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Modeling Cryptocurrency Market Volatility during FOMC Announcements: Evidence from High-Frequency Data

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Abstract

This study investigates the impact of Federal Open Market Committee (FOMC) announcements on cryptocurrency market volatility using high-frequency data. Realized Variance (RV) is used to measure cryptocurrency market volatility, with a focus on Bitcoin (BTC). Using a dataset of over 3.4 million observations, our results indicate that cryptocurrency market volatility significantly increases on FOMC announcement days. Furthermore, we show that intraday volatility is not stable during the FOMC announcement period, with notable fluctuations both before (11 a.m.) and after (3 p.m.) the key monetary policy announcement. The empirical evidence provides crucial information about the reaction of the cryptocurrency market to macroeconomic policy news, offering valuable insights for investors, policymakers, and researchers.

Keywords

Realized Volatility, Cryptocurrency, High-Frequency Data, FOMC

1. Introduction

Cryptocurrencies are digital assets that employ cryptography for security and run on decentralized networks using blockchain technology. Unlike traditional financial assets, cryptocurrencies are not controlled by central banks or the government, making them alternative assets for investors. This decentralized nature of the crypto market also allows for significant price fluctuations, creating both opportunities and risks for investors.

Understanding crypto market volatility is important, allowing investors to shape how they manage their portfolios and decide on trading strategies. Furthermore, as the cryptocurrency market is now directly connected to numerous traditional markets, the volatility of crypto affects a multitude of different markets, helping regulators and policymakers develop methods for risk management.

This study distinguishes itself from the current body of research by specifically examining the dataset that emerged after the introduction of derivative markets[1]. This is significant as it allows for analysis in the context of a more stable cryptocurrency market. In addition, this paper measures volatility by using high-frequency data, which is a more accurate indicator of volatility compared to traditional measurement approaches. Moreover, it specifically analyzes the impact of FOMC announcements on cryptocurrency assets rather than on bond and stock markets, which are much more commonplace in economic research articles. Furthermore, it distinguishes itself by not just examining the immediate impact of FOMC announcements on the daily volatility of Bitcoin but also by quantifying the way in which intraday BTC volatility reacts to these announcements. This research aims to provide a comprehensive analysis of the relationship between FOMC announcements and cryptocurrency volatility, shedding light on potential market trends and investor behavior. By doing so, this study will contribute valuable insights to the field of financial economics and influence future investment strategies.

This paper proceeds as follows: Section 2 provides background information on the existing literature, Section 3 highlights the empirical findings, and Section 4 concludes the paper.

2. Literature Review

In the financial markets, volatility is a key concept that shows how much prices change over time. A lot of different models have been developed to measure and predict volatility. Engle (1982) created the commonly known volatility model, the Autoregressive Conditional Heteroskedasticity (ARCH) model [1]. Bollerslev extended this model by creating the Generalized ARCH (GARCH) model [2]. These models let volatility change over time based on past error terms. Introducing asymmetric effects, the Exponential GARCH (EGARCH) model by Nelson shows that negative shocks may cause higher volatility than positive ones [3]. Another method is to use stochastic volatility (SV) models, in which volatility changes with time according to a random process. Recently, models like the asymmetric diagonal BEKK-MGARCH have been popular for quantifying volatility in multi-asset situations [4].

The literature extensively documents the influence of Federal Open Market Committee (FOMC) announcements on stock and bond markets [5]. Furthermore, according to Bomfim (2021), FOMC announcements lead to low volatility before the announcement and a sharp increase in volatility following the announcement. In addition, the author highlights that positive shocks result in heightened short-term instability in the stock market [6]. In 2005, Lucca and Moench show that there is a noticeable pre-FOMC announcement drift, in which

[1]https://www.dunya.com/finans/haberler/bitcoinde-vadeli-islemler-basladi-haberi-393988.

average market returns are abnormally high in the hours before scheduled announcements but revert to normal afterward [7]. Andersen et al. used high-frequency data to study the intraday effects of macroeconomic news [8].

The introduction of derivative markets has effects on asset pricing, liquidity, and volatility. In traditional markets, it is clear that derivatives like options and futures can make markets fuller and open up new ways to hedge. But they also add to the instability, especially when the market is under a lot of stress. Since derivatives have been introduced, the cryptocurrency market has also undergone changes. In 2020, Corbet et al. investigate the impact of Bitcoin futures on the volatility of cryptocurrencies. The study reveals that the implementation of futures trading decreased the level of volatility in Bitcoin's market as it progressed, allowing for better risk management and price discovery [9].

There has been an increasing focus on how FOMC statements affect cryptocurrencies. In 2015, Yermack et al. claim that cryptocurrencies are less vulnerable to central bank policies than equities and bonds because they are decentralized [10]. In 2019, Katsiampa *et al.* determined that regulatory changes and social media activity can affect cryptocurrency volatility more than FOMC announcements [11]. In 2018, Corbet *et al.* demonstrate that cryptocurrency markets, notably Bitcoin, are sensitive to global macroeconomic news and digital asset-related announcements [12]. Many factors cause cryptocurrency markets to have high levels of volatility [13]. For instance, lack of regulation, low liquidity, and market immaturity are the root causes of extreme price volatility [14]. Like a commodity and a currency, Bitcoin has complex volatility patterns influenced by market speculation, technology adoption, and regulatory changes [15]. Kyriazis *et al.* emphasized that social media activity, particularly Twitter, has a significant impact on the volatility of cryptocurrencies [16]. Finally, according to Omrane *et al.*, volatility clustering, news sensitivity, and macroeconomic factors are the three main causes of cryptocurrencies' high volatility [17].

3. Empirical Findings

3.1. Data

The data consists of intraday data on the closing prices of BTC from December 11, 2017 to June 9, 2024, which consists of 2372 days[2]. The intraday interval is 1 minute from 00:00 to 23:59, including 1440 observations per day. Thus, the total number of observations is 3,417,120. This data is provided by Kaggle[3]. The data starts from the date of the introduction of derivatives into the cryptocurrency market, as we believe that from then on, the risk structure of the market becomes more stable.

We assume that X_t is the log of the asset price. Thus, return for Δ intervals is given by:

[2]https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm, https://www.ig.com/en-ch/financial-events/fomc-meeting-announcement.

[3]https://www.kaggle.com/datasets/kacobe/btcusdt.

$$r_{t+j\Delta,\Delta} = X_{t+j\Delta} - X_{t+(j-1)\Delta}$$

The Realized Variance (RV_t) for each period t (one day in the application here) is sum of squared intraday period returns (Barndorff-Nielsen and Shephard, 2002):

$$RV_{t+1} = \sum_{j=1}^{\frac{1}{\Delta}} r_{t+j\Delta}^2,$$

We create a dummy variable for FOMC announcements. The dummy variable takes value 1 on FOMC meeting days, and 0 otherwise.

3.2. Descriptive Statistics

Table 1. Descriptive statistics of RV.

Variables	Obs	Mean	Std. dev.	Min	Max
FOMC Announcement Day	53	23.09938	62.82595	1.13536	459.1114
Non-FOMC Announcement Day	2321	17.32982	41.98994	0.0643159	939.8553
Total Sample	2374	17.45863	42.5558	0.0643159	939.8553

Table 1 provides descriptive statistics of realized volatility in the cryptocurrency market for both FOMC announcement and non-FOMC announcement days. On FOMC announcement days, we have 53 observations with a mean of approximately 23.1 and a standard deviation of 62.8, ranging from a minimum of 1.14 to a maximum of 459. On non-FOMC announcement days, we have 2321 observations with a mean of nearly 17.3 and a standard deviation of 42.0, ranging from a minimum of 0.06 to a maximum of 940. Hence, **Table 1** obviously shows that volatility dramatically increases during the announcement period.

3.3. Results

The graphical representation of realized volatility for FOMC announcement days, non-FOMC announcement days, and the total sample are presented below in **Figure 1**. According to **Figure 1**, there is an increase in the average realized volatility during the FOMC announcement period.

Table 2 provides descriptive statistics of intraday realized volatility in the cryptocurrency market for both FOMC announcement and non-FOMC announcement days. On FOMC announcement days, we have 1440 observations with a mean of approximately 1.6 and a standard deviation of 3.03, ranging from a minimum of 0 to a maximum of 70.0. On non-FOMC announcement days, we have 1440 observations with a mean of roughly 1.2 and a standard deviation of 0.37, ranging from a minimum of 0 to a maximum of 3.89. Hence, it is obvious that volatility dramatically increases during the announcement period. Furthermore, due to the large discrepancy between the max and min values (or the high standard deviation value) on FOMC announcement days, it could be said that realized volatility spikes occur at a particular time of the day, consistently.

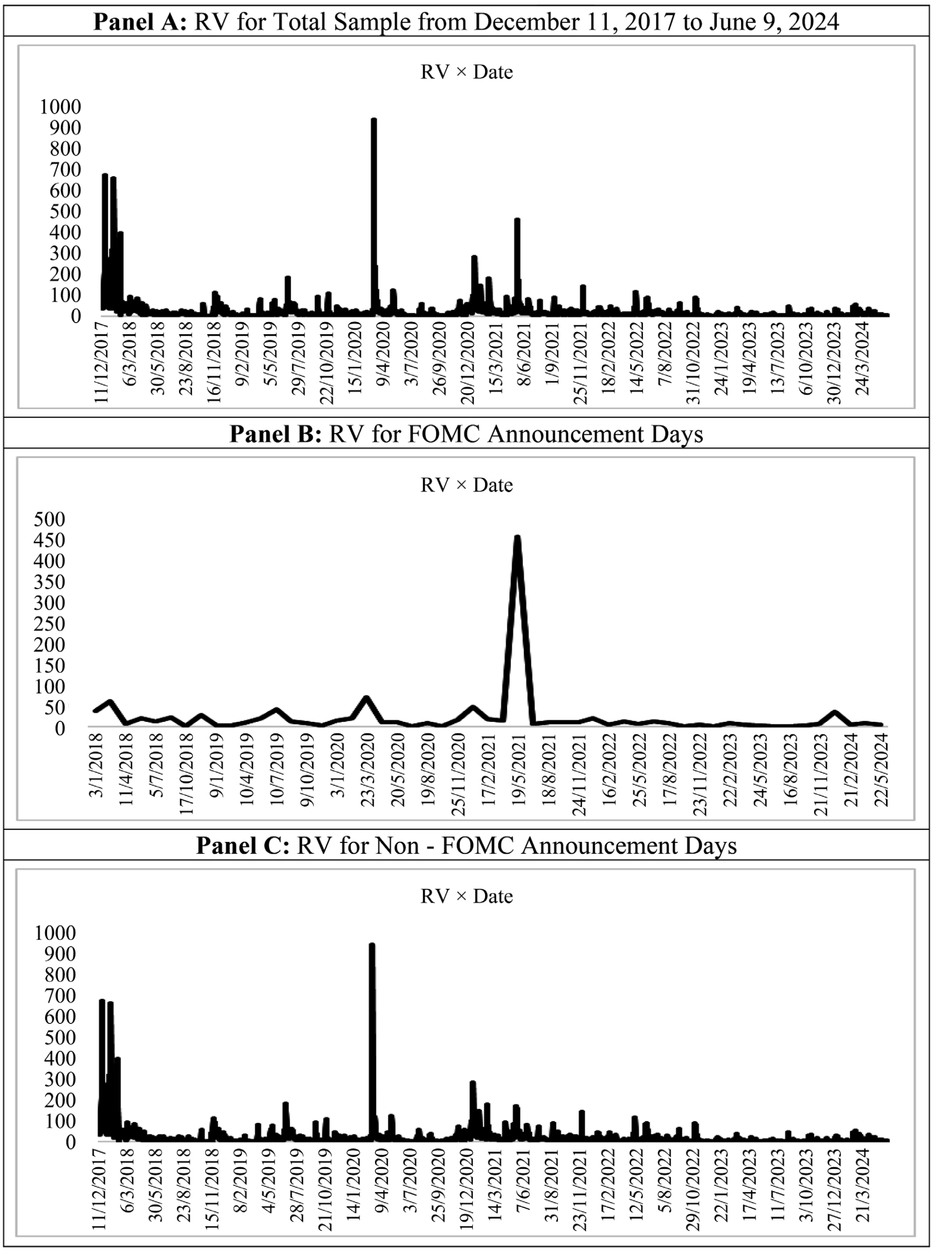

Figure 1. Realized volatility.

Table 2. Descriptive statistics of intraday RV.

Variables	Obs	Mean	Std. dev.	Min	Max
FOMC Announcement Day	1440	1.604123	3.032169	0	67.9878
Non-FOMC Announcement Day	1440	1.203975	0.3699374	0	3.885279
Total Sample	1440	1.212912	0.3774384	0	3.931761

The graphical representation of intraday realized volatility for FOMC announcement days, non-FOMC announcement days, and the total sample are presented below in Figure 2.

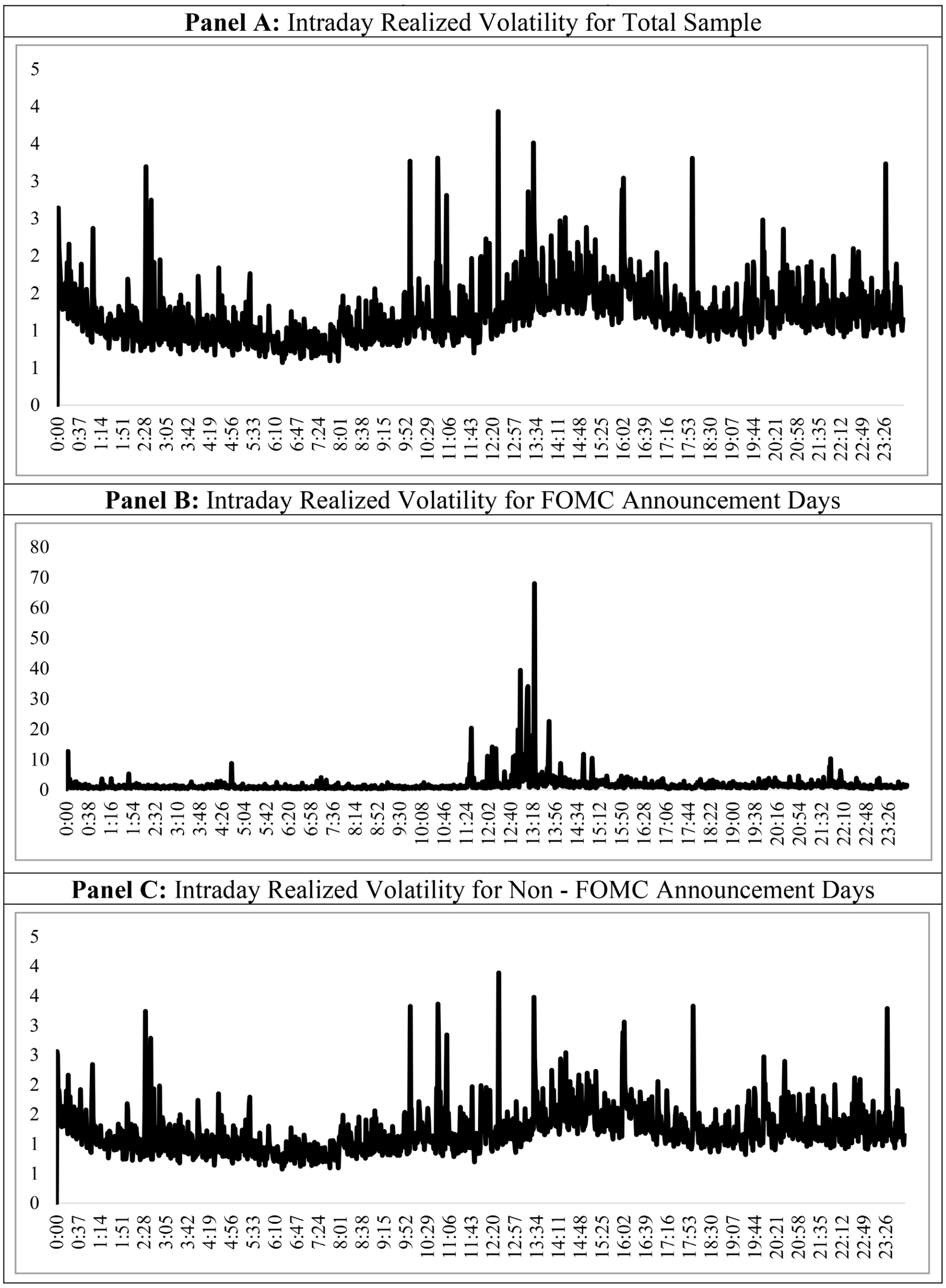

Figure 2. Intraday realized volatility.

According to **Figure 2** Panel B, the intraday realized volatility dramatically increases around the FOMC announcement period, specifically between 11 a.m. and 3 p.m., while the intraday realized volatility remains relatively constant for the whole 24 hours on non-FOMC announcement days (see Panel C). These findings differ from existing literature in terms of the reaction of the market before the FOMC announcement (around 2 p.m.); specifically, the stock market shows a lower realized volatility reaction or the volatility remains constant in the hours before the announcement [6] [7].

Table 3. Regression results.

RV	Coefficient	Robust std. err.	t	p > |t|
Constant	17.3355	0.0230	754.70	0.000
FOMC	5.7639	0.2264	25.46	0.000

The regression analysis in **Table 3** indicates that FOMC announcements have a statistically positive effect on the realized volatility of BTC, with p-values even below 0.01. This highlights the fact that FOMC announcements have a robust contribution to realized volatility. The regression model that explains this case is given below:

$$RV_t = \beta_0 + \beta_1\left(\mathrm{FOMC}_t\right) + \varepsilon_t$$

$$RV_t = 17.3355 + 5.7639\left(\mathrm{FOMC}_t\right) + \varepsilon_t$$

In the regression model where RV_t is the dependent variable and $FOMC_t$ is the independent variable, a beta coefficient of 5.76 means that when there is an FOMC announcement, the predicted value of RV_t increases by approximately 5.8 units, assuming all other factors are constant. This indicates a positive and direct relationship between FOMC announcements and realized volatility.

4. Conclusions

The study examines the impact of the Federal Open Market Committee (FOMC) announcements on the volatility of the cryptocurrency market, notably Bitcoin (BTC), using high-frequency data. Our analysis demonstrates that FOMC announcements have a significant effect on the volatility of the cryptocurrency market. This is obvious from the observed rise in realized volatility on the days the announcements are made. This phenomenon is even more noticeable during specific time periods throughout the day, especially between 11 a.m. and 3 p.m. This emphasizes a period of increased volatility around the FOMC announcements. The empirical evidence showing signs of higher volatility on FOMC announcement days suggests that cryptocurrency markets are sensitive to monetary policy announcements, which can help with the risk management strategies of investors.

Furthermore, our findings enhance the existing body of literature by providing insights into the response of cryptocurrency markets to FOMC announcements, which is essential to establishing trading strategies and risk management tools that are specifically designed for the distinct dynamics of the Bitcoin market.

Investors can improve decision-making and risk assessment by comprehending the timing and influence of FOMC announcements on Bitcoin volatility. Policymakers can utilize the data to better understand the financial market impacts of monetary policy decisions.

Future research could investigate the mechanism behind the observed volatility spikes and explore how different cryptocurrencies or different financial markets respond to macroeconomic announcements.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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