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The Impact of Cryptocurrency Volatility Dynamics on the Islamic Equity Market: The Case of Emerging Asia

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This paper investigates the impact of the realized volatility of positive and negative intraday Bitcoin returns on the sensitivity of Shariah-compliant stocks' orthogonalized returns. We identify the impact in different market states and find that Bitcoin's upside volatility negatively affects the returns of Islamic equities. The paper contributes to uncovering the properties of a niche Islamic Emerging Asian equity market. The findings offer important implications for investors' diversification strategies.

I. Introduction

In this paper, we examine how the Islamic equity markets in emerging Asia respond to the positive and negative intraday returns of cryptocurrencies. The analysis is motivated by the increased prominence of cryptocurrencies as well as the continuous growth of Islamic equity markets. Since the inception of blockchain technology in cryptocurrencies in 2009, cryptocurrencies have become the most popular financial assets in the market (Vidal-Tomás, 2022). Following the current trend, cryptocurrencies provide investors with an alternative and complementary option for their portfolio diversification strategies. This conjecture has raised numerous studies examining the relationship of cryptocurrencies with various financial variables, such as equities, exchange rate, commodities, and economics factors (e.g., Akhtaruzzaman et al., 2022; Elsayed et al., 2022; Guesmi et al., 2019; Klein et al., 2018; Kristjanpoller & Bouri, 2019; Zeng et al., 2020). Despite this, the link between cryptocurrencies and Islamic equity markets, mainly in the context of emerging Asian markets is relatively unexplored in the literature. Analysing the link between these asset classes is vital because Islamic equity markets are niche markets with distinctive properties.[1] Hence, the study's findings provide insights into the diversification possibilities, particularly for the Shariah-compliant investors.

Currently, more than 1000 different cryptocurrency coins are in circulation, including stablecoins and tokens, representing more than 2.6 trillion US dollars (Ren & Lucey, 2022). Numerous cryptocurrencies have been released, such as Cardano, Litecoin, Ehtereum, and Stellar, which are currently meant for investment purposes instead of mode of exchange (Kumar et al., 2022). As an alternative investment instrument, cryptocurrencies have become popular among investors by promising appealing returns compared to conventional investment instruments, such as equities, bonds, and commodities (Ji et al., 2019; Kristjanpoller et al., 2020). In line with this trend, various theoretical and empirical studies have emerged to investigate the unique characteristics of this new digital asset (Corbet et al., 2018). Among notable studies, many researchers examine the spillover effect of digital currencies in general and of Bitcoin, in particular, on several types of conventional assets, such as stocks, gold, and currencies (Akhtaruzzaman et al., 2022; Elsayed et al., 2022; Guesmi et al., 2019; Klein et al., 2018; Kristjanpoller & Bouri, 2019; Mo et al., 2022; Zeng et al., 2020). Meanwhile, the realm of cryptocurrencies has also been vastly examined from various perspectives, including return and volatility (Bianchi & Babiak, 2022; Chaim & Laurini, 2018; Huang et al., 2022; Malladi & Dheeriya, 2021), fundamental value (Cheah & Fry, 2015; Vidal-Tomás, 2022), and liquidity dynamics (Eross et al., 2019; Li et al., 2022; Scharnowski, 2020; Tong et al., 2022). However, these studies are mainly from the perspective of mainstream finance.

In a study of the relationship between Bitcoin and the Islamic equity market, Ahmed (2021) discovers the impact of Bitcoin's volatility risks on Islamic equity for the developed and emerging markets under different market conditions. The study reports that upside volatility tends to exert a negative influence on Islamic stocks more in bear than in

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1 Islamic equities exclude Shariah non-compliant industries, such as defense, tobacco, alcohol, gambling, and entertainment. It also needs to be free from the elements of excessive risks resulting from high debts.

bull market conditions. In contrast, the downside counterpart positively affects returns when Sharia-compliant equities are in bear and bull phases. This discovery signifies that the volatilities of cryptocurrencies are significantly related to the Islamic equity markets. Therefore, more empirical tests from the perspective of Shariah-compliant investment are required to provide more constructive evidence on the association between these distinctive asset classes. Moreover, this prior study only focuses on the global developed and emerging markets. Whether the findings are consistent in a more focused market segment, such as emerging Asia, is still a puzzle. Therefore, we extend prior literature by shedding more light on digital assets from the perspective of Sharia-compliant equities. In particular, this paper is trying to provide an answer to whether Islamic equities in emerging Asia exhibit asymmetric responses to the positive and negative volatility components of Bitcoin returns. This perspective of analysis is essential for investors' portfolio diversification strategies.

II. Methodology

A. Sample and variables

The analysis employs three different datasets for Bitcoin, emerging Asian Islamic stock indices, and confounding variables. The Bitcoin dataset represents the intraday exchange rates relative to the US dollar between January 1, 2014, and June 20, 2022. Following recent leading studies, (e.g., Ahmed, 2021; Wang & Ngene, 2020) the price observations are sampled at a 15-minute frequency from 00:00:00 to 23:45:00, yielding 96 equidistant data points per day and a total of 296,370 observations. The chosen frequency is to capture the intraday price dynamics and patterns of Bitcoin returns, while overcoming plausible measurement errors and the market microstructure biases. The Bitcoin dataset is obtained from https://www.Bitcoincharts.com.[2] The second dataset comprises of daily closing price levels of Shariah-compliant equity index representatives gathered from Refinitiv Datastream. We employ MSCI Emerging Markets Asia Islamic Investable Market (IEMA), which captures large, mid, and small-cap representations across emerging Asian markets.[3] The final dataset encompasses extraneous determinants for the data filtration purpose. The analysis identifies six variables that capture the driving market forces in the Bitcoin–equity relationship. The variables include daily observations of the global mainstream stock index, emerging market mainstream stock index, energy, gold, economic policy uncertainty index, and the volatility index. These factors are selected based on supporting empirical evidence (Ahmed, 2021).

B. Dynamics volatility

We employ a model-free non-parametric volatility measure using Andersen and Bollerslev (1998) realized variance estimator and the intraday dataset of Bitcoin's prices. Assume that $p_{t,i}$ is the natural logarithm of Bitcoin at the intraday time point i of a trading day t within a sample period T. The intraday prices are sampled q times at intervals of equal duration (i.e., 15 minutes). The continuously compounded return is measured as r_t=$p_{t,i}$ − $p_{t,i-1}$. Hence, Bitcoin's realized variance (BRV) is the sum of squares of all intra-period return within a trading day:

$$BRV_t = \sum_{i=1}^{q} \left(p_{t,i} - p_{t,i-1}\right)^2 = \sum_{i=1}^{q} r_{t,i}^2 \tag{1}$$

From Eq. (1) above, we estimate the downside and upside realized semivariance measures to distinguish variations of negative price movements and positive price movements, which are defined as:

$$RSV_t^+ = \sum_{i=1}^{q} r_{t,i}^2 \left(r_{t,i} > 0\right) \tag{2}$$

$$RSV_t^- = \sum_{i=1}^{q} r_{t,i}^2 \left(r_{t,i} < 0\right) \tag{3}$$

$$BRV_t = RSV_t^+ + RSV_t^- \tag{4}$$

where RSV_t^+ and RSV_t^- are the positive and negative realized semivariances, respectively. These variables are identified by interacting $r_{t,i}^2$ with an indicator variable, which is equal to one if the respective arguments $(R_{t,\,i} > 0)$ and $(R_{t,\,i} < 0)$ are true, and zero otherwise.

C. Orthogonalize returns

Islamic returns are measured in two steps to remove the potential impact of equity price changes and to eliminate the possibility of endogeneity due to simultaneity between Islamic equity and cryptocurrency price movements. Thus, the two-step procedures serve as the data filtration process. In these steps, we filter raw Islamic returns of the potential confounding effects of various influential factors documented in the literature as significant determinants of equity price movements (Ahmed, 2021). In the preliminary step, we estimate the following ordinary least squares (OLS) time-series regression model for the emerging Asian return series:

$$\begin{aligned} IR_t = {} & \alpha + \beta_1 WSI_{t-1} + \beta_2 EMSI_{t-1} \\ & + \beta_3 ENRI_{t-1} + \beta_4 GSI_{t-1} \\ & + \beta_5 AVOL_{t-1} + \beta_6 EUAP_{t-1} \\ & + \sum_{i=1}^{4} \delta_d W_d + v_t^{\perp} \end{aligned} \tag{5}$$

IR_t signifies daily Islamic equity index return, α is a constant term, and W_d is a vector of weekday dummy variables (Monday until Thursday). The determinants are MSCI world stock index (WSI), MSCI emerging market stock index

2 One of the leading platforms that provide extensive market information for Bitcoin.

3 Emerging Asian markets according to the MSCI IMI factsheet include China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan, and Thailand.

(EMSI), MSCI energy stock index (ENRI), MSCI gold stock index (GSI), MSCI Asia market minimum volatility (AVOL), and economic policy uncertainty index for the Asia Pacific (EUAP). The selected factors are extensively documented in the literature as significant determinants of equity price movements (Ahmed, 2021). All regressors are lagged one period, to minimize the potential endogeneity problems in the model.

In the second step, we take the residual component of Eq. (5), $v_t^{\perp}$ and fit a *p*-order autoregressive model, *AR(p),* where the order *p* is identified by the Akaike information criterion (AIC). The *AR(p)* model can be written as:

$$v_t^{\perp} = \mu + \sum_{i=1}^{p} \xi_i v_{t-1}^{\perp} + \varepsilon_t \tag{6}$$

We predict the residual from the above estimation Eq. (6), hence, ε_t is a sequence of serially independent residuals, which will serve as the regressand in the consequent analysis.

D. Model specifications

Given ε_t as the orthogonalize returns of the Islamic index, we examine the sensitivity of the index returns to the positive and negative volatility components of Bitcoin intraday prices using the following OLS distributed lag regression model:

$$\begin{aligned}\varepsilon_t = C + \xi_1 BRV_t^{+} + \xi_2 BRV_{t-1}^{+} \\ +\xi_3 BRV_t^{-} + \xi_4 BRV_{t-1}^{-} + \iota_t\end{aligned} \tag{7}$$

where C is a constant term, BRV_t^{+} and BRV_t^{-} are positive and negative realized semivariances of Bitcoin returns that indicate the sign and magnitude of Bitcoin's upside (downside) risk exposure of Islamic returns. The model includes one-period lagged explanatory variables to allow for the possibility of delayed reactions. The analysis account for structural breaks in the parameters of Eq. (7), and subsequently divides the estimation based on the identified time intervals. Finally, the estimation employs quantile regression (QR) parameters to investigate the sensitivity of the asymmetric responses over different market conditions (i.e., bear, normal, and bull market):

$$\begin{aligned}Q_{\varepsilon t}\left(\tau \mid BRV_t^{+} + BRV_{t-1}^{+} + BRV_t^{-} + BRV_{t-1}^{-}\right) = C^{\tau} + \xi_1 BRV_t^{+} \\ +\xi_2 BRV_{t-1}^{+} \\ +\xi_3 BRV_t^{-} \\ +\xi_4 BRV_{t-1}^{-} \\ +\iota_t^{i}, \tau \epsilon [0,1]\end{aligned} \tag{8}$$

The market conditions are identified according to the quantile levels; lower quantiles as bear market (τ = 0.05, 0.10, 0.25), median quantile as normal market (τ = 0.50), and upper quantiles as bull market (τ = 0.75, 0.90, 0.95).

III. Main Findings

The objective of our study is to discover the sensitivity of Shariah-compliant equities to Bitcoin's positive and negative realized volatility during various market conditions, particularly for emerging Asian markets. Panels A and B of Table 1 reports the QR parameter estimates for the first and second intervals, respectively. For Panel A, Bitcoin's volatilities show statistically significant coefficients during the bear periods (i.e., 0.05th and 0.10th quantiles). The coefficients are negative in sign for the upside realized semivariance measure (BRV_t^{+} and BRV_{t-1}^{+}), while positive in sign for the downside realized semivariance measure (BRV_t^{-} and BRV_t^{-}). The findings suggest an inverse relationship between the returns of Shariah-compliant equities and Bitcoin's volatilities.

The inverse relationship is more pronounced in Panel B. The upside realized semivariance measure (BRV_{t-1}^{+}) demonstrates a statistically significant coefficient with a negative sign for all market conditions, except for the 0.05th and 0.95th quantiles. The relationship between Shariah-compliant equities and Bitcoin's positive volatilities are consistent with Ahmed (2021). However, we find the lack of evidence on the significance of the downside realized semivariance measure (BRV_t^{-} and BRV_t^{-}). The results are slightly inconsistent with prior literature, suggesting that there might be some idiosyncrasies in the emerging Asian markets that require more thorough attention.

IV. Conclusion

This paper explores the sensitivity of Islamic equities in emerging Asia to the dynamic volatility of Bitcoin in different market states. The results contribute to a broader knowledge of Islamic equity markets and offer practical implications for investors and portfolio managers in these markets. In particular, the sensitivity of Sharia-compliant stocks to Bitcoin price changes implies that investors from emerging Asia may use Islamic equities as a portfolio diversification asset, especially when Bitcoin prices experience large upward trends. The findings are pronounced in the bear market as compared to the normal and bull markets. Hence, investors need to incorporate the realized volatility measures when modelling equity return dynamics, since the volatility components demonstrate important information for risk management and for portfolio allocation decisions. The analysis suggests some idiosyncrasies in the emerging Asian markets, particularly for the Bitcoin downward trends. Therefore, future studies should undertake more empirical analysis concentrating on emerging Asian markets.

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Table 1. Sensitivity of Islamic emerging Asia market to Bitcoin's volatilities

Variables	Quantiles						
	Bear			Normal	Bull		
	τ 0.05	τ 0.10	τ 0.25	τ 0. 50	τ 0.75	τ 0.90	τ 0.95
Panel A: 1st subperiod (n=843)							
C	-0.013*** (0.000)	-.0107*** (0.001)	-0.002** (0.001)	0.005*** (0.001)	0.016*** (0.001)	0.027*** (0.001)	0.032*** (0.001)
BRV_t^+	-0.632* (0.344)	-.807 (0.671)	-0.390 (0.675)	-0.157 (0.424)	-0.373 (0.849)	-1.349 (0.858)	-1.354 (0.8807)
BRV_{t-1}^+	-0.962** (0.418)	-1.109 (0.819)	-0.521 (0.819)	-0.617 (0.514)	-0.679 (1.030)	-1.524 (1.041)	-1.078 (1.069)
BRV_t^-	0.587** (0.260)	0.686 (0.508)	0.252 (0.510)	-0.065 (0.321)	-0.046 (0.642)	0.527 (0.647)	0.502 (0.666)
BRV_{t-1}^-	1.093*** (0.346)	1.212* (0.674)	0.490 (0.677)	0.439 (0.426)	0.362 (0.852)	1.078 (0.861)	0.604 (0.884)
Pseudo R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Panel B: 2nd subperiod (n=1301)							
C	-0.020*** (0.001)	-0.014*** (0.001)	-0.009*** (0.000)	-0.005*** (0.000)	0.001*** (0.001)	0.012*** (0.001)	0.019*** (0.001)
BRV_t^+	-0.402 (0.277)	-0.607 (0.495)	-0.167 (0.191)	-0.319** (0.166)	-0.200 (0.400)	-0.493 (0.489)	-0.462 (0.837)
BRV_{t-1}^+	-0.1263 (0.366)	-1.221* (0.654)	-1.794*** (0.252)	-0.834*** (0.220)	-1.202** (0.529)	-1.677** (0.646)	-1.649 (1.107)
BRV_t^-	0.009 (0.270)	0.0001 (0.482)	-0.411** (0.186)	-0.064 (0.162)	-0.088 (0.390)	-0.054 (0.476)	-0.250 (0.816)
BRV_{t-1}^-	-0.291 (0.363)	-0.125 (0.647)	0.400 (0.250)	0.118 (0.218)	0.589 (0.524)	0.945 (0.639)	0.897 (1.096)
Pseudo R^2	0.01	0.04	0.05	0.02	0.01	0.02	0.02

Notes: Panels A and B report the quantile regression parameter estimates of the impact of Bitcoin's realized volatility components on Islamic emerging Asia market returns in the first and second subperiods, respectively. C is a quantile-specific intercept. BRV_t^+ and BRV_t^- are positive and negative realized semivariances of Bitcoin returns, respectively. The robust t-statistics are shown in parentheses. Pseudo R^2 implies the goodness of fit of each quantile regression model. ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

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