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Volatility and Stability of ESG Equity in Indonesia toward Internal and External Shocks

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Abstract

The environmental, social, and governance (ESG) index is rising in popularity globally, especially in Indonesia. This study, therefore, attempts to prove that ESG equity is less volatile than non-ESG equity since specific ESG components are essential parts of the Shariah values. Using data from 2009 to 2020, the Vector Error Correction Model (VECM) method was utilized to investigate further the link between ESG and other endogenous variables, such as the Dow Jones Islamic Market (DJIM), Fed rate, Jakarta Composite Index (JCI) index, exchange rate, and BI rate. The results showed that all internal and external variables significantly influenced ESG equity in very low magnitude, except for DJIM negatively and Fed rate positively. However, the IRF findings revealed what transpired to the ESG equity, which could endure shocks from both internal and external simultaneously and stabilize more swiftly. Moreover, the FEVD results uncovered that all internal and external variables had a minor impact on ESG equity, totaling less than 9 percent. Meanwhile, the impact of the same variables on non-ESG equity, i.e., JCI and DJIM, were higher at 38 percent and 13 percent, respectively. In addition, ESG equity tended to have a dominant influence on other non-ESG equity. Therefore, the Indonesian stock market will be more stable if ethical investing norms, such as ESG equity, are followed, which will be more judicious in achieving long-term growth.

Keywords: Environmental Social and Governance; Equity, Market; VECM.
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I. Introduction

1.1. Background

According to the 2018 Global Sustainable Investment Review, more than 25% of US-domiciled assets under management were invested in sustainable strategies as of the beginning of 2018. BlackRock and Goldman Sachs, two of the world's largest asset managers, have recently pledged to make sustainability a fundamental component of their investment strategy. It was slightly over 50% in Canada at 2.1 trillion Canadian dollars, a 42 percent increase from 2016. In 2018, ESG accounted for 63 percent of investment in Australia, whereas the European continent accounted for 46 percent in the same year. In Japan, the ESG trend rose rapidly from 3% to 18% in two years, from 2016 to 2018.

Specifically, Indonesia's capital market is rapidly increasing. Indonesia still has limited fiscal space, poor institutional capacity, and thin domestic financial markets, according to an IMF report by Breuer et al. (2018). Hence, the government must work to address structural barriers, such as a poor investment climate, complicated laws, and limited financial markets (International Monetary Fund [IMF] 2016). A prior IMF research by Arslanalp et al. (2006) also implied that a financial spillover occurs when a shock from one country's market turbulence spreads to other sectors or even across countries. In this case, the Fed rate, foreign exchange, the Dow Jones ESG index, and other macroeconomic variables are all likely to have different effects on ESG. More particularly, the SRI-KEHATI index was launched on June 8th, 2009, and managed in collaboration with the Indonesian Biodiversity Foundation (KEHATI Foundation). According to the Indonesian Stock Exchange (IDX), the SRI-KEHATI (SKEHAT) is the first green (ESG) investment index in Indonesia and ASEAN, as well as the second in Asia. This index is also part of the SRI category, or ethical investing, which is an investment approach that considers both financial and social rewards that contribute to positive change. The first selection process employs negative screening, which is the rejection of particular sectors, firms, or practices from a fund or portfolio based on specified ESG criteria, consisting of 25 listed companies that have done well in encouraging sustainable businesses and have good environmental, social, and governance, also known as Sustainable and Responsible Investment (SRI).

In addition, there is a favorable relationship between ESG equity investing and greater returns, particularly with the ESG or SKEHAT. It is Indonesia's sole ESG Index, focusing on ESG firms. In 2019, the ESG Index beat the Jakarta Composite Index (JCI) and the LQ45 index. According to the Bloomberg terminal, the ESG index had a return of 174 percent, outperforming the JCI and the Liquid index, which generated returns of 149 percent and 104

percent, respectively. In 2018, under bearish conditions, the JCI returned a negative 2.5 percent, the Liquid index returned a negative 9.0 percent, and the ESG returned a negative 4.3 percent.

According to empirical studies, previous studies have confirmed the substantial link between lower sustainability risk and higher financial success (Whelan et al., 2021). During the global financial crisis of 2008, Fernández et al. (2019) discovered that German green mutual funds outperformed their peers in terms of risk-adjusted returns. After the global financial crisis of 2008, ESG stocks gained better and recovered faster (Wu et al. 2017). Mutual funds with high ESG stocks outperformed those that invested in low ESG stocks (Abate et al., 2021), while according to Gil-Bazo et al. (2010), SRI funds succeeded in outperforming other funds. Interestingly, Islamic funds usually have lower systematic risk than conventional funds during financial crises, regardless of the benchmarks used.

For this reason, the study attempts to prove that ESG is less volatile than non-ESG since specific components are also encouraged in Islamic financing value. A similar connection between ESG performance and other behavioral finance, including Islamic equity, was noted by Marwan et al. (2019). They asserted that ESG's overarching concept and goals are incorporated into the theory, practice, and spirit of Maqashid Shariah and seek to develop better laws for the benefit of society, confirming the identical values of ESG and Islam. Zulkafli et al. (2017) found that from 2009 to 2004, the Sri Kehati Index provided competitive returns, outperforming the Jakarta Composite Index in four out of six measuring tools. In addition, Gunawan et al. (2021) compared Indonesia's ESG, Islamic, and liquid equity and discovered that ESG provided a better return with rising risk and volatility.

Further, the major contribution of this research is multidimensional. It adds to the scant empirical study in emerging countries, notably Indonesia. It is also one of the first to use Vector Auto Regression (VAR) and the Vector Error Correction Model (VECM) to investigate the relationship between ESG (using JCI as the benchmark for equity and BI interest rate) and external variables (foreign exchange, Dow Jones ESG index, and Fed rate) for market sensitivity.

1.2. Objectives

This study aims to determine how internal and external factors affect the volatility and stability of the SRI-KEHATI Index. Using Vector Error Correction Model, the study explores the impact on ESG equity with JCI as the benchmark for equity, BI interest rate, and external variables (foreign exchange, Dow Jones ESG index, and Fed rate) for the market's impact on the volatility parameter. The estimation of market shocks or volatility, which are rare and often manually dated after the fact based on the development of

macroeconomic phenomena, has been assessed before by Reinhart and Rogoff (2009). Then, the structure of this paper is as follows. Section I is an introduction, while Section II is a literature survey. In Section III, the researchers discuss data, techniques, and all variables characterizing the entire VECM process. Section IV analyzes the result, whereas Section V concludes and discusses the empirical findings, managerial implications, and limitations.

II. Literature Review

2.1. Background Theory

Economists and scholars have generally endorsed the efficient market hypothesis (EMH), which argues that securities markets are efficient in reflecting information about single stocks or the broader market, as described by Fama in his key survey paper "Efficient Capital Markets" (Fama, 1970). Weak-form efficiency, semi-strong form efficiency, and strong form efficiency are the three categories of form efficiency. The weak form means that past performance in terms of return cannot be used to anticipate the future price. Meanwhile, the semi-strong version assumes that the price of securities reacts swiftly to fresh publicly available data.

Moreover, volatility studies conducted during market turbulence, pioneered by LeRoy, Stepen and Richard (1981) and Shiller (1979,), have spawned substantial research. One fundamental assumption in the early volatility tests is that anticipated returns are constant and that the market solely causes stock price fluctuation. Evidence that projected stock returns fluctuate with predicted inflation rates, interest rates, and other term-structure factors was becoming widespread by the end of the 1970s (Bodie (1976), Nelson (1976), Fama (1976), Fama and French (1989)). With more recent data on return predictability, it appears that volatility tests are yet another helpful approach to demonstrate that anticipated returns change over time. However, predictably, they run into the joint hypothesis difficulty. They put market efficiency to the test alongside the supposition that their versions of the consumption-based asset-pricing model incorporate all reasonable variance in expected returns (Bertschinger and Pfante, 2020).

Further, this research enriches the literature on the influence of the global financial crisis, including COVID-19, stock market index volatility, Federal Reserve Rates, and other monetary policies, on stock market volatility. Aside from a single bottom line objective of a stable profit, companies must also be accountable for positive or negative economic, social, and environmental repercussions (Elkington, 1997), commonly referred to as the Triple Bottom Line (TBL) genuine concept of the ESG.

2.2. Previous Studies

As a reference for long-term and sustainable investment, SKEHAT, which represents Indonesia's ESG equity, has to follow consistently with the interpretation of what drives investors' choice to choose SRI as organizational and managerial behavior or empirically because of morality (Lewis, 2001). SRI indexes must also follow a continuous investment cycle, not only to achieve short-term profits but also to combine socio-cultural, educational, economic, technological, and climatic aspects to produce complex causal patterns that influence the efficacy of community-based sustainable initiatives (Parnell and Seemann, 2005). In addition, the connection between the market's impact and stock price fluctuations has long been considered significant. In characterizing African equity market behavior, Yartey (2008) and Gupta and Modise (2013) employed a predictive regression framework to evaluate macroeconomic factors. Sims et al. (1990) also demonstrated that, from a macroeconomic standpoint, all variables must be controlled endogenously since the approach employed does not put the response variable as a function of other variables, time lag, and other variables lag exogenously if the error term is not autocorrelated. According to Maysam et al. (2004) and Muzindutsi and Niyimbanira (2012), the stock market sector responds differently to macroeconomic change factors. Thus, several investors want to commit more funds to investing methods that fulfill certain environmental or ethical standards.

Previous similar studies of co-integration volatility between equity and macroeconomic factors have been conducted in the scope of a country or the international markets. Barakat et al. (2016) showed a positive correlation between exchange rate and equity market performance. The external variables can be presumed from the study of the impact on the Islamic equity markets conducted by Husin et al. (2013). Antonio et al. (2013) also investigated the significant and positive association between the oil price change and the JII Islamic as the dependent variable. Moreover, the evidence of the non-significant association between the currency on equity volatility was studied by Gay Jr (2008). Studying long-term relationships between time series is significant to studying co-integration between the surrounding markets. These findings suggested that equities volatility and market turbulence had comparable long-run connections. It is consistent with Udoka and Anyingang (2013) for the Nigerian equity market from 1980 to 2009 and Jefferis and Okeahalam (2000) for three Southern African equity markets from 1985 to 1995, using both domestic and foreign economic factors on real equity market returns in South Africa, Zimbabwe, and Botswana.

Recently, Khatatbeh et al. (2020) investigated the influence of COVID-19 on quick reaction to afflicted nations. The results indicated a considerable

negative impact on 11 major stock market indices. Alali (2020) also scrutinized WHO's declaration of COVID-19 as a global pandemic and its impact on the five largest stock exchanges. The analysis revealed that the WHO statement negatively impacted the performance of the biggest Asian stock markets.

In addition, Alam and Chavali (2020) analyzed the Indian stock market and how it was affected during the COVID-19 shutdown period of 31 companies listed on BSE from February 24th to April 17th, 2020. According to the statistics, the market had a strong favorable response. During the shutdown, the Indian stock market performed well. During COVID-19, Chaudhary et al. (2020) also investigated stock volatility. The GARCH model was used to analyze the indices of the top ten nations from January 2019 to June 2020. The study showed that returns were negative during the COVID-19 period. For some indexes, the GARCH model had a largely beneficial influence. Meanwhile, Meher et al. (2020) examined the impact of COVID-19 on natural gas and crude oil price fluctuations from May 1st, 2017, to April 30th, 2020. Here, COVID-19 substantially impacted natural gas and crude oil price volatility.

To assess macroeconomic variables, Yartey (2008) and Gupta and Modise (2013) used a predictive regression approach. Meanwhile, according to Maysam et al. (2004) and Muzindutsi and Niyimbanira (2012), the stock market sector responds differentially to macroeconomic change variables. Then, according to Barakat et al. (2016), there was a positive link between the exchange rate and equities market performance. Besides, the external variables may be assumed based on the research performed by Husin et al. (2013), Udoka and Anyingang (2013), and Jefferis and Okeahalam (2000) on the impact on Islamic equities markets utilizing both local and foreign market factors. In comparison, Khatatbeh et al. (2020) and Alali (2020) investigated the global pandemic and its impact on stock exchanges. On the other hand, Alam and Chavali (2020), Chaudhary et al. (2020), and Meher et al. (2020) studied the impact on similar market volatility.

Therefore, this study is one of the first to use Vector Auto Regression and the Vector Error Correction Model to examine the relationship between ESG performance (using JCI as the benchmark for equity and BI interest rate) and external variables (foreign exchange, Dow Jones ESG index, and Fed rate).

2.3. ESG in Islamic Perspective

The increasing expansion of environmental, social, and corporate governance requirements in global investment has sparked fresh courses regarding the essence of Islamic financing. These add poignancy to perennial concerns, such as whether financial goods should conform with Shariah by utilizing structures that fulfill the text of religious precepts or if it is better to focus on the

outcomes of investments and how they will benefit society and the natural environment. In addition, shariah investment is a subset of environmental, social, and governance (ESG) investing, and this can also work vice versa since it uses the same sorting and filtering techniques to exclude certain assets. Many studies, notably Kumar et al. (2018), have focused on ESG investment. Fu et al. (2019) also conducted a literature review on various ESG styles, including sharia, and concluded that developing shariah-compliant portfolios requires the same exclusion processes as ESG investing and that in all-equity, shariah-compliant portfolios incur no additional performance costs. The foundation theories of ethical investment established that portfolio restrictions are also based on moral decisions that limit the investible universe.

Moreover, Sandwick and Collazzo (2021) found that the impact of restricted investing is most obvious during the asset selection process. The portfolio management techniques backed by the theory are otherwise unchanged for limited investment. In this regard, Shariah rules impose simple constraints: no interest-bearing investments, investing only in the real economy and avoiding prohibitions (e.g., alcohol, gambling, pork). As an aside, there are parallels between shariah-compliant and SRI and ESG investment, which both adhere to many of the same principles as shariah-compliant investing.

III. Methodology

3.1. Method

Current academics investigated dynamic connections between economic climates. In this case, VAR is a time-series data analysis method developed in reaction to major macroeconomic models' inability to effectively anticipate the economy in the 1970s. VAR is also an equation system in which each linear function variable and the lag value of all endogen variables in the equation system is represented as a constant. Stock (1987), West (1988), and Sims et al. (1990) found that when variables are non-stationary, parameter estimates of VAR are consistent, but small samples can lead to biased estimations. According to Sims (1989), the Bayesian estimation approach may be better suited for designing and estimating VAR models with non-stationary variables.

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-1} + \cdots + A_p Y_{t-p} + \varepsilon t \qquad (1)$$

Where:
Y_t: The dependent variable vector (Y_{1t}, Y2t,…, Ynt) is n x 1 in size.
A_0: The intercept vector is n x 1.
A_i: The parameter matrix of size n x n, for every i = 1, 2,…, p
n: The number of variables in the system of equations
p: The amount of lag in the system of equations

ε_t: The remaining vector (ε_{1t}, ε_{2t},…,ε_{nt}) of size n x 1

In the case of two variables, $\{y_t\}$ and $\{z_t\}$, $\{y_t\}$ affects $\{z_t\}$, and vice versa $\{z_t\}$ also affects $\{y_t\}$. In VAR, the circular effect (mutual influence) between the two variables is modeled as follows:

$$y_t = b_{10} - b_{12}z_t + y_{11}y_{t-1} + y_{12}z_t + \in y_t \quad (2)$$

$$z_t = b_{10} - b_{12}y_t + y_{21}y_{t-1} + y_{22}z_{t-1} \in z_t \quad (3)$$

VECM is a subset of the VAR. Because of the existence of a non-stationary yet co-integrated data type, this extra constraint is required. When two or more variables in an equation are not stable at the data level, co-integration may occur in the equation (Verbeek, 2000). If there is a co-integration equation in the model following the co-integration test, it is advised that the co-integration equation be entered into the model. Most time-series data have I (1) or are stationary in the first difference.

As a result, the VECM model was utilized in this study to predict the loss of long-term data if it turns out that the data used I (1). The co-integration restriction information was then used by VECM in its requirements. Thus, the VAR design for non-stationary series with a co-integration relationship is frequently referred to as VECM. The VECM specification prevents endogenous variables' long-term relationships from converging into co-integration relationships while allowing for short-term dynamics. Because the divergence from the long-run equilibrium is progressively rectified by a partial sequence of short-run adjustments, the term co-integration is also known as the error term. The following equation from Verbeek (2000) shows the VECM equation:

$$\Delta y_t = \beta x_t + \Gamma \Delta y_{t-1} + \Gamma \Delta y_{t-2} .... + \Gamma \Delta y_{t-k} + \gamma z_{t-1} + \varepsilon_t \quad (4)$$

Where:
Γ = Short-term coefficient of relationship
β = Coefficient of a long-term relationship
yt = Endogenous variables used in the model

3.2. Data

Weekly observations of ESG Index share prices combined with the DJIM index, FDTR index, JCI index, exchange rate, and BI rate from Bloomberg Terminal were used from the first week of June 2009 to the fourth week of June 2020. The SRI-KEHATI index, Indonesia's sole ESG index with JCI as the equity benchmark, and the BI rate were all used as the interest rate benchmark, according to Maysam, et al. (2004) and Muzindutsi and Niyimbanira (2012), and Barakat et al. (2016). For market turbulence, external variables, such as

foreign exchange, Dow Jones ESG index, and the Fed rate, are all likely to have varying influences, as mentioned by Yartey (2008) and Gupta and Modise (2013).

3.3. Model Development

This section explains the established models, assumptions, and modifications. For the chosen approach, the researchers follow Hasan and Javed (2009), who used VAR. However, because the data were stable in I(1) and contained co-integration, the researchers employed VECM instead by using weekly data with macroeconomic factors, including the exchange rate and the foreign portfolio investment. The proposed modified model also follows Beenstock and Chan (1988), using both interest rates and foreign equity markets. For additional Dow Jones Index and the exchange rate, the researchers follow Kumar and Sahu (2017). Then, the general-purpose econometric model was upgraded by adding the Fed rate following Yartey (2008) and Gupta & Modise (2013) using weekly instead of monthly data:

$$\mathrm{ESG} = \mathrm{f}\,(\mathrm{DJIM}, \mathrm{FDTR}, \mathrm{JCI}, \mathrm{XR}, \mathrm{BI} - \mathrm{rate}) \qquad (5)$$

Where: ESG is the real value of the ESG Index; DJIM is Dow Jones Index; FDTR is the Federal Reserve rate (Fed rate); JCI is the Jakarta Composite Index; XR is the exchange rate; BI rate is the BI rate. The researchers elaborated on the logarithmic model:

$$ESG_t = DJIM_t + FDTR_t + JCI_t, + LXR_t + BI - rate_t + U_t \qquad (6)$$

Where: ESG is the real value of the ESG Index; DJIM is the Dow Jones Index; FDTR is the Fed rate; JCI is the Jakarta Composite Index; LXR is the log of USD IDR currency; BI-rate is the BI-rate.

Chan (2010) stated that the VAR is a form of a starting point for other analyses, such as co-integration analysis, stability test, impulse response, and variance decomposition.

Then, to determine the optimal lag, the following procedure began with stationary, unit root, and co-integration tests. In addition, the impulse response function and prediction error variance decomposition were used to better comprehend the long-run connection with the vector-autoregressive model. Changes in the variables were represented by shocks to error terms in the structural VAR form, depending on the impulse response function. The researchers also generated ESG Index forecast error variance decompositions to see which proxy measures, such as the DJIM index, FDTR index, JCI index, exchange rate, and BI rate, were most significant to ESG. Besides, the study applied the Augmented Dickey-Fuller (henceforth ADF) test developed by

Dickey and Fuller (1981) to examine the unit root in each series, with the following hypothesis:

$H0$: θ = 0, i.e., the time series is non-stationary and needs to be differenced (has a unit root).

Ha: θ < 0, i.e., the time series is stationary (has no unit root).

If the estimated value is more than the t-statistic value (or the p-value is less than 5%), the null hypothesis (= 0) is rejected, and the time series is considered stationary. The order of the stationary series is denoted as I(0) if the null hypothesis is rejected at level (without differencing), but the order is marked as I(1) if the null hypothesis is rejected at the first difference I(1).

IV. Results and Analysis

4.1. Preliminary Tests

4.1.1. Stationarity Test

The first stage in VAR VECM modeling is to evaluate the stationarity of each variable included in the model. The results of each variable's stationarity test for the model of the effect of the DJIM index, FDTR, JCI, XR, and BI rate on the ESG Index are presented below.

Table 1. Unit Root Test

	Level			First Difference		
Variables	t-Statistic	Prob.*	Conclusion	t-Statistic	Prob.*	Conclusion
ESG	-1.84772	0.3573	Non-Stationary	-26.1223	0.0000	Stationary
DJIM	-0.758	0.8294	Non-Stationary	-24.7052	0.0000	Stationary
FDTR	-1.24316	0.6571	Non-Stationary	-13.0882	0.0000	Stationary
JCI	-2.3561	0.1549	Non-Stationary	-25.7243	0.0000	Stationary
XR	-0.41396	0.9041	Non-Stationary	-21.5096	0.0000	Stationary
BI-rate	-2.04725	0.2666	Non-Stationary	-10.0139	0.0000	Stationary

Table 1 shows the stationarity test findings, revealing that all variables were not stationary at the level. It is supported by the Augmented Dickey-Fuller (ADF) test findings, which were completely negligible in ordinary real-world scenarios (5 percent). In other words, the null hypothesis (that there is a unit root or that the data is non-stationary) was accepted. Furthermore, using the ADF test to re-test the stationarity of each variable in the first differentiation condition (first difference), it was discovered that each variable coming from the first distinction was stationary.

4.1.2. Johansen-Julius's (1990) Co-integration Test

The Johansen test of co-integration established by Johansen and Juselius (1990) may be used to determine the number of the co-integrating vector if the time series are non-stationary at the level and the variables are integrated in the same order (s). Then, the Maximum Eigenvalue test's null hypothesis compares the number of r co-integrating vectors against the alternative of r+1 co-integrating vectors. If the variables are found to be co-integrated after performing the Johansen-Juselius test, it may be argued that the variables have a long-run equilibrium connection. The VECM technique may also be used for these objectives.

Table 2. Co-integrating Test

No. of CE (s)	Eigenvalue	Statistic	Critical Value	Prob.**
None*	0.082316	117.0187	103.8473	0.0051
At most 1	0.040439	67.71061	76.97277	0.2061
At most 2	0.034333	44.01605	54.07904	0.2872
At most 3	0.021765	23.96289	35.19275	0.4651
At most 4	0.013101	11.33174	20.26184	0.5105
At most 5	0.006533	3.762331	9.164546	0.4487

The Johnsen (1988) and Juselius (1990) method is generally used to test the co-integration relationship between variables in the VAR model. Johansen's co-integration test on ESG index, DJIM index, FDTR, JCI, XR, and BI-rate showed in table 2 that with probability (0.0051), test results were to reject the null hypothesis under the 5% level, meaning that there was at least one co-integration equation.

4.1.3. The Optimum Lag

A crucial step for Structural VAR models will determine the optimal amount of lag to use in the model. Examining the optimal lag length can have the benefit of a variety of valuable information, specifically by using Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). To be able to determine this lag, the previous step was to evaluate the value of the residual covariance ($\left|\hat{\Omega}\right|$), which can be calculated as follows:

$$\left|\Omega\right| = \det\left(\frac{1}{T-p}\sum_{t}\hat{e}_t\hat{e}_t^{'}\right) \quad (7)$$

Where p is the parameter number of each equation in VAR. Furthermore, the log-likelihood value assuming a normal (Gaussian) distribution can be calculated:

$$\mathbf{l} = -\frac{T}{2}\left\{k(1+\log 2\pi)+\log\left|\hat{\Omega}\right|\right\} \quad (8)$$

Where p is the parameter number of each equation in VAR. Furthermore, the log-likelihood value assuming a normal (Gaussian) distribution can be calculated as follows:

AIC $\quad -2\left(l/T\right)+2\left(k/T\right)$

SC $\quad -2\left(l/T\right)+k\log(T)/T$

HQ $\quad -2\left(l/T\right)+2k\log(\log(T))/T$

A VAR test was conducted to determine the optimal amount of lag used in the variables to be analyzed. This study's optimal amount of lag was based on the smallest or minimum Akaike Information Criteria (AIC) value. The determination of the optimal lag of the exchange rate transmission model affected by the shock through the indirect exchange rate transmission line can be seen in the following table.

Table 3. Optimum Lag

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-864.266	NA	8.58E-07	3.058931	3.104737	3.076805
1	5875.645	13313.99	5.01E-17	-20.5049	**-20.18427***	**-20.37979***
2	5937.624	121.1266	4.57E-17	-20.5962	-20.0008	-20.3639
3	5985.304	92.17527	4.39E-17	-20.6373	-19.767	-20.2977
4	6030.919	87.22152	**4.25e-17***	**-20.67107***	-19.5259	-20.2242
5	6064.133	**62.80879***	4.29E-17	-20.6613	-19.2413	-20.1072
6	6076.542	23.20434	4.66E-17	-20.5784	-18.8836	-19.917
7	6093.935	32.15773	4.98E-17	-20.513	-18.5433	-19.7444
8	6118.309	44.54907	5.19E-17	-20.4721	-18.2276	-19.5963

* indicates lag order selected by the criterion.

LR: Sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

If the AIC size becomes the benchmark for determining the optimum lag, the VECM model will be optimum at lag 4. If the SC size is the benchmark for determining the optimum lag, the VECM model will be optimum at lag 1 (table 3). To know the best model, the test was done with the trial system from lag 1 to lag 8. It indicates that the current events were affected by the events of the previous 1 to 8 weeks.

4.1.4. The VAR Stability Test

The VAR equation system is first checked for stability using the VAR stability condition test. The VAR model is considered stable if all the polynomial function's roots are in the unit circle or if the absolute value is 1, and the resulting IRF and FEVD are considered valid.

Table 4. VAR Stability Test

Root	Modulus
0.999542 - 0.007488i	0.99957
0.999542 + 0.007488i	0.99957
0.986882 - 0.008737i	0.98692
0.986882 + 0.008737i	0.98692
0.972927	0.97292
0.943555	0.94355
-0.17662	0.17662
-0.081177 - 0.147207i	0.16810
-0.081177 + 0.147207i	0.16810
0.031351 - 0.054339i	0.06273
0.031351 + 0.054339i	0.06273
0.046327	0.04632

No root lies outside the unit circle.
VAR satisfies the stability condition.

Based on Table 4, the VAR stability test results of the model showed a modulus value below 1, meaning that the VECM model was more stable than could be considered a robustness test. It can be proven that the model had a modulus of all roots of a characteristic polynomial in the range of 0.04632-0.99957.

4.1.5. Robustness and Correlation Tests

Before, Ebiwonjumi et al. (2022) examined the presence of multicollinearity using the variance inflation factor (VIF) for the explanatory components in Nigeria's economic determinant, whereas Avdiu and Stephan (2022) used VIF to predict US inflation. Because all models employed the same independent variables (see Table 5), this study's additional robustness test based on VIF findings revealed that all independent variables had a VIF value less than 10,

indicating that they were free of multicollinearity. The fact that all regressions had minimal VIF statistics also indicates that the predictors were not correlated and were jointly significant to explain the response variable.

Table 5. Robustness Test with Variance Inflation Factor (VIF)

Independent	VIF Results
BI-rate	3.17
XR	3.48
FDTR	4.43
DJIM	3.46
JCI	6.48

Each variable was ranked according to the correlation test findings, with JCI having the highest correlation to ESG, followed by FDTR, DJIM, XR, and BI rate. Correlation rank order test is shown in Table 6.

Table 6. Correlation Rank Order Test

	ESG	JCI	FDTR	DJIM	LNKURS	BIRATE
ESG	1	0.876	0.751	0.745	0.743	-0.606
JCI	0.876	1	0.738	0.888	0.793	-0.759
FDTR	0.751	0.738	1	0.767	0.626	-0.338
DJIM	0.745	0.888	0.767	1	0.861	-0.629
XR	0.743	0.793	0.626	0.861	1	-0.69382
BIRATE	-0.606	-0.759	-0.338	-0.629	-0.694	1

4.2. Results

4.2.1. VECM Estimation

ESG investors are primarily concerned with long-term gains (Herringer et al., 2009). A long-run equilibrium explains why the ESG index with various economic climate factors co-integrates. On the other side, economic conditions, such as inflation, money supply, or GDP, are not useful in projecting changes in the ESG index in the short term because of the time lag period. In this case, GDP is typically provided quarterly, whereas share prices are available within seconds during trade days. Then, the VECM was built using R Studio, an open-source econometric program. The first equation is explained as the co-integration equation of the ECM, and the equation's results are shown in Table 7.

The results uncovered that all variables were significant in the long run, and the variables had some effects as well. Then, the following co-integration equation is set from the VECM estimation analysis:

ESG Index = 99.91006 -0.20964 DJIMt-1 + 0.06392 JCIt-1 + 0.05095 FDTRt-1 + 0.06122 BI ratet-1 + 0.17438 LNKURS t-1 (9)

The long-term equation results explained that the DJIM negatively and significantly affected the ESG index. In this regard, if the offshore market continues in a bullish trend, capital flight will have a negative impact on the Indonesian market, particularly the ESG index. It is in line with Bhat (2018) and Adrangi et al. (2019) but is contrary to Wongbangpo and Sharma (2002), who found a negative link between ASEAN stocks and inflation. Meanwhile, Bekhet and Mugableh (2012) focused on the Malaysia stock exchange. In the 50-bps (shock) FFR impulse simulation, according to McCarthy and Zakrajsek (2003), the effect varied to the market.

Table 7. VECM Model (Long Run and Short Run)

ESG (SKEHATI)		
Long Run Model		
Variable	**Coeff**	**|t-stat|**
DJIM(-1)	-0.2096	[4.33782] **
JCI(-1)	0.0639	[-2.06689] **
FDTR(-1)	0.051	[-3.90154] **
BIRATE(-1)	0.0612	[-2.47588] **
LNKURS(-1)	0.1744	[-2.38963] **
C	99.91	
Short Run Model		
CointEq1	-0.0181	[-2.06597] **
D(S_SKEHAT(-1))	0.0002	[0.00451]
D(S_SKEHAT(-2))	0.0208	[0.39900]
D(S_DJIM(-1))	1.7779	[3.67933] **
D(S_DJIM(-2))	-0.4939	[-1.00991]
D(S_JCI(-1))	-1.6355	[-3.55913] **
D(S_JCI(-2))	-0.1677	[-0.36079]
D(FDTR(-1))	0.6175	[2.15035] **
D(FDTR(-2))	0.6618	[2.34852] **

ESG (SKEHATI)		
D(BIRATE(-1))	-0.1275	[-0.25947]
D(BIRATE(-2))	0.2343	[0.47693]
D(LNKURS(-1))	0.5719	[0.29324]
D(LNKURS(-2))	-1.0812	[-0.56362]
C	0.0379	[0.38098]
DUMMY	0.009	[3.09887] **
R-squared		0.06788
Adj. R-squared		0.04282
Sum sq. resids		74.51278
S.E. equation		0.36543
F-statistic		2.70889
Log-likelihood		-228.5147
Akaike AIC		0.85197
Schwarz SC		0.9733
Mean dependent		0.00457
S.D. dependent		0.37351

4.2.2. Impulse Response Function

The best way to characterize the dynamic structure in a model is to analyze the response of the model to shocks or innovation that occurs in the model. There are two ways to do this: IRF (Impulse Response Function) analysis or FEVD (Forecast Error Variance Decomposition) analysis. IRF can examine the relationship between variables by showing how endogenous variables react to a shock within the variable and other endogenous variables. IRF is also used to determine the response of an endogenous variable to significant innovations from an endogenous variable that directly affects the variable

itself and is passed on to all other endogenous variables through dynamic structures in the VECM model. In short, IRF measures the effect of a shock at one time on shocks from endogenous variables at that time and in the future.

Then, Impulse Response Function (IRF) was carried out to assess the dynamic response of the ESG Index, DJIM index, FDTR index, JCI index, XR, and BI-rate variables to a certain variable shock. Meanwhile, IRF aimed to isolate a shock to make it more specific, meaning a variable that could be affected by a particular shock. The following is the result of the impulse response of the ESG index if other variables, such as DJIM, FDTR, JCI, LNKURS, and BI rate, were imported.

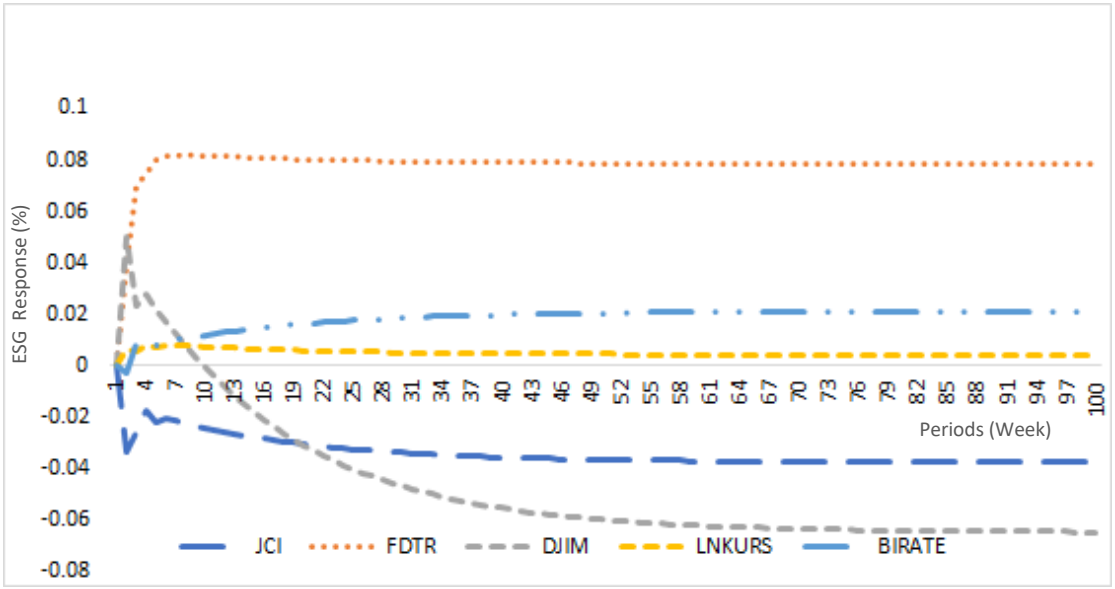

Figure 1. ESG response if JCI, FDTR, DJIM, LNKURS, and BI rate are impulse

Figure 1 depicts that a shock of one standard deviation of the DJIM in the second week would increase the ESG index by 0.05 percent, after which it continued to depreciate at the lowest level in a negative zone by -0.06 percent. The FDTR line in Figure 1 also shows that a shock of one standard deviation of FDTR in the seventh week would increase the ESG index by 0.08 and be stable in a positive trend for the next 100 weeks.

In addition, the BI rate and exchange rate standard deviation would slightly increase (appreciation) the ESG index, and both would continue to be stable after the seventh week in the positive range; the BI rate was a bit higher than the exchange rate percent for the next 100 weeks. Meanwhile, JCI responded in a negative zone along the 100 weeks but below DJIM response. Besides, BI Rate, exchange rate, and JCI were considered neutral. Thus, the researchers inferred that the speed of ESG towards the new stable equilibrium was extremely excellent based on all results of the impulse of all endogenous factors on the ESG response.

Figure 2 illustrates that a shock of one standard deviation of SRIKEHATI's would increase up to 0.03 percent as the top to the bottom of 0.01 percent on the positive level. The shock on the DJIM in the fourth week would increase (appreciation) of the ESG index by 0.005 percent and continued to decline until it reached the lowest point of appreciation in the fiftieth week of 0.01 percent, after which it continued to depreciate at the lowest level until 100-week period. Figure 2 also explains that a shock on FDTR, BI rate, and the exchange rate would not impact the JCI (neutral) for 100 weeks.

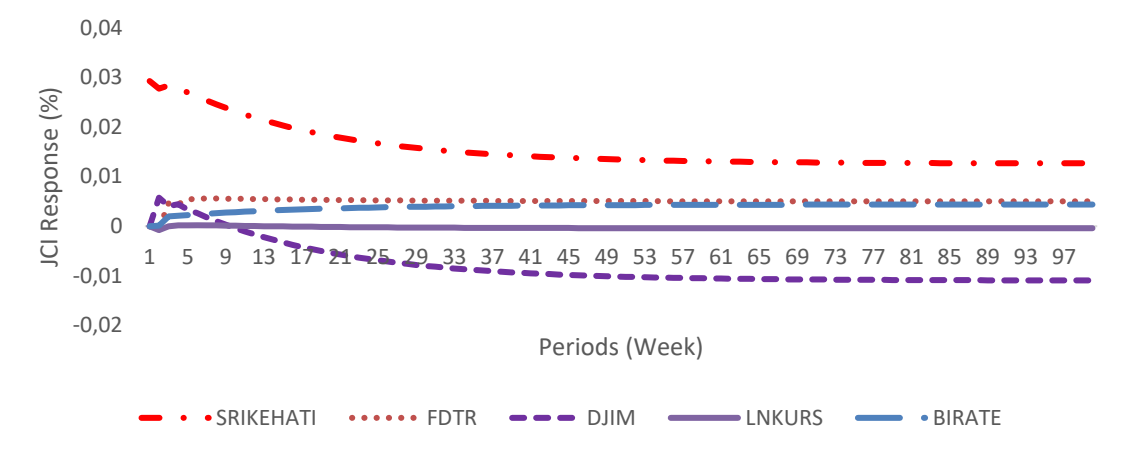

Figure 2. JCI response if SRIKEHATI, FDTR, DJIM, Exchange Rate, and BI rate are impulse.

Then, the JCI response was positive at 0.03 percent on the first week, then turned negative, remained positive until the 28th day, and stable for the next 100-week period. JCI response after DJIM shock was positive 0.005 percent to the third week until the 10th week slid down and stable in the negative zone until the end period. Then, JCI response after FDTR shock was positive 0.005 percent until the fourth week and stable in a positive trend. In addition, JCI did not react when there was a shock from the exchange rate, even though it was initially in a positive position. Meanwhile, the JCI response was higher than the SRIKEHATI and DJIM. DJIM as the external shock consistently influenced SRIKEHATI and JCI.

Based on Figure 3, if the JCI was startled, DJIM's response was positive by 0.018 percent until the fourth week period and then dipped to 0.015 percent until the tenth week and remained constant until the end. Meanwhile, if SKEHATI was startled, DJIM's reaction increased by 0.014 percent in the fourth week, continued to fall negatively until the 43rd week, and was stable to the end. On the other hand, DJIM's response was insignificant when FDTR, LNKURS, and BIRATE were impulsive from the first to the fourth week at 0.005 percent and remained practically neutral until the end of the period.

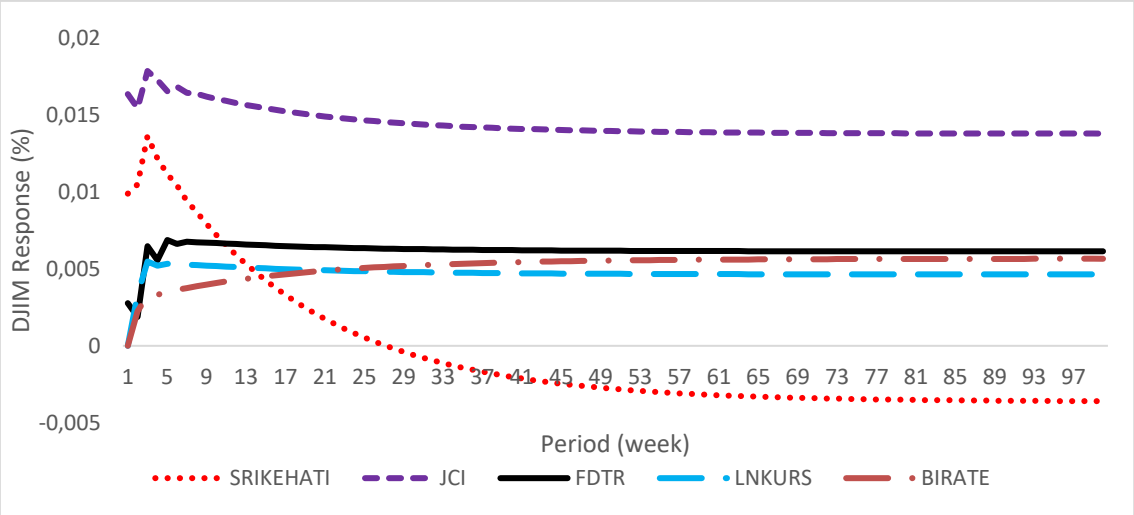

Figure 3. DJIM response if SRIKEHATI, JCI< FDTR, Exchange Rate, and BI rate are impulse

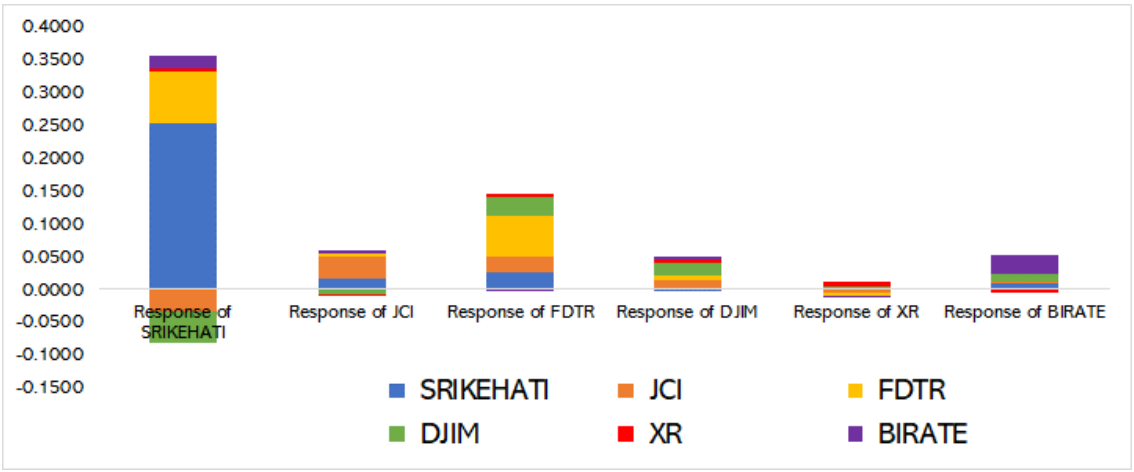

Figure 4. ESG Impulse Response

Accumulated IRF comparison of all variables' responses (SKEHATI, JCI, FDTR, DJIM, XR, BIRATE) shown in Figure 4, while other variables are stimulated or shocked indicates that SKEHATI's response was largest when FDTR, JCI, and DJIM were stimulated. SKEHATI, in other words, was the most responsive and had the biggest reaction. The second variable with a substantial reaction was FDTR, and the response value seemed large when the impulses from the JIC, DJIM, and SKEHATI variables were considered. The FDTR reaction, on the other hand, was not as robust as the SKEHATI response. When the impulses from the DJIM and SKEHATI variables were combined, the JCI response was observed. However, JCI's response was not as strong as SKEHATI's and FDTR's.

4.2.3. The Forecast Error Variance Decomposition (FEVD)

FEVD describes a dynamic structure in the VAR model to determine the strengths and weaknesses of each variable in affecting other variables in the long run. The FEVD breaks down the range from forecasting errors to the components associated with each endogenous variable in the model. It can be ascertained that factors influence the fluctuation of certain variables. In this analysis, the variables were the ESG Index, DJIM index, FDTR index, JCI index, LNKURS, and BI rate, as shown in Figure 1, Figure 2, and Figure 3.

Figure 5 ilustrates that the most important factor influencing SRI-KEHATI in variance decomposition was SRI-KEHATI itself, followed by the Fed rate. The DJIM itself, as well as the minor between SRI-KEHATI and the exchange rate, had the most prominent impact on DJIM. Meanwhile, the JCI findings were mixed, with SRI-KEHATI and DJIM having a significant effect. In addition, the Fed's results differed from theirs and were heavily influenced by DJIM and SRI-KEHATI. Then, the BI rate had the most influence, with modest contributions from DJIM and SRI-KEHATI. On the other hand, the exchange rate varied greatly between itself, JCI, the Fed rate, and DJIM.

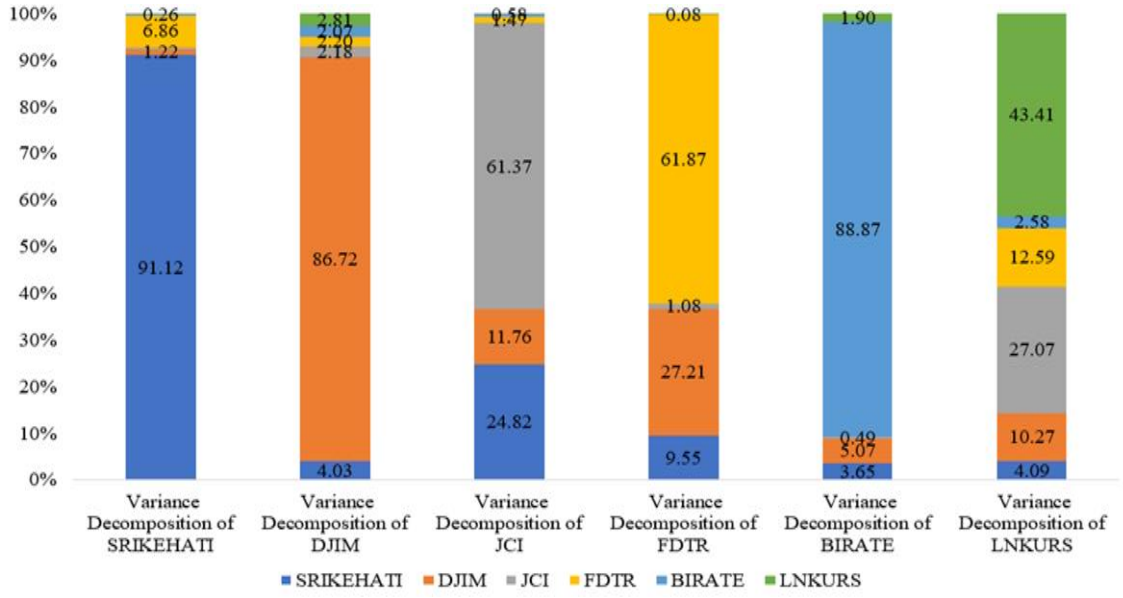

Figure 5. ESG SKEHATI FEVD

Based on Figure 6, during the first week of shock, ESG was affected by itself 100 percent. Contributions from other variables began to play a role in the second week, where ESG contributed 97.87 percent, DJIM by 0.458 percent, JCI by 1.1803 percent, FDTR by 0.474, and BI rate by 0.002045 percent. At week 100, the ESG shock was still dominated by itself with a smaller proportion of 88.48 percent, DJIM of 2.318 percent, JCI of 0.2716 percent, FDTR of 8476, BI rate of 0.406595 percent, and exchange rate of 0.052007

percent. Thus, the stability of FDTR and DJIM is required in the short and long term, which can affect ESG. If the shock from the US, for instance, is followed by the phenomenon of fly-to-quality and forced selling actions due to risk mitigation from global investors, this may affect ESG and other asset classes in Indonesia or even wider markets.

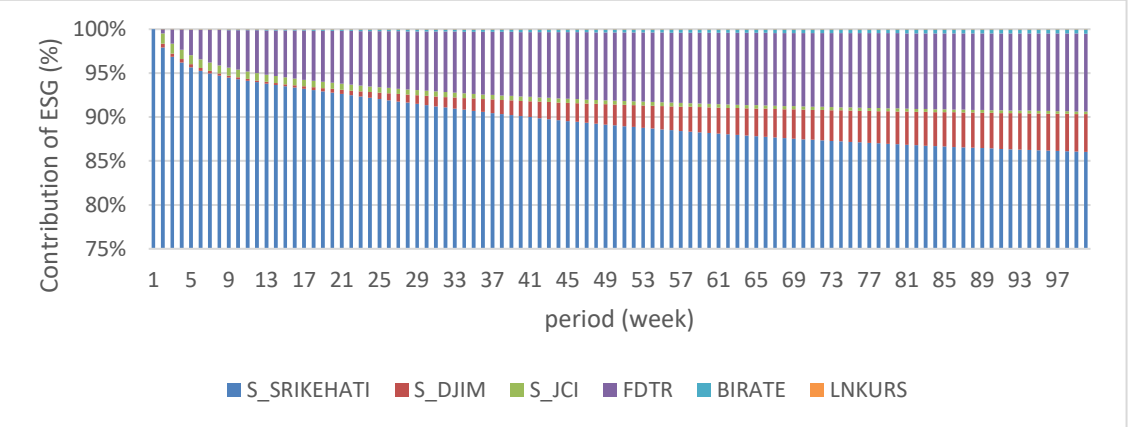

Figure 6. Variance Decomposition of ESGKEHATI

The impulse result showed how a variable responded if another variable was shocked. The overall results demonstrated SRI-KEHATI's response within 5-7 weeks and back to the stable. The impulse response by large was in the SRI-KEHATI 's response when there was a shock from the Fed rate, JCI, and DJIM. The second largest was the Fed rate response if there were innovations from DJIM and SRI-KEHATI. Another result of DJIM response if other variables were imported was not very significant, along with JCI's small response when SRI-KEHATI and DJIM were shocked.

4.2. Analysis

This study adds to the body of knowledge about the impact of the global financial crisis on stock market volatility, including COVID-19, stock market index volatility, Federal Reserve Rates, and other monetary policies. It is one of the first studies to explore the connection of three stock indexes with the co-integrating equation using VAR VECM. In this case, the ESG index is expected to do well if the Fed rate and the DJIM remain stable. In the short run, market volatility influenced forecasts of ESG price changes. It was verified by variance decomposition analysis, which indicated that shocks in the ESG Index were explained by the Fed rate and the Dow Jones, both of which have consistently had the greatest impact on the ESG Index. In addition, there was a long-run link between the ESG index and external variables, in line with Maysam et al. (2004) and Muzindutsi and Niyimbanira, that the stock market sector responded differently to macroeconomic change factors (2012). There was also a positive relationship between the exchange rate and the equity market's performance.

Johansen's co-integration test showed a significant long-run relationship between all market variables. In a co-integration approach, VAR followed by VECM tests were used to analyze the relationship between the ESG with other endogenous variables: DJIM index, Fed rate, JCI index, exchange rate, and BI rate. The negative effect of interest on stock prices suggests that varying inflation rates generated more volatility, and thus the demand for minimum returns would also rise, lowering market valuations. Wongbangpo and Sharma (2002) have established a negative correlation between inflation and stock prices in five Asian countries, namely Indonesia, Singapore, Malaysia, Thailand, and the Philippines, while Bekhet and Mugableh (2012) proved the case on the Malaysia stock exchange.

In this respect, Bank Indonesia always considers the FFR in making decisions, with the term of sufficient space to consider changes in the BI rate corresponding to the FFR cut or hike. Nowadays, not only central banks or regulators, entrepreneurs, industries, and academia will respond positively to the decline in interest rates, so it is hoped that strong support for BI and the government will strengthen to increase public confidence significantly. McCarthy and Zakrajsek (2003) estimated that the 50-bps (shock) FFR impulse simulation responded to the company's sales of manufactured products with optimum longevity. In general, existing research indicates that effective corporate governance and sound environmental standards may generate value for shareholders (Renneboog et al., 2008). Another interesting finding is that Islamic equity has proven to be the most stable in all periods. It is in line with Husin et al. (2013), Udoka and Anyingang (2013), and Jefferis and Okeahalam (2000) on the impact on Islamic equity markets utilizing both local and foreign market factors, which could infer the external influences. Before, Khatatbeh et al., Chaudhary et al. (2020), Alam and Chavali (2020), Maher et al. (2020), and Alali (2020) examined the global pandemic and its impact on stock markets.

Furthermore, Islamic equity is generally considered in line with ESG since they both apply ethical and value screening requirements. The main distinction is that most of ESG Indonesia's members work in traditional banking and finance, which Islam bans and is likely the source of instability. The further result from the non-parametric test discovered by Gunawan et al. (2021) is that Indonesia's ESG index is riskier and offers higher profit than Islamic and liquid equity.

V. Conclusion and Recommendation

5.1. Conclusion

According to the co-integrating equation, FDTR and DJIM stability is necessary, which might affect ESG in the short term. For the estimate of the dynamic response, only DJIM and JCI exhibited negative correlations with the ESG

Index simultaneous impulse response function. In the long term, the findings of the variance decomposition for ESG demonstrated that the Fed rate had the largest impact on ESG, followed by the Dow Jones Index. Both impacts indicated capital flight, most likely prompted by rising interest rates or a possible bullish trend in offshore equity. In the near run, every market volatility considerably impacted forecasting ESG price fluctuations. It was confirmed by variance decomposition analysis, which revealed that shocks in the ESG Index were explained by shocks in the Fed rate and Dow Jones, which have had the biggest impact on the ESG Index in the past. As a result, this article stressed that the ESG Index and a mix of the chosen market's impacts had a long-run correlation. However, the limitation of the study is due to the small sample size, few market variables, and only focus on Indonesia. Therefore, the future extension may involve a greater scope of higher-scale data, with sophisticated methods applying artificial intelligence to a huge, big data panel.

5.2. Recommendation

The SRI-KEHATI issuers' strict selection is projected to become a standard for the foundation of capital markets investment instruments, such as traditional mutual fund investments, Exchange Trade Funds (ETFs), and other forms of novel structured ESG-based products. The SRI-KEHATI index's working pattern is based on global investing trends because today's investors are examining not only financial factors but also social, environmental, and sustainable development principles. These crucial factors have a significant impact on investment decisions.

Thus, estimating the market's impact on Indonesia's ESG Index will not only benefit investors' portfolio and risk management strategy but also provides important implications for regulators, especially Indonesia's Financial Service Authority (OJK) and the Central Bank of Indonesia. In addition, the significant negative impact of ESG performance from the Fed rate and Dow Jones ESG during the short and long run will have to be managed considerably. Firstly, OJK and Bank Indonesia must enforce market deepening campaigns to strengthen Indonesia's financial inclusion and intensify public literacy over ESG investment. It aims to reinforce the domestic financial capacity to enter the market, replacing the capital flight. Secondly, Bank Indonesia must also be ready with the policy-mix strategy to tackle some external factors on the monetary side supported by the Ministry of Finance on the fiscal side.

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