. First, the automatic method yielded a lag length of zero, which was unsuitable since previous research shows that several variables affect the green stock market. Second, using the same lag lengths ensures a fairer comparison. Based on these considerations, the fixed lag model was selected, with seven lagged variables and trends being the most appropriate configuration. The Wald test was used to analyze short-term effects, allowing for a more comprehensive analysis based on the hypotheses outlined in Table 2.

The model's validity was tested using a bound test to evaluate the long-run relationship, which indicates whether the model captures both short-term and long-term dynamics. Two distributions are available; the *F* distribution and the *t* distribution. The *t* distribution was selected for this study to assess the short- and long-term relationship. Table 5 presents the bound test results, which show significance at the 5% level. This confirms that the model accurately reflects both short-term and long-term relationships, making it suitable for this analysis.

Table 1: Variables definitions and the sources

Variable	Definition	Source
Green Stock Index (GSI)	Sustainable and Responsible Investment (SRI) consisting of 25 listed companies in the Indonesia Stock Exchange (IDX)	https://www.investing.com/indices/sri-kehati
Federal Interest Rate (Fed)	The average monthly interest rate in the United States	https://fred.stlouisfed.org/series/fedfunds
Indonesia Interest Rate (IR)	Monthly saving interest rate	https://www.bi.go.id/id/statistik/ekonomi-keuangan/seki/Default.aspx#headingThree
Industrial Production Index (IPI)	Monthly income	https://macrovar.com/indonesia/industrial-production/
Inflation (INF)	Monthly inflation rate	https://www.bi.go.id/id/statistik/ekonomi-keuangan/seki/Default.aspx#headingThree
Exchange Rate (ER)	The exchange rate IDR to USD	https://www.bi.go.id/id/statistik/ekonomi-keuangan/seki/Default.aspx#headingThree
Oil Price (OP)	Monthly Western Texas Oil Price	https://www.oilcrudeprice.com/wti-oil-price/

Table 2: Short–run dynamic effects

Short-Term Dynamic Influences	Null Hypothesis	Alternative Hypothesis
Federal Interest Rate	$\beta_{31} = \beta_{32} = \cdots = \beta_{3j} = 0$	$\beta_{31} \neq \beta_{32} \neq \cdots \neq \beta_{3j} \neq 0$
Indonesia Interest Rate	$\beta_{41} = \beta_{42} = \cdots = \beta_{4j} = 0$	$\beta_{41} \neq \beta_{42} \neq \cdots \neq \beta_{4j} \neq 0$
Income	$\beta_{51} = \beta_{52} = \cdots = \beta_{5j} = 0$	$\beta_{51} \neq \beta_{52} \neq \cdots \neq \beta_{5j} \neq 0$
Inflation	$\beta_{61} = \beta_{62} = \cdots = \beta_{6j} = 0$	$\beta_{61} \neq \beta_{62} \neq \cdots \neq \beta_{6j} \neq 0$
Exchange Rate	$\beta_{71} = \beta_{72} = \cdots = \beta_{7j} = 0$	$\beta_{71} \neq \beta_{72} \neq \cdots \neq \beta_{7j} \neq 0$
Oil Price	$\beta_{81} = \beta_{82} = \cdots = \beta_{8j} = 0$	$\beta_{81} \neq \beta_{82} \neq \cdots \neq \beta_{8j} \neq 0$

Table 3: Testing for symmetric effects

Short-term dynamic influences	Null hypothesis	Alternative hypothesis
Federal Interest Rate and Indonesia Interest Rate	$\sum_{i=0}^{j3}\beta_3 = \sum_{i=0}^{j4}\beta_4$	$\sum_{i=0}^{j3}\beta_3 \neq \sum_{i=0}^{j4}\beta_4$
Exchange Rate and Oil Price	$\sum_{i=0}^{j7}\beta_7 = \sum_{i=0}^{j8}\beta_8$	$e\sum_{i=0}^{j7}\beta_7 \neq \sum_{i=0}^{j8}\beta_8$

Table 4: ADF and PP stationarity test results

Variable	Method	Level	First Difference	Cointegration
		Statistics	Statistics	
Green Stock Index	ADF	–2.1675	–11.5941***	I (1)
	PP	−2.2432	−12.4215***	I (1)
Federal Interest Rate	ADF	–2.2581	–3.6605***	I (1)
	PP	−0.9276	−6.0427***	I (1)
Indonesia Interest Rate	ADF	–2.3743	–10.6176***	I (1)
	PP	−2.2822	−10.5769***	I (1)
Industrial Production Index	ADF	–5.6774***	–15.6499***	I (0)
	PP	−5.6938***	−17.7676***	I (0)
Inflation	ADF	–10.9996***	–12.3931***	I (0)
	PP	−9.5038***	−33.2954***	I (0)
Exchange Rate	ADF	–1.2939	–10.7029***	I (1)
	PP	−1.5663	−10.0349***	I (1)
Oil Price	ADF	–2.9283	–9.9374***	I (1)
	PP	−2.6093	−11.1124***	I (1)

Table 5: Bound test of long–run relationship

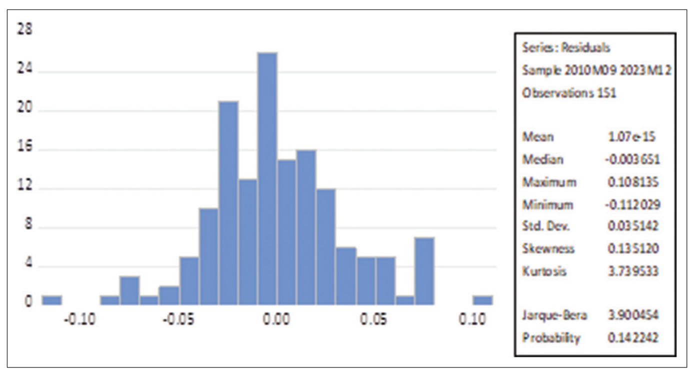
Test Statistic Value	Significant	I (0)	I (1)
–4.3762	10%	−3.13	−4.37
	5%	−3.41	−4.69
	1%	−3.96	−5.31

Next, the assumptions of classical linear regression were tested to ensure that the ARDL model used in this study met all necessary criteria. Figure 3 shows the normality test of the residuals, and the results indicate that the residuals are normally distributed, satisfying the assumption of a classical linear regression model.

Following this, tests for serial correlation and heteroscedasticity were conducted. The Breusch–Godfrey test was used to check for serial correlation, while the ARCH test was employed for heteroscedasticity. The results of these tests are displayed in Table 6. Both tests confirm that there is no serial correlation and that the model is homoscedastic. Therefore, the essential assumptions of the classical linear regression model are satisfied, confirming that this model is highly appropriate for this research.

The results of the model superiority test, measured by goodness of fit, are presented in Table 7. This model demonstrates excellent performance, as indicated by the high R-squared and Adjusted R-squared value (0.9726). The distinction in value between both measurements shows that the model did not suffer from the inclusion of too many variables. Additionally, the standard error of regression is also very low, further supporting the model's robustness for this analysis. The *F*-statistic also reinforces the strength of the estimation, showing that all independent variables significantly (at a 1% significant level) explain variations in the dependent variable. Moreover, the Durbin-Watson statistics confirm that the model does not suffer from serial correlation, which is consistent with the Breusch-Godfrey test results. The Akaike information criterion also shows a very low value, indicating a strong interdependence among the set of variables.

Figure 3: Testing for the residual normality distributions



The final test is the model stability test, assessed using the Cusum and Cusum-*Q* tests, shown in Figures 4 and 5. Figure 4 illustrates that the model is highly stable, fulfilling the necessary criteria for this analysis. The confirmation from the Cusum-*Q* test (Figure 5) further verifies the model's stability. Since all model requirements have been satisfied, the analysis will proceed in the following section.

4.2. Discussion

4.2.1. Coefficients of correlation

The correlation coefficient of the independent variables is used to detect potential multicollinearity among large variables.

Table 6: Testing for the selected classical linear regression assumptions

Testing for CLRM Assumptions	Type of Test	Statistics	P-value	Conclusion
Serial Correlation	Breusch-Godfrey	0.5761	0.5641	No serial correlation
Heteroscedasticity	ARCH Test	0.0254	0.8736	Homoscedasticity
Normality	Jarque–Berra	3.9004	0.1422	Normality
RESET Test	t–Statistics	1.3016	0.1950	The Model is Correctly Specified

Table 7: Goodness of fit of the estimated model

R-squared	0.9746
Adjusted R-squared	0.9729
S.E. of regression	0.0454
F-statistic	586.6348***
Akaike info criterion	−3.2832
Durbin-Watson stat	1.6820

Typically, macroeconomic variables exhibit some degree of multicollinearity, but it only leads to inefficient estimation results when multicollinearity is very high or nearly perfect. As shown in Table 8, all correlation coefficients of the independent variables are below 0.8, indicating no possibility of multicollinearity present in this model, making it suitable for analysis.

4.2.2. ARDL model estimated results

Since the model used in this analysis meets all ARDL requirements, the next step is to analyze and discuss the estimation results. The short-term dynamic effects were assessed using the Wald test, as shown in Table 9. The results reveal that only one variable, the exchange rate, significantly influences the green stock index in Indonesia. This indicates that domestic currency depreciation increases demand for Indonesian shares, including those in the green stock market, thereby impacting the Green Stock Index. The growing interest in environmentally friendly companies, as part of broader environmental protection efforts, further attracts investors to green market shares.

Currency depreciation affects green market shares and boosts demand across various stocks in Indonesia as they become relatively cheaper for foreign investors. These findings differ from prior studies, such as Mensi et al. (2022, 2023) but align with other research showing the green stock market's sensitivity to exchange rate fluctuations, including studies by Shahbaz et al. (2021), Li et al. (2022), Pham and Nguyen (2022), Long et al. (2022), Li et al. (2023), Hanif et al. (2023), and Umar et al. (2024).

4.2.3. Short-run dynamic effects

Several other variables do not exhibit a short-term influence on Indonesia's green stock market. The federal interest rate, for instance, has no effect, as Indonesia's central bank regularly adjusts domestic interest rates to mitigate capital flight from its stock market. These findings suggest that economic policy uncertainty does not impact Indonesia's conventional stock market, aligning with previous research on both general and green stock markets.

Several studies support these findings concerning economic policy uncertainty in major countries like the US (Tzika and Pantelidis, 2024), Japan (Li et al., 2023), and the US and UK stock markets (Shao et al., 2022). Specific to the green stock market, research by Mensi et al. (2022, 2023) similarly found no significant impact of economic policy uncertainty. However, other studies, including

Figure 4: Cusum recursive stability test

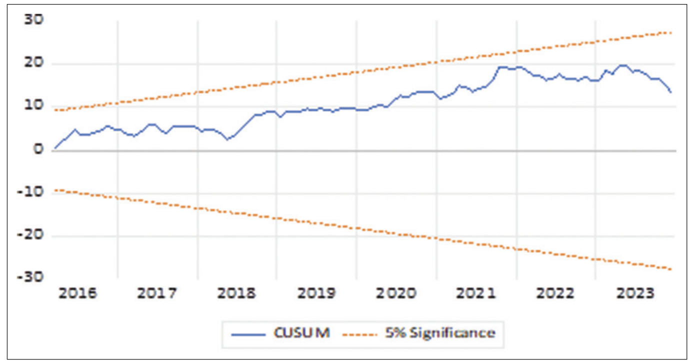
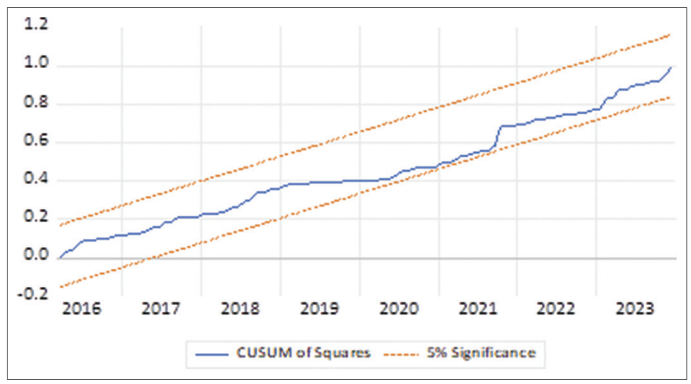


Figure 5: Testing for squared recursive stability test



Shahbaz et al. (2021), Li et al. (2022), Pham and Nguyen (2022), and Long et al. (2022), report different outcomes.

This study also reveals that domestic interest rates, income, inflation, and oil prices do not significantly impact Indonesia's green stock market. These findings align with prior research, such as Mensi et al. (2022) and Mensi et al. (2023). The results may suggest that the green stock market is relatively more stable than the broader stock market. This stability could be attributed to growing investor awareness and preference for green stocks, driven by a global desire to promote a healthier and more sustainable environment.

4.2.4. Testing for symmetric effect

Another key finding to analyze is the comparison between the impact of the Federal interest rate and the domestic interest rate and the comparison between the effects of the exchange rate and oil prices on the green stock market. This was tested using the Wald test, with results in Table 10. The first test shows no significant difference between the influence of the Federal and domestic interest rates on the green stock market, which corroborates the findings in Table 9, indicating that neither interest rate affects Indonesia's green stock market.

However, the test results comparing the exchange rate and oil price effects reveal a difference. Specifically, the exchange rate impacts

Table 8: Correlation matrix of the coefficients

Variable	Green Stock Index	Indonesia Interest Rate	Industrial Production Index	Inflation	Federal Interest Rate	Oil Price
Green Stock Index	1.0000					
Indonesia Interest Rate	0.5588	1.0000				
Industrial Production Index	0.1883	0.0197	1.0000			
Inflation	0.1718	0.0767	0.0738	1.0000		
Federal Interest Rate	−0.6562	−0.0766	−0.0667	−0.1019	1.0000	
Oil Price	0.3101	−0.1525	0.3312	0.1674	−0.1841	1.0000

Table 9: Short–run dynamic effects

Variable	Chi–squares Statistic/Coefficient	Conclusion
Federal Interest Rate	8.2355	Do not reject Ho
Indonesia Interest rate	5.9321	Do not reject Ho
Income	8.7155	Do not reject Ho
Inflation	8.1330	Do not reject Ho
Exchange Rate	16.7574**	Reject Ho
Oil Price	6.2009	Do not reject Ho

Table 10: Testing for symmetric effects

Symmetric Test	Statistics	Conclusion
Ho: FED=IR	0.0004	Do not reject Ho
Ho: ER=OP	9.2182***	Reject Ho

Table 11: Long-run estimated results of the green stock index in Indonesia

Variable	Coefficient	Standard Error
Green Stock Index	−0.2571 (−3.2606)	0.0789
Federal Interest Rate	−0.0082 (−1.1033)	0.0075
Indonesia Interest rate	−0.0080 (−0.8811)	0.0090
Income	−0.0014 (−1.1394)	0.0013
Inflation	−0.0361 (−0.8601)	0.0420
Exchange Rate	0.4655*** (2.8883)	0.1612
Oil Price	0.0415 (1.2195)	0.0340

the green stock market, while the oil price does not. This aligns with Table 9, where the exchange rate shows a dynamic influence on the green stock market. The depreciation of the domestic currency encourages foreign investors to increase their purchases in the green stock market. This is a logical outcome, as lower stock prices tend to boost demand, subsequently raising the green stock index.

4.2.5. The long-run estimated results

A long-term analysis of each variable in this study was conducted following the short-term analysis. The results indicate that, in the long term, only the exchange rate has a positive and significant coefficient. This finding reinforces the short-term results, highlighting the exchange rate as a crucial variable in Indonesia's green stock market (Table 11). These results contrast with the findings of Mensi et al. (2022) and Mensi et al. (2023), which reported that the green stock market was unaffected by exchange rate fluctuations.

5. CONCLUSION

This research offers several key conclusions based on the analysis that was conducted. First, in the short term, only the exchange rate has a dynamic impact on Indonesia's green stock market, while other variables show no significant effect. Second, there is no asymmetrical influence between the Federal and domestic interest rates on the green stock market. Third, the exchange rate and oil prices have differing impacts on the green stock market in Indonesia. Fourth, in the long term, only the exchange rate affects Indonesia's green stock market, indicating that, at this stage, both federal and domestic interest rates, as well as oil prices, do not significantly influence investor decisions. This could suggest that investment choices in the green stock market are driven more by a commitment to sustainable practices and a shift toward environmentally conscious business models, both in the short and long run. Thus, this offers an exciting result that indicates that the investment landscape in Indonesia is facing a shift in paradigm towards a more sustainable approach.

Additionally, several recommendations can be drawn from these findings. First, stock market regulators should encourage more companies to participate in the green stock market, which is relatively more stable than the conventional market. This could enhance market predictability and reduce the risk associated with changes in interest rates and oil price fluctuations. Second, investors may consider the green stock market as a more stable investment option less susceptible to internal and external shocks, potentially lowering the risk of stock price volatility. Thus, this study emphasizes that managing the exchange rate effectively could boost investment in the green stock market in Indonesia, further promoting sustainable business practices and investments. It also indirectly highlights the commendable role of Bank Indonesia in maintaining a prudent exchange rate policy, which has facilitated a larger inflow of foreign investments in the past.

For future research, it is recommended that similar tests be conducted on green stock markets in other countries. This would help determine whether the stability observed in Indonesia's green stock market also holds in other markets, allowing for better cross-national comparisons, especially within regional economies.

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APPENDIX

Appendix 1: The estimated regression results of the green stock index in Indonesia

Variable	Coefficient	Standard Error	t-statistic	P-value
C	−2.7801	0.6339	−4.3857	0.0000
@TREND	−0.0030	0.0007	−4.4080	0.0000
D (FED)	0.0169	0.0406	0.4174	0.6774
D (FED(−1))	−0.0435	0.0489	−0.8903	0.3756
D (FED(−2))	−0.0082	0.0512	−0.1598	0.8733
D (FED(−3))	0.0610	0.0538	1.1321	0.2605
D (FED(−4))	−0.0450	0.0514	−0.8753	0.3836
D (FED(−5))	0.0629	0.0495	1.2716	0.2067
D (FED(−6))	−0.0210	0.0496	−0.4236	0.6728
D (FED(−7))	−0.0330	0.0434	−0.7607	0.4487
D (IR)	0.0043	0.0115	0.3752	0.7083
D (IR(−1))	0.0111	0.0115	0.9607	0.3392
D (IR(−2))	0.0117	0.0107	1.0885	0.2792
D (IR(−3))	−0.0089	0.0106	−0.8400	0.4031
D (IR(−4))	0.0070	0.0106	0.6591	0.5115
D (IR(−5))	0.0116	0.0112	1.0400	0.3010
D (IR(−6))	−0.0010	0.0116	−0.0848	0.9326
D (IR(−7))	0.0177	0.0113	1.5657	0.1208
D (IPI)	0.0003	0.0010	0.3126	0.7553
D (IPI(−1))	0.0012	0.0010	1.2579	0.2115
D (IPI(−2))	0.0012	0.0010	1.1663	0.2464
D (IPI(−3))	0.0015	0.0010	1.4860	0.1406
D (IPI(−4))	−0.0007	0.0010	−0.7565	0.4512
D (IPI(−5))	−0.0011	0.0009	−1.1982	0.2338
D (IPI(−6))	−0.0002	0.0009	−0.2045	0.8384
D (IPI(−7))	−0.0007	0.0008	−0.8231	0.4126
D (INF)	−0.0152	0.0119	−1.2844	0.2021
D (INF(−1))	0.0303	0.0144	2.0988	0.0385
D (INF(−2))	0.0060	0.0162	0.3674	0.7142
D (INF(−3))	0.0289	0.0169	1.7058	0.0913
D (INF(−4))	0.0016	0.0166	0.0991	0.9213
D (INF(−5))	0.0153	0.0149	1.0237	0.3086
D (INF(−6))	0.0060	0.0131	0.4592	0.6472
D (INF(−7))	0.0019	0.0110	0.1772	0.8597
D (LER)	−0.0823	0.2887	−0.2850	0.7762
D (LER(−1))	−0.2408	0.3237	−0.7440	0.4588
D (LER(−2))	−0.5808	0.3052	−1.9034	0.0600
D (LER(−3))	−0.2851	0.3154	−0.9039	0.3683
D (LER(−4))	0.0927	0.3029	0.3059	0.7604
D (LER(−5))	−0.4898	0.3046	−1.6077	0.1113
D (LER(−6))	−0.0697	0.2822	−0.2470	0.8055
D (LER(−7))	−0.3455	0.2737	−1.2623	0.2100
D (LOP)	−0.0891	0.0451	−1.9743	0.0513
D (LOP(−1))	−0.0376	0.0479	−0.7835	0.4353
D (LOP(−2))	−0.0210	0.0455	−0.4607	0.6461
D (LOP(−3))	−0.0513	0.0441	−1.1632	0.2477
D (LOP(−4))	−0.0295	0.0436	−0.6765	0.5004
D (LOP(−5))	−0.0401	0.0452	−0.8868	0.3775
D (LOP(−6))	−0.0078	0.0443	−0.1762	0.8606
D (LOP(−7))	−0.0500	0.0423	−1.1806	0.2408
CointEq(−1)*	−0.2571	0.0588	−4.3762	0.0000
R−squared	0.3736	Mean dependent var		−0.0082
Adjusted R−squared	0.0604	S.D. dependent var		0.0444
S.E. of regression	0.0430	Akaike info criterion		−3.1900
Sum squared resid	0.1852	Schwarz criterion		−2.1709
Log likelihood	291.8441	Hannan-Quinn criteria		−2.7760
F-statistic	1.1929	Durbin-Watson stat		1.8322
Prob (F-statistic)	0.2262			