“Uncovering dynamic relationships across sustainable-ethical financial assets: A new outlook from Indonesia”

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UNCOVERING DYNAMIC RELATIONSHIPS ACROSS SUSTAINABLE-ETHICAL FINANCIAL ASSETS: A NEW OUTLOOK FROM INDONESIA

Abstract

Against the rapid developments in cross-border investment that shed light on portfolio diversification opportunities, this study investigates the relationship between Indonesia's sustainable ethical stocks and global sustainable financial assets. Amid market uncertainty, the need for safe havens and diversification of investment portfolios is imperative. Given the remarkable performance of Indonesia's Islamic stocks, which are considered ethical stock, and the importance of sustainable stocks, this study examines how global financial assets such as Green Bonds, Artificial Intelligence (AI) stocks, and clean cryptocurrencies are interconnected. Employing a Dynamic Conditional Correlation – Generalized Autoregressive Heteroskedasticity (DCC-GARCH) model within the Structural Vector Autoregression (SVAR) framework, this study examined daily data spanning January 2, 2020, to August 6, 2023. This study finds strong evidence of dynamic relationships across assets, implying limited diversification benefits in the market. The results show that Cardano, as a clean cryptocurrency, can serve as a short-term safe haven, while the Green Bond potential is a long-term safe haven against Indonesia's Islamic stocks. However, green bonds, Cardano, and AI stocks are suggested as potential diversifiers for sustainable stocks. Understanding these dynamics offers valuable insights into asset selection and diversification strategies, particularly for investors focusing on sustainable ethical assets.

Keywords dynamic conditional correlation, Islamic stock, portfolio diversification, sustainable stock, Cardano, green bonds

JEL Classification G11, G15

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INTRODUCTION

In today's global investment management industry, the endeavor to achieve sustainability has emerged as a vital objective that transcends the mere focus on returns. It now incorporates Environmental, Social, and Governance (ESG) aspects (Mensi et al., 2017). Ethical investment, commonly referred to as socially responsible investing (SRI), is an investment strategy that considers both financial returns and ethical or moral values. Ethical and sustainable assets are emerging alternatives to investment in conventional assets due to their ability to provide financial stability and the benefits of portfolio diversification, including Islamic stocks and environmentally friendly assets such as sustainable stocks, green bonds, and clean energy (Agustin, 2021; Delle Foglie & Panetta, 2020; Ouchen, 2022). Hence, the stability and resilience of Islamic stocks, as the most pronounced ethical investment against the global financial crisis, has become an interesting topic in several studies. Meanwhile, the rapid development of technological assets in the twenty-first century, such as cryptocurrency, fintech, and artificial intelligence markets, became the spotlight and triggered investors' attention to risk management (Abakah et al., 2023).

Indonesia, as a Muslim-majority country, is recorded as the Best Islamic Capital Market 2022 at the International Global Islamic Finance Award (GIFA). This is the fourth time the IDX has received an award in a row since 2019. However, Global economic uncertainty and increasingly unpredictable volatility, such as the black swan COVID-19 pandemic, require asset management professionals and investors to seek new investment opportunities that offer diversified assets to maintain optimum portfolios. As markets around the world become more integrated during the pandemic, assets tend to move in the same direction (Disli et al., 2021; Zaimovic et al., 2024). This leads to the implementation of portfolio diversification strategies that become more complex and increase the level of portfolio risk. Understanding how uncertainty causes price volatility in financial markets is important for investment managers and investors to be enthusiastic about effectively modifying their portfolios to minimize risk (Asgharian et al., 2023).

1. LITERATURE REVIEW

Continued attention to sustainable and ethical stocks has gained attention from scholars in this field. Several studies have sought to explore the potential performance of sustainable and ethical assets under the spirit of the Modern Portfolio Theory (MPT) by Markowitz (1952), which emphasizes the benefits of diversification in minimizing risk while maximizing returns. The MPT provides a systematic approach to constructing a portfolio that considers the correlation between different asset classes, guiding investors in selecting a combination of sustainable assets that align with their risk tolerance and investment objectives. The main idea is that investors can construct optimum portfolios to maximize their expected returns through a diversification strategy. The notion behind this theory posits that risk-averse investors can create portfolios to optimize expected returns at a specified level of market risk by acknowledging the trade-off between risk and potential rewards.

However, the MPT underlies some basic assumptions, including an efficient market. In 1970, Eugene Fama introduced the concept of efficient markets, defined as a market with a great number of rational, profit-maximizers actively competing, with each trying to predict future market values of individual securities, and where current important information is almost freely available to all participants. Eugene Fama (1970) identified three primary levels of market efficiency: weak, semi-strong, and strong. Weak-form efficiency is characterized by stock prices that fully reflect historical market data and past prices, but do not predict future price movements. In Indonesia, it has been proven that the Efficient Market Hypothesis is efficient in the weak form for the Indonesian Sharia stock market (ISSI) (Agustin, 2019).

Modern Portfolio Theory and its development have been used by many scholars to construct optimum portfolios. Investors seek portfolio diversification to reduce the risk of heavy losses. However, in times of financial crisis, contagion effects may cause markets to strongly co-move, even when macroeconomic fundamentals do not suggest strong interdependence (Dornbusch et al., 2000; Hasman & Samartin, 2008). Baur and Lucey (2010) and Baur and McDermot (2010) introduced the concept of Safe Haven and Diversifier assets, motivated by previous studies that show flight to quality behavior" during times of crisis (Gubareva et al., 2022). Safe Haven defined as A safe-haven is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil. A diversifier is an asset positively (but not perfectly) correlated with another asset or portfolio on average. Scholars have utilized this concept in terms of asset selection and portfolio optimization across different classes of assets (Agustin, 2022; Chu et al., 2021; Lim & Neoh, 2023; Tiwari et al., 2021; Urom et al., 2022).

By analyzing the correlations and performance of these asset classes, researchers aim to determine whether they can serve as an effective safe haven against market volatility and economic uncertainty. Some studies in Indonesia indicate that sustainable stocks and Islamic stocks perform better than conventional stocks (Asutay et al., 2022; De La O González et al., 2019; Jabeen & Kausar, 2022; Shear & Ashraf, 2022). Sustainable and ethical stocks are

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considered to have lower risk because they possess strong intrinsic values (Curto & Vital, 2014; Kang et al., 2020) and are often referred to as safe-haven assets that can reduce risk in portfolios (Balcilar et al., 2017; Jain et al., 2019; Mensi et al., 2017).

Companies that prioritize environmental, social, and governance (ESG) considerations are the focus of sustainable investment. The development of a sustainability index shows an increase in investor interest in sustainability issues (Jain et al., 2019). Sustainable Stocks encompass shares from companies that prioritize environmental, social, and governance (ESG) factors, followed by a strand of studies showing that companies with good ESG practices perform better than other markets (Liu et al., 2023; Liu & Guo, 2023; Naseer et al., 2023). On the other hand, Sharia shares are proof of the ownership of a public company (issuer) that complies with Sharia principles. Sharia stock investment is based on five fundamental principles: prohibiting interest (riba), prohibiting excessive uncertainty (gharar), prohibiting speculation (maysir), sharing risks and profits, and prohibiting investment in industries that do not comply with Islamic Sharia rules (haram) (Abbes & Trichilli, 2015; Abdul-Rahim et al., 2019; Suryadi et al., 2021). Therefore, sharia-based companies are expected to have lower leverage and lower exposure to the credit market. This indicates that Islamic financial instruments are better able to manage and minimize systematic risk than conventional assets (Delle Foglie & Panetta, 2020).

The rise of artificial intelligence (AI) has transformed various sectors, leading to increased interest in investing in AI stocks. As companies leverage AI technologies to improve efficiency, drive innovation, and create new products, these stocks have emerged as compelling investment categories (Tiwari et al., 2021). Furthermore, a growing number of AI companies are recognizing the importance of aligning their business models with sustainable and ethical practices. This alignment not only enhances their market appeal but also attracts a new demographic of socially conscious investors who prioritize both financial returns and positive social impacts. By adopting sustainable practices, these companies not only address environmental and social concerns but also position themselves competitively in an evolving market. As a result, the intersection of AI and sustainability is becoming a key driver of investment interest, reflecting a broader trend in which ethical considerations play an integral role in financial decision making (Urom et al., 2022).

Several studies have revealed that high-tech stock returns are more volatile than non-technology equities, which may indicate that investors feel uncertain about the profitability of high-tech companies because of the complexity of implementing new technological innovations (Demiralay et al., 2021; Le et al., 2021). AI stocks also provide investment benefits when combined with traditional and alternative investments (Demiralay et al., 2021). Moreover, a recent study by Tiwari et al. (2021) discovered a significant negative comovement between AI Stock and carbon prices. AI stocks can be considered a safe haven for carbon prices when volatile events occur. Symitsi and Chalvatzis (2018) found that the AI & Robotics index is not linearly and significantly aligned with cryptocurrency. Huynh et al. (2020) suggest that combining AI equities with other assets provides lower hedging and diversification benefits. In addition, recent studies by Abakah et al. (2023) and Tiwari et al. (2021) discovered a significant negative co-movement between AI Stock and conventional stock during a market downturn and found a negative correlation between AI stock and the Islamic index. Moreover, Urom et al. (2022) find that AI offers diversification benefits that are significant (negative) in the renewable energy sector.

As the world becomes increasingly aware of the environmental impact of traditional cryptocurrency mining, clean cryptocurrencies have emerged as sustainable alternatives. Traditional cryptocurrencies, particularly those utilizing proof-of-work mechanisms, such as Bitcoin, have faced significant criticism for their high energy consumption and substantial carbon emissions associated with mining activities. In response to these concerns, clean cryptocurrencies have leveraged energy-efficient consensus mechanisms. Since the launch of Bitcoin, the first decentralized virtual currency, only 13 years have passed, and as of November 2021, over 1000 distinct cryptocurrency coins are in circulation. Currently, the total market capitalization of over 7,000 varieties exceeds 2.6 trillion U.S. dollars (www.coinmarketcap.com). Corbet

et al. (2021) and Gallersdörfer et al. (2020) recommend that practitioners differentiate between cryptocurrencies based on their energy-intensive or energy-efficient algorithms. Numerous energy-efficient cryptocurrencies exist, with further ones under development, including Cardano, Ripple, and IOTA, which have been among the top 10 cryptocurrencies by market capitalization. As global policies increasingly favor ecologically sustainable practices, investors are likely to switch from energy-intensive cryptocurrencies to more sustainable alternatives. This study uses Cardano to represent the "green" or "clean" cryptocurrencies.

Stocks and cryptocurrencies might have a relationship because these two assets have emerged globally. However, they might be uncorrelated due to their different natures and investors' risk appetites. Previous research (Chu et al., 2021; Kang et al., 2020; Mariana et al., 2021; Wang et al., 2020) examined the relationship between cryptocurrency and various stock markets, finding significant negative results for cryptocurrency can be perfect safe haven, hedge, and diversifier of assets in various stock markets including the global stock index, Asian stock market, and U.S. stock market returns. Barbu et al. (2022) found that cryptocurrencies fulfill a diversifier role for the responsible investments represented by sustainable stocks.

Meanwhile, Ahmed (2021) found that cryptocurrencies such as Bitcoin and Islamic assets seem to have a significant negative effect on returns if Sharia-compliant stocks are in bear than in bull market conditions. In line with Widjaja et al. (2023), cryptocurrency is a good diversifier and safe-haven asset against Islamic stocks. This finding is similar to that of Lim and Neoh (2023), who examined the relationship between Bitcoin and Islamic stock returns. Bitcoin is found to have a significantly low correlation with Islamic stock returns.

In recent years, green bonds have become a potential asset for portfolio diversification and have the advantage of providing funding to support environmental sustainability. Several studies have examined green bonds as having the potential for diversification with other assets. For example, Naeem et al. (2023) noted that green bonds have a negative correlation and act as a safe-haven investment and diversifier for green investments, such as clean energy and sustainability indices. Ren and Lucey (2022) examined the relationship between green assets and cryptocurrency and found a significant negative effect, providing diversification benefits for investors who invested in cryptocurrency. This is in line with Naeem and Karim (2021), who showed that all green assets, especially clean energy, can become hedge assets for Bitcoin. Other studies by Abuzayed and Al-Fayoumi (2023) and Nguyen et al. (2021) state that green bonds provide diversification benefits for investors who invest in four financial assets: global stocks, commodities, and clean energy.

In summary, the concepts of safe haven and diversifier introduced by Baur and Lucey (2010) and Baur and McDermott (2010) are important for constructing a well-diversified portfolio of Islamic and sustainable stocks in Indonesia. Therefore, this study aims to examine the dynamic relationship between the two types of stocks with global sustainable assets, namely clean cryptocurrency, AI stock, and green bonds. As investors increasingly prioritize sustainability, the insights from this study can help align their portfolios with ethical standards and achieve favorable financial outcomes. Additionally, many studies have not explored the correlations between different sustainable assets and Sharia-compliant assets. Addressing these gaps will provide clearer insights into making informed investment decisions and help investors effectively integrate these assets into diversified portfolios while aligning with their values. Thus, the use of time-varying analysis to examine the relationship between assets is expected to capture dynamic co-movements across asset markets. This study is essential for Islamic market investors to apply asset allocation strategies to portfolios that focus on sustainability goals.

In light of the the explanation above, this research aims to examine the relationship between Islamic and sustainable stocks with several sustainable financial assets, namely Artificial Intelligence stocks, clean cryptocurrency, and green bonds. The proposed hypotheses are as follows:

H_1: *Artificial intelligence stocks have a significant negative effect on sustainable stocks.*

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H_2: *Artificial intelligence stocks have a significant negative effect on Islamic stocks.*

H_3: *Clean cryptocurrency has a significantly negative effect on sustainable stocks.*

H_4: *Clean cryptocurrency has a significantly negative effect on Islamic stocks.*

H_5: *Green bond stocks have a significant negative effect on sustainable stocks.*

H_6: *Green bond stocks have a significant negative effect on Islamic stocks.*

2. METHODOLOGY

This study used daily closing price data of Islamic stocks (Jakarta Islamic index) and sustainable stocks (Sri-Kehati index) collected from the official IDX website. While daily prices of AI stocks (Nasdaq CTA Artificial Intelligence index), clean cryptocurrency (Cardano), and green bonds (S&P Green Bond Index) were collected from www.investing.com. The study spans from January 2, 2020 to August 6, 2023, resulting in 911 observation days. Table 1 shows the data for sustainable financial asset indices.

Since COVID-19 has been proven to increase market volatility, this study uses dynamic correlation rather than constant correlation, such as the VAR model or other constant approaches. This study uses the DCC-GARCH approach proposed by Engle (2002). This model is used to measure stock market correlations because it can dynamically determine investor behavior in response to news or innovation. This describes the dynamic connection between different time series. It is possible to perform a dynamic correlation between time series fluctuation analysis, which means that the fluctuation between series is not a constant, but a coefficient that evolves with time. Many academics have begun to explore the relationship between different markets based on this paradigm from a static to a dynamic standpoint. Two procedural steps exist in the DCC-GARCH model to measure the correlation between markets.

The conventional DCC-GARCH model comprises a two-step estimation method. First, the conditional variance is determined using the GARCH process (1,1). The next step was to estimate the pairwise DCC between the variables. This study used the DCC-GARCH Model under the SVAR framework proposed by Akkoc and Civcir (2019). In the first step, the Structural Vector Autoregressive (SVAR) model was used to obtain the residual. Second, the residuals were used as the input for the DCC-GARCH Model. The SVAR model was used because Indonesia is a small economy that is assumed to be influenced by the movement of Global Financial Assets. Under the SVAR Model, the influence of the Indonesian market on global financial assets is blocked. Combining the VAR/SVAR and DCC-GARCH models is expected to solve endogeneity issues, time-varying, and dynamic conditional correlations in the model. The DCC-GARCH model is represented as:

$$r_t = u_t + e_t, \tag{1}$$

where $e_t \sim N(0, H_t)$.

$$H_t = D_t R_t D_t, \tag{2}$$

$$R_t = \left(Q_t^*\right) Q_t \left(Q_t^*\right)^{-1}, \tag{3}$$

$$Qt = (1-\alpha-\beta)\bar{Q} + \alpha\varepsilon_{t-1}\,\varepsilon_{t-1} + \beta Q_{t-1}, \tag{4}$$

where e_t – error terms, H_t – The matrix generated from the SVAR and GARCH process, α – Short-run coefficient, β – Long-run coefficient.

Table 1. Variables description

Market	Description	Abbr	Time interval	Freq	Data source
Islamic stocks	Jakarta Islamic Index	IS	02/01/2020-06/10/2023	Day	IDX
Sustainable stocks	Sri-Kehati index	SS	02/01/2020-06/10/2023	Day	IDX
AI stock	Nasdaq CTA Artificial Intelligence index	AI	02/01/2020-06/10/2023	Day	investing.com
Clean cryptocurrency	Cardano Index	Cardano	02/01/2020-06/10/2023	Day	investing.com
Green bonds	S&P Green Bond Index	GB	02/01/2020-06/10/2023	Day	IDX

The DCC-GARCH estimation results in two important parameters, α and β. α defines the short-run persistence of shocks to conditional variance, indicating the impact of new information on market fluctuation correlations. B represents the long-run persistence of shocks to conditional variance, highlighting the influence of past market volatility on future market volatility correlations. Furthermore, the condition $\alpha + \beta < 1$ suggests that the conditional correlation in the models is not constant and that the dynamic correlation is valid.

3. RESULTS AND DISCUSSION

Table 2 presents the results of descriptive statistics for the daily return series of Islamic stock, sustainable stock, and three globally sustainable financial assets over the entire study period. Judging from the daily mean returns, all variables have positive average daily returns, except for the green bond. Cardano, as part of cryptocurrency assets, records the highest average return, which confirms the nature of cryptocurrency markets in having a high probability of gaining abnormal returns. The Indonesian Islamic stocks and sustainable stocks showed positive returns during the COVID-19 period. This implies that these two ethical assets were resilient during the crisis.

Cardano has the highest standard deviation, following the nature of cryptocurrency assets, indicating high volatility. This means a significant return difference compared with other instruments, which are riskier and more sensitive to overall market fluctuations. Unsurprisingly, green bonds have the lowest volatility, confirming that bonds are one of the stable assets during the economic downturn, at least among other assets. However, the Indonesian stock market shows a slight difference in volatility between Islamic and Sustainable stocks.

The graphical analysis presented in Figure 1 elucidates distinct trends in each market index. Green bonds emerged as a standout performer with a steady upward trend throughout the sample period, indicating resilience and stability in turbulent times compared to other assets. During a period of stress, such as the COVID-19 pandemic in March 2020, most assets experienced sudden price declines and moved in the same direction, reflecting a lack of diversification benefits and safe-haven characteristics among these assets. However, Cardano stood out for its steady movement, indicating the potential characteristics of a safe-haven asset with a lower correlation to broader market movements. Specifically, for sustainable stock, Islamic stock, AI stock, and green bonds fell in February 2020 and reached their lowest points in March 2020. This synchronized movement suggests that during pandemic-induced market turmoil, these assets failed to provide effective safe-haven protection for each other, highlighting their vulnerabilities to systemic risks.

As a global experience of the Russia-Ukraine war, a similar pattern emerges, with Cardano, sustainable stocks, and Islamic stocks experiencing a downward trend. By contrast, AI stocks and green bonds demonstrate an upward trajectory, indicating potential safe-haven qualities that could offer protection to investors seeking refuge from uncertainties and market turmoil.

Table 2. Descriptive statistics

Statistics	AI	CARDANO	GB	IS	SS
Mean	0.000286	37.39529	–0.000196	0.000211	0.000201
Median	0.000791	0.001456	–8.17E–05	0.000256	0.000302
Maximum	0.095281	11845.85	0.023685	0.090729	0.158664
Minimum	–0.099491	–0.999912	–0.023811	–0.063471	–0.078616
Std. Dev.	0.016687	651.3172	0.004787	0.010809	0.014351
Skewness	–0.345542	17.37203	–0.103473	0.094209	0.995095
Kurtosis	8.536367	303.1612	6.368073	12.41190	22.93582
Jarque–Bera	1181.603	3465745.	432.2218	3363.840	15236.39
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	0.260816	34067.11	–0.178592	0.192425	0.183423
Sum Sq. Dev.	0.253403	3.86E+08	0.020856	0.106320	0.187419
Observations	911	911	911	911	911

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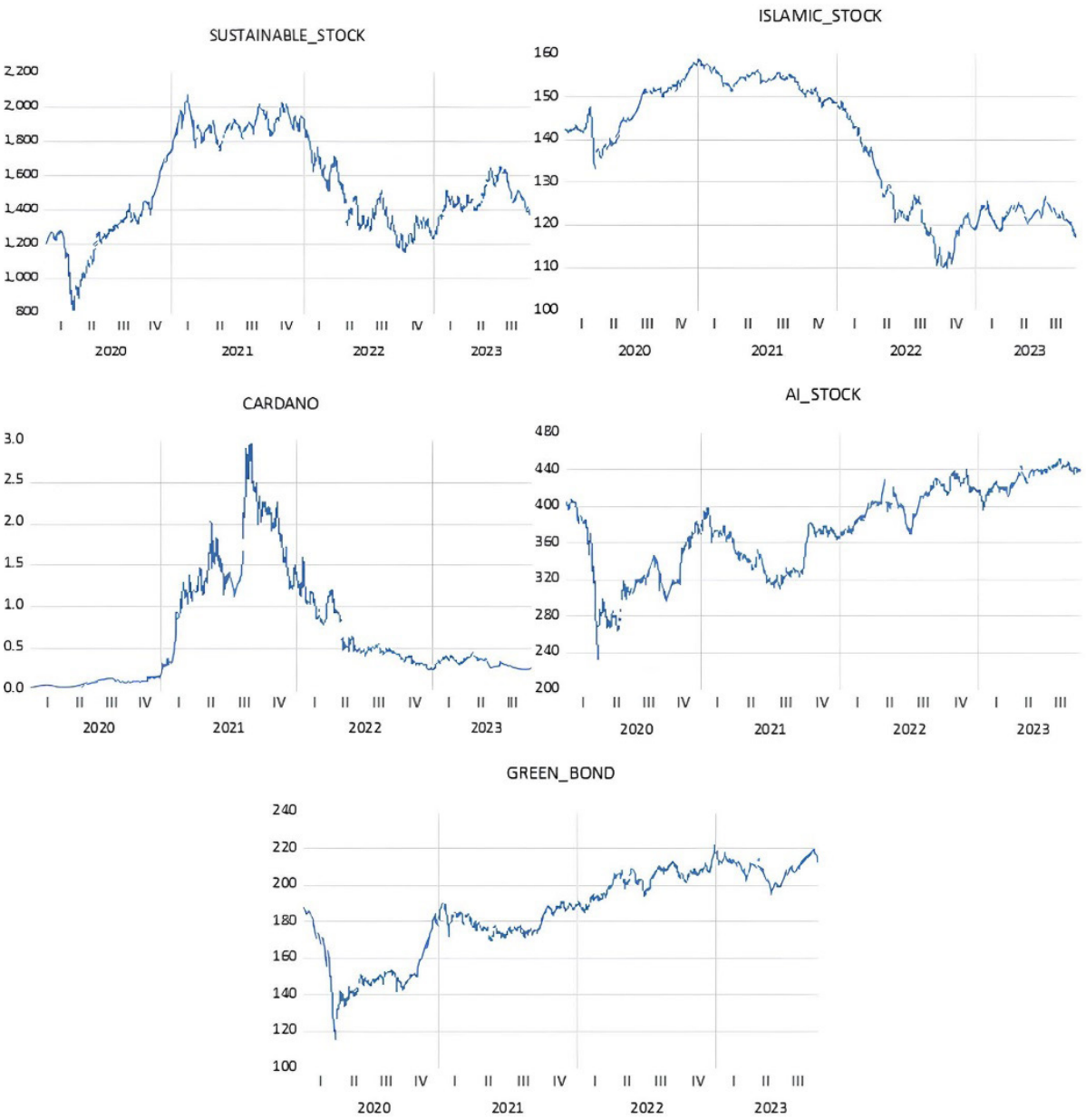

Figure 1. Trend graph for each market index

Before employing DCC-GARCH, Table 3 displays an unconditional or simple correlation matrix between the assets as a preliminary insight into how each variable correlates in a static mode. It can be seen that the Cardano index has a negative correlation with other markets, with the Islamic stock having the lowest correlation with them, followed by the Green Bond index. It shows the relation-

Table 3. Pearson correlation of every asset prices

	AI	CARDANO	GB	IS	SS
AI	1.000000				
CARDANO	–0.031030	1.000000			
GB	0.371661	–0.004293	1.000000		
IS	0.298818***	–0.003111***	0.198579**	1.000000	
SS	0.292030***	–0.015401	0.170732***	0.831491	1.000000

Note: *, **, and *** denote significant correlation at 10%, 5%, and 1%, respectively.

Table 4. Dynamic conditional correlation model estimate result

Markets	Variables	α	β	α+β
IS and others	AI and IS	0.010292(0.1841)	0.97248388(0.0000)	0.982775
	Cardano and IS	–0.002177(0.0000)	0.792193(0.6985)	0.790016
	Green Bond and IS	0.099764(0.0110)	–0.195428(0.4099)	–0.095664
SS and others	AI and SS	0.007880(0.2710)	0.965344(0.000)	0.973224
	Cardano & SS	0.053417(0.7365)	0.767525(0.1197)	0.820942
	Green Bond & SS	0.044759(0.1177)	0.715532(0.0012)	0.760291

Note: Probability values are in parentheses.

ship between price movements that are opposite or do not affect each other, and there is a certain ability to resist the risk. The relationship between AI stock and other markets is positive, with the highest correlation with Islamic stock, except for Cardano. Similarly, the green bond market is also positively correlated with other markets, with the highest correlation with sustainable stock, except for Cardano. Finally, there is a positive correlation between sustainable stock and other markets, with the highest correlation to AI stock, and there is a negative correlation for Cardano.

The effects of shocks, such as the COVID-19 pandemic and the Russia-Ukraine war in February 2022, have impacted Indonesia and the global financial market. A dynamic conditional correlation (DCC) model can be used to capture this situation. The advantage of the Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model is its ability to measure the diversification potential of financial products within a portfolio.

Table 4 illustrates the results of the DCC-GARCH model between the three global financial assets and two financial assets from the Indonesian market to reveal the correlation between each asset and its potential diversification benefits for investors. The sum (α + β) value between each asset is less than one, indicating that the DCC-GARCH model and correlation are valid. The Islamic stock and AI correlation is positively insignificant in the short term, but positively significant in the long term. This means that the AI stock can only be used as a diversifier asset in the short run, but is not suggested as a diversifier in the long run. The dynamic correlation between Islamic stock and Cardano is significantly negative in the short term and positive and insignificant in the long term; Cardano is a safe haven in the short run but can only be a diversifier in the long run. Interestingly, green bonds have been suggested as safe havens for Islamic stocks in the long run.

Refering to the proposed hypotheses, The results of the analysis show that H_3 and H_2 are proven. Whereas H_1, H_2, H_4, and H_5 are not proven. These results indicate that the financial markets have become increasingly integrated (Zaimovic et al., 2024). In this case, Islamic stocks still provide room for diversification with other financial assets, considering that there is a negative relationship with other assets, namely AI stocks and Cardano which is in line with study by Urom et al. (2022) and Abakah et al. (2023). However, since the hypothesis only points to the potential safe haven, there is still room to diversify assets through diversification opportunities.

Meanwhile, it was found that there are limited diversification opportunities in the relationship between sustainable stocks and other markets. This is because there is no negative correlation or safe haven assets. Moreover, the correlation between all assets and sustainable stocks is positively insignificant in the short term. This means that AI stocks, Cardano, and green bonds can be used as diversifier assets in the short run. Likewise, in the long run, the correlation between Cardano and sustainable stocks is positively insignificant. This means that Cardano can also be used as a diversifier asset in the long run.

Based on the results of this study, three key findings emerged. First, the study suggests that AI stocks could serve as a diversifier for Islamic and sustainable stocks, particularly in the short term. This finding aligns with the existing literature, such as Huynh et al. (2020), that incorporating AI equities into a portfolio alongside other assets can offer diversification benefits.

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Second, Cardano, as a clean cryptocurrency, can be a safe haven in the short term and a diversifier in the long term for Islamic stock (Ahmed, 2021; Chu et al., 2021; Lim & Neoh, 2023; Wang et al., 2020; Widjaja et al., 2023). In other words, Cardano can also be a diversifier for sustainable stocks. The results of this research are supported by research conducted by Barbu et al. (2022), which incorporates cryptocurrency into a portfolio of sustainable investment and can enhance diversification benefits because it can potentially improve the portfolio's risk-return profile.

Finally, the Green Bond market was found to be a safe-haven asset for Islamic stocks. This finding is consistent with those of Abuzayed and Al-Fayoumi (2023) and Naeem and Karim (2021). These studies highlight the significance of Green Bonds in providing stability and resilience to Islamic stocks. Green bonds can serve as diversifying assets for sustainable stocks in the short term. This idea is reinforced by the recent research conducted by Naeem et al. (2023), which highlights the potential for diversification opportunities for investors in sukuk and green bonds, particularly during the challenging period of COVID-19. Investors seeking to enhance their portfolios with environmentally friendly investments may find green bonds to be a valuable addition, not only for their potential financial returns but also for their positive impact on the environment. By including green bonds along with other sustainable assets, investors can potentially benefit from greater diversification and resilience in their investment strategies.

CONCLUSION

Since the advent of financialization and globalization, the relationship between financial markets worldwide has become increasingly strong. This is evidenced, among other things, by the increasing integration of financial markets worldwide, which limits the potential for diversification. The integration of ethical and sustainable assets into investment strategies has become a cornerstone of the global investment management industry, signifying a paradigm shift towards sustainability and ethical considerations beyond mere profitability. This study aims to examine the dynamic relationship between Islamic and sustainable stocks with several financial assets, namely artificial intelligence stocks, clean cryptocurrency, and green bonds using daily data from January 2, 2020 to August 6, 2023 by employing the DCC-GARCH model.

In conclusion, the study suggests that AI stock could be a diversifier for Islamic and sustainable stocks in the short term, while Cardano, as a clean cryptocurrency, is suggested as a short-term safe haven and long-term diversifier for Islamic stocks, but only as a diversifier asset for sustainable stocks in the short term. Meanwhile, the Green Bond market was found to be a long-term safe-haven asset for Islamic stocks and a short-term diversifier for sustainable stocks.

The results have beneficial implications for portfolio management and are of great interest to investors in avoiding risk during uncertainty and extreme market volatility. Furthermore, the findings of this study are important for investors and portfolio managers, as the results reveal alternative safe haven instruments for portfolio diversification for those who seek to use sustainable financial assets, and emphasize the importance of supporting environment-friendly investments.

Since this study posits the imperative role of Cardano and Green Bonds for Islamic Stocks, regulatory frameworks might be established to promote investments in cryptocurrencies with a reduced environmental impact, such as Cardano, which highly corresponds with international sustainability objectives. Governments should establish incentives such as tax benefits or subsidies for green initiatives that comply with sustainability criteria and promote their inclusion in sustainable investment portfolios. The government could implement advantageous policies specifically for Green Bond investors or provide subsidies for companies issuing Green Bonds, thus enhancing their appeal to both domestic and international investors. This may also encompass enhanced reporting and certification procedures to guarantee the openness and integrity of green-bond investments.

However, it is also worth noting that these sustainable assets are not the only alternatives for investors to avoid high levels of risk during uncertainty. A recommendation for further research is to add the research time span and a number of alternative safe-haven instruments. Moreover, a portfolio diversification strategy consists of two processes: asset selection and allocation. However, this study covers only the first step. Further studies could explore the proportion of each asset included in the portfolio.

AUTHOR CONTRIBUTIONS

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