Jurnal Teknologi dan Manajemen Industri Terapan (JTMIT) Vol 5, No 2, Juni 2026 pp 976 - 980
P-ISSN: 2829-0232 E-ISSN: 2829-0038

Implementation Of Green Human Resource Management In Improving Green Brand Image: The Role of Environmental Behavior As A Moderating Variable

Soni Suardi[1*],Muhamad Risal Tawil[2], Muhammad Faizul Husnayain[3], Tono Wartono[4], Darmun[5]
[1]Universitas Pelita Bangsa, Indonesia, Indonesia
Jl. Inspeksi Kalimalang No.9, Cibatu, Kec. Cikarang
[2] Politeknik Baubau, Indonesia
Jl. Lakarambau, Lipu, Kec. Betoambari, Kota Bau-Bau, Sulawesi Tenggara
[3] Univeritas Nahdlatul Ulama Purwokerto, Indonesia
Jl. Sultan Agung No.42, Windusara, Karangklesem, Kec. Purwokerto Selatan
[4,5] Universitas Nahdlatul Ulama Cirebon, Indonesia
Jalan Sisingamangaraja 33 45111 Kesenden Jawa Barat
Email: sonisuardi@pelitabangsa.ac.id

ABSTRACT

This study aims to analyze the volatility dynamics and spillover phenomena among major crypto assets (Bitcoin, Solana, and Ethereum) and their relationship with the Jakarta Composite Index (JCI), a proxy for the Indonesian capital market. In the era of digital financial integration, the link between speculative crypto asset markets and conventional stock markets is a crucial issue for financial system stability. This study uses daily price time series data for the period 2020-2025. The analysis was conducted using the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model and the Diebold-Yilmaz spillover index approach to measure the magnitude of shock transmission between markets. The results indicate significant volatility transmission between the three crypto assets, with Bitcoin remaining the primary volatility transmitter. Furthermore, this study finds an increasing dynamic correlation between the global crypto market and the Indonesian capital market during periods of economic uncertainty. These findings have important implications for investors in portfolio diversification strategies and for Indonesian regulators in monitoring systemic risks originating from digital assets.

Keywords: *Volatility Spillover, Bitcoin, Ethereum, Solana, IHSG, GARCH, Financial Integration.*

Introduction

The global financial landscape has undergone a radical transformation over the past decade, with the emergence of crypto assets as a new asset class challenging the dominance of traditional capital markets. Bitcoin (BTC), Ethereum (ETH), and Solana (SOL) have evolved from mere technological experiments to investment instruments with trillions of dollars in market capitalization. However, a key characteristic of these digital assets is their extreme price volatility, often undriven by clear economic fundamentals. According to Baur and Hoang (2021), crypto asset volatility tends to follow a different pattern than traditional assets, where shocks in one cryptocurrency often spread rapidly to other cryptocurrencies through contagion mechanisms. This dynamic creates challenges for global risk management.

The phenomenon *of volatility spillover* refers to a situation where shocks or uncertainty in one market cause price fluctuations in another. In the crypto ecosystem, Bitcoin's dominance often creates a "herding effect" *where* BTC movements signal the movements of other assets such as Ethereum and Solana. Ethereum, with its smart contract functionality, and Solana, with its superior transaction speed, have created strong internal correlations within the crypto market. As explained by Diebold and Yilmaz (2012), the transmission of volatility between markets can be systematically measured to identify which markets act as transmitters *and* which markets act as receivers. Understanding this interconnection is crucial to understanding the stability of the digital financial ecosystem as a whole.

The link between crypto assets and traditional stock markets, particularly in emerging markets *like* Indonesia, is an interesting phenomenon to study. Indonesia's Composite Stock Price Index (IHSG) is no longer isolated from global financial market movements, including digital asset markets. As the number of retail investors in Indonesia growing, holding mixed portfolios of stocks and crypto assets, market psychology transmission becomes more readily apparent. According to Corbet et al. (2018), although crypto assets were initially considered a decoupled diversified asset, recent evidence suggests that during times of market stress,

the correlation between crypto and equities tends to increase sharply. This creates new risks for Indonesia's domestic capital market, which may be exposed to negative sentiment from the global crypto market.

Theoretically, the relationship between crypto volatility and capital markets can be explained through *Market Contagion Theory*. This theory states that shocks in one market can spread to other markets due to financial interconnectedness or shared risk perceptions among investors. In the Indonesian context, investors experiencing significant losses in the crypto market may be forced to liquidate their stock positions on the Indonesia Stock Exchange (IDX) to cover margins or simply reduce overall risk exposure. Forbes and Rigobon (2002) emphasize that market contagion often manifests through a significant increase in correlation during periods of crisis compared to periods of stability, a phenomenon relevant to observing the relationship between BTC, SOL, ETH, and the Jakarta Composite Index (JCI).

The rise of Solana (SOL) as a major competitor to Ethereum adds a new dimension to *spillover* analysis. Solana offers extremely lowcost efficiency, attracting significant capital inflows quickly, but it also carries unique technical volatility risks. When the Solana network experiences disruptions or price spikes, it not only impacts SOL holders but also fuels speculation across crypto assets. Katsiampa (2019) notes that each cryptocurrency has distinct volatility characteristics, but their integration within a single crypto exchange ecosystem makes isolating shocks nearly impossible. The competitive dynamics between ETH and SOL create a two-way flow of volatility that impacts the price of Bitcoin, the market anchor.

The Indonesian capital market (IHSG) has unique characteristics, dominated by the banking and commodities sectors. However, the entry of millennials and Gen Z into the capital market, who are also active in crypto trading, has changed demand dynamics. "Risk-on" or "risk-off" sentiment in global markets is often triggered by Bitcoin price movements. When Bitcoin prices surge, investor risk appetite increases, which often positively impacts stock markets in *emerging markets*. Conversely, a drastic fall in Bitcoin can trigger global panic, causing capital outflows *from* the IHSG to *safe-haven* assets such as gold or the US dollar. As concluded by Guesmi et al. (2019), diversification between crypto assets and stocks is only effective if the correlation between the assets remains low, but data show that this financial integration is strengthening over time.

The use of the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model in this study allows for the estimation of time- varying volatility. Crypto assets are known for their *volatility clustering* phenomenon, where periods of high volatility tend to be followed by subsequent periods of high volatility. This contrasts sharply with the Jakarta Composite Index (JCI), which has an *auto-rejection* threshold to mitigate excessive fluctuations. This difference in market mechanisms creates asymmetry in shock transmission. Engle (1982) demonstrated that heteroskedasticity models are crucial for capturing risk dynamics in volatile financial markets. In this context, the model helps identify how long shocks from the crypto market persist and impact the Indonesian stock price index.

In addition to economic factors, Indonesian government regulations regarding crypto assets also influence *spillover* dynamics. The recognition of crypto assets as commodities by Bappebti, but not as legal tender by Bank Indonesia, creates a unique position for domestic investors. Crypto tax policies and regulations regarding national crypto exchanges influence trading volume and, indirectly, the stability of capital flows in the stock market. According to Borri (2019), regulatory uncertainty is often a source of volatility itself. Therefore, the relationship between the JCI and crypto assets also reflects how the capital market responds to the evolving digital policy landscape in Indonesia.

The "Great Transition" toward decentralized finance (DeFi), of which Ethereum and Solana are the backbone, has also attracted institutional investors. Institutional involvement in crypto assets means that the same capital that moves in the Jakarta Composite Index (JCI) is now also moving in the global crypto market. This strengthens the volatility transmission channel through institutional portfolios. As noted by Ji et al. (2019), the integration of modern financial markets has reached a point where the boundaries between physical and digital assets are increasingly blurred, allowing shocks in digital assets such as Ethereum to have a systemic impact comparable to shocks in energy commodities or major currencies.

Finally, the importance of this research lies in its risk-mitigation implications for investors in Indonesia. Understanding that Bitcoin, Solana, and Ethereum do not operate in a vacuum but rather influence one another and are interconnected with the domestic stock market will help build a more resilient portfolio. This analysis of *spillover* dynamics provides an early warning for monetary authorities to be aware of potential financial crises triggered by the unregulated digital asset market. As the crypto market matures, monitoring these interconnections will become the new standard in macro-financial analysis in Indonesia, ensuring that national economic growth is not disrupted by speculative volatility in the digital realm.

Research Method

This study uses a quantitative, descriptive-causal design to analyze the dynamics of volatility transmission across financial markets. The data used are secondary, in the form of daily closing prices for crypto assets

(Bitcoin, Ethereum, Solana) and the Jakarta Composite Index (JCI) over a five-year observation period (2020-2025). The data are then transformed into *logarithmic returns* to address nonstationarity in the original time series. According to Sekaran and Bougie (2016), the use of daily *return* data is very effective in capturing the high volatility and market anomalies that often occur in digital assets in the short term. The data population covers all price movements on global crypto exchanges and the Indonesia Stock Exchange, with time zone adjustments to synchronize correlation analysis between markets.

Data analysis was performed using *the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to estimate time-* varying volatility. This model was chosen because of its ability to capture the phenomenon of *volatility clustering*, where periods of high volatility tend to be followed by similar fluctuations, a dominant characteristic of the crypto market and *emerging market capital markets*. Engle (1982) stated that the GARCH model provides a more accurate picture of risk than the standard linear regression model because it accounts for non-constant error variance. In this study, stationarity testing was carried out using the *Augmented Dickey-Fuller* (ADF) test, followed by the ARCH-LM test to assess heteroscedasticity, before the GARCH model was fully applied.

To measure the magnitude of volatility spillovers between variables, this study applies the *Diebold-Yilmaz Spillover Index* methodology. This approach is based on *the Generalized Forecast Error Variance Decomposition* (FEVD) within a *Vector Autoregression* (VAR) framework to measure the contribution of shocks from one asset to the variance of the forecast errors of another asset. This technique allows researchers to identify the role of each asset, both as a "receiver" *and* "transmitter" *of* net volatility within the system. Diebold and Yilmaz (2012) emphasize that this index excels in mapping the dynamic interconnections of financial markets, allowing detailed mapping of the relationship between the global crypto market and the Indonesian domestic capital market index, both overall and by sector.

Result And Discussion

Analysis of Data Characteristics and Asset Volatility

The results of descriptive statistical analysis of the daily *log-returns* of Bitcoin (BTC), Ethereum (ETH), Solana (SOL), and the Jakarta Composite Index (JCI) show stark differences in risk profiles. All three crypto assets recorded significantly higher standard deviations than the JCI, with Solana having the most extreme daily volatility. This confirms the speculative nature of crypto assets, which are susceptible to information shocks. Based on the *Augmented Dickey-Fuller* (ADF) test, all data series were found to be stationary in first differences, allowing the use of VAR and GARCH models in subsequent analyses. As stated by Katsiampa (2019), stationarity is an absolute prerequisite in *time-series* analysis to avoid *spurious regression*, which often occurs in financial asset price data that exhibit random trends (random walks).

Furthermore, the *return* distribution across all assets exhibits leptokurtosis, with kurtosis significantly exceeding that of the normal distribution, indicating a higher probability of "extreme events" or *black swans. This phenomenon is reinforced by the ARCH-LM test results, which indicate a strong heteroscedasticity effect across all variables. The effect of volatility clustering* was clearly visible in the 2021-2022 period, where similar movements followed large fluctuations in Bitcoin in Ethereum, and Solana. Engle (1982) explains that this volatility clustering reflects how information is gradually absorbed by the market, creating a persistent risk that investors should consider when managing a mixed portfolio of stocks and cryptocurrencies.

Dynamics of Volatility Transmission Between Crypto Assets

The Diebold-Yilmaz Spillover Index model estimates reveal very strong interconnectedness within the crypto ecosystem. Bitcoin remains the largest *net* transmitter of volatility for Ethereum and Solana. This demonstrates that Bitcoin continues to serve as a bellwether for the global digital market. Shocks to Bitcoin are quickly responded to by Ethereum with a significant transmission coefficient, reflecting the strong structural correlation between the two assets. According to Ji et al. (2019), Bitcoin's dominance in volatility transmission stems from its greater liquidity and its role as a primary trading pair for other cryptocurrencies (*altcoins*).

Table 1. Volatility Spillover Matrix (Diebold-Yilmaz Index)

From/To	BTC	ETH	SOL	IHSG	Contribution from
BTC	65.2%	15.8%	14.5%	4.5%	34.8%
ETH	18.4%	58.7%	16.2%	6.7%	41.3%
SOL	12.1%	14.3%	71.4%	2.2%	28.6%
IHSG	5.4%	6.2%	1.8%	86.6%	13.4%
Contribution TO	35.9%	36.3%	32.5%	13.4%	Total Index: 29.5%

The data in Table 1 shows that, despite its high individual volatility, Solana tends to be a net recipient *of* volatility from Bitcoin and Ethereum. This indicates that Solana's price movements are more dependent on broader crypto-ecosystem sentiment than on its own internal fundamentals. Diebold and Yilmaz (2012) emphasize that in an integrated system, understanding who transmits the greatest risk is crucial for crisis management, as shocks to key *transmitters* can collapse the entire market structure systemically.

Spillover Relationship between the Global Crypto Market and IHSG

One of the most important findings of this study is the increasing transmission of volatility from the crypto market (particularly Bitcoin and Ethereum) to the Indonesian capital market (JCI), particularly during periods of global economic uncertainty. Although the JCI has a high degree of self-persistence (86.6%), the contribution of crypto assets to the JCI's forecast error variance has begun to show an increasing trend compared to the pre-pandemic period. This reflects the phenomenon of *financial* contagion, where negative sentiment in the digital asset market spills over into the domestic equity market. As explained by Forbes and Rigobon (2002), interdependence between markets often turns into contagion when correlations increase sharply during major shocks.

Discussions on this relationship also touch on investor behavior in Indonesia. The increasing number of active retail investors in both markets (the IDX and crypto exchanges) creates a transmission channel through the "wealth effect. " When the value of crypto portfolios drops drastically, investors tend to sell stocks on the Jakarta Composite Index (JCI) to maintain liquidity or cover losses, which then depresses the domestic stock price index. Baur and Hoang (2021) note that the integration of speculative assets with traditional capital markets is becoming increasingly inevitable as financial technology facilitates the rapid transfer of capital between asset classes.

The Effect of Solana's Asymmetry and Dynamics on the JCI

This study also found that Solana has the weakest *spillover relationship with the Jakarta Composite Index (JCI) compared to Bitcoin and Ethereum. This is likely due to Solana's investor profile being more segmented within the DeFi and NFT developer communities, which have a lower correlation with key JCI-driving sectors such as conventional banking. However, during major shocks to the Solana network (such as network outages), asymmetric spillovers* occur that impact investor confidence in *blockchain* technology in general, indirectly impacting technology companies listed on the Indonesian stock exchange. Corbet et al. (2018) argue that even though a particular asset appears isolated, technical shocks can trigger widespread panic that extends beyond the boundaries of its underlying asset.

Overall, this discussion highlights that the Jakarta Composite Index (JCI) can no longer be considered immune to crypto market volatility. Risk transmission from Bitcoin and Ethereum to the JCI demonstrates that the Indonesian capital market has become integrated into a global risk network encompassing digital assets. The GARCH model successfully captured the tendency for crypto market shocks to affect the JCI, with shocks lasting several trading days before subsiding. According to Guesmi et al. (2019), a diversification strategy that combines stocks and crypto requires dynamic weighting adjustments (rebalancing) because the correlation between the two assets is not constant but is highly reactive to macroeconomic conditions and global market sentiment.

Implications for Investment Policy and Strategy

These findings regarding *volatility spillovers* serve as a warning to Indonesian monetary authorities, such as Bank Indonesia and the Financial Services Authority (OJK), to begin considering crypto market risks when monitoring the stability of the national financial system. The increasing connectivity between crypto and the Jakarta Composite Index (JCI) means that a crisis in the crypto market could trigger instability in the domestic stock market, which in turn could impact the real sector. Stricter regulations regarding financial institutions' exposure to digital assets are highly relevant. Borri (2019) suggests that monitoring tail risk *is* crucial because crypto assets tend to fall simultaneously on a very large scale, which could trigger massive capital outflows from emerging markets such as Indonesia.

For investors, this research suggests that Bitcoin and Ethereum no longer serve as pure diversifiers against stocks during crises. Instead, they act as high-risk assets whose volatility can undermine stock portfolio performance during global market downturns. Investors in Indonesia should monitor Bitcoin movements as an early signal of volatility in the Jakarta Composite Index (JCI). This deepening market integration demands a more holistic risk management approach, complementing technical and fundamental stock analysis with monitoring capital flow dynamics in the global digital asset market.

Conclusion

This study concludes that there is a very strong and significant volatility transmission dynamic among the major cryptocurrencies, namely Bitcoin, Ethereum, and Solana. Bitcoin is proven to remain a dominant net transmitter of volatility, *dictating* the direction of price movements and risk levels in the global digital asset ecosystem. The *volatility clustering* phenomenon captured by the GARCH model indicates that shocks in one cryptocurrency will quickly spread to others, creating a domino effect that amplifies systemic risk in the digital

market. This finding confirms that despite differences in technological functionality, cryptocurrencies move within a highly integrated sentiment continuum (Diebold & Yilmaz, 2012).

The relationship between the global crypto market and the Indonesian capital market (JCI) shows a trend of deepening integration, particularly during periods of high market uncertainty. Although the JCI still exhibits strong internal persistence, volatility transmission from Bitcoin and Ethereum to the domestic index has increased significantly through psychological contagion and investor liquidity channels. This increasing dynamic correlation indicates that crypto assets can no longer be considered a pure diversification instrument isolated from traditional capital markets. Instead, the Indonesian capital market is now indirectly exposed to digital asset market volatility through the behavior of investors managing portfolios across asset classes (Baur & Hoang, 2021).

As a policy implication, financial regulators in Indonesia need to strengthen systemic risk monitoring mechanisms that consider the interconnectedness between equity markets and crypto assets. Risk mitigation strategies for both retail and institutional investors must be adjusted to the fact that the benefits of diversification between stocks and crypto tend to diminish during global market turmoil. Therefore, regulatory synergy between capital market authorities and crypto asset supervisors is crucial for maintaining national macrofinancial stability. This research provides empirical evidence that the future stability of the JCI will be increasingly influenced by dynamics occurring in the global decentralized digital economy (Guesmi et al., 2019).

References

[1] Baur, D. G., & Hoang, L. T. (2021). A crypto-currency barometer: A world market index for digital assets. *Journal of International Financial Markets, Institutions and Money*, 70, 101261.https://doi.org/10.1016/j.intfin.2020.101261

[2] Borri, N. (2019). Conditional tail-risk in cryptocurrency markets. *Journal of Empirical Finance*, 50, 1–19.https://doi.org/10.1016/j.jempfin.2018.11.002

[3] Corbet, S., Meegan, A., Larkin, C., Lucey, B., & Yarovaya, L. (2018). Exploring the dynamic relationships between cryptocurrencies and other financial assets. *Economic Letters*, 165, 28–34.https://doi.org/10.1016/j.econlet.2018.01.004

[4] Diebold, F.X., & Yilmaz, K. (2012). Better to give than to receive: Predictive directional measurement of volatility spillovers. *International Journal of Forecasting*, 28(1), 57–66.https://doi.org/10.1016/j.ijforecast.2011.02.006

[5] Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, 50(4), 987–1007.https://doi.org/10.2307/1912773

[6] Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: Measuring stock market spillovers. *The Journal of Finance*, 57(5), 2223–2261.https://doi.org/10.1111/0022-1082.00494

[7] Guesmi, K., Saadi, S., Abid, I., & Pappas, N. (2019). Portfolio diversification with Bitcoin: Evidence from recurrent marginal expected shortfall. *Resources Policy*, 63, 101445.https://doi.org/10.1016/j.resourpol.2019.101445

[8] Ji, Q., Bouri, E., Lau, C.K.M., & Roubaud, D. (2019). Dynamic connectedness and integration in cryptocurrency markets. *International Review of Financial Analysis*, 63, 257–272.https://doi.org/10.1016/j.irfa.2018.12.002

[9] Katsiampa, P. (2019). Volatility dynamics of crypto-currencies: A GARCH-type approach. *Physica A: Statistical Mechanics and its Applications*, 523, 1057–1065.https://doi.org/10.1016/j.physa.2019.04.153

[10] Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach* (7th ed.). John Wiley & Sons.