Impact of Market Volatility on Investor Sentiment: Evidence from COVID-19 and Crypto-Currencies

Abstract

We study how investor sentiment responds to the prevalence of COVID-19 induced equity market volatility. Using the quantile-on-quantile approach, we report a strong relationship between sentiment and volatility. We note that low to medium volatility yield minimum fear, with high volatility triggering extreme fear in the crypto market.

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1. Introduction

The challenge of conventional asset pricing models to thoroughly explain asset pricing and investor decisions underscores sentiment relevance. A global pandemic such as COVID-19 presents unprecedented fear and uncertainty, yielding severe consequences for economies, capital markets, risk management, asset allocation, and hedging and safe-haven features of financial instruments (Baker et al., 2020). In response, investors seek nonconventional assets such as oil, gold, and, more recently, crypto-currencies. As individual investors dominate the crypto market (Schilling & Uhlig, 2019), this offers a reasonable metric for market sentiment.

There are several studies exploring this: Gurdgiev and O'Loughlin (2020) find that investor sentiment can predict the price direction of cryptocurrencies. Goodell and Goutte (2020) show a negative association between COVID-19 and Bitcoin prices. Umar and Gubareva (2020) find high correlation between investors' panic and several cryptocurrencies. Chen et al. (2020) report exacerbating volatility in the crypto market. These studies are mostly consistent with interpreting the crypto market as sensitive to investor sentiment and susceptible to underlying market conditions.

Using the more sensitive crypto market investors, this study sheds further light on the relationship between volatility and sentiment. In a fearful market, investors likely have higher risk aversion. So, in an extreme event such as COVID-19, investors may pull capital out of both equity and crypto markets to avoid massive loss, causing both markets to move together. This is especially likely given the herding and anchoring aspects of crypto investors (Gurdgiev & O'Loughlin, 2020). Hence, we expect a reasonable association between equity market volatility and crypto market sentiment during the COVID-19 pandemic. Importantly, unlike past studies, this study considers the development of such association in various investment horizons using both quantile-on-quantile and period-frequency domain approaches.

The remainder of this article is organized as follows. Section 2 presents data sources, samples, and some descriptive statistics, and the employed econometric methodology. The empirical estimation with findings and insights are presented in Section 3. Section 4 concludes with summary findings and explores implications.

2. Data & Econometric Methodology

We investigate the relationship between investor sentiment and market volatility. For sentiment, we use the Crypto Fear & Greed Index[1] (CF&GI), a weighted multi-factor index that accounts for volatility (30%), market momentum/volume (30%), social media (20%), dominance (10%), and trends (10%). The index is scaled from '0' to '100', with '0' implying 'extreme fear' and '100' indicates 'extreme greed'. Due to the crypto market's sentiment-driven nature, we expect a reasonable association with the equity market volatility during extreme events.

We use the newspaper-based Daily Infectious Disease Equity Market Volatility Tracker (IDEMV)[2] (Baker et al., 2019, Baker et al., 2020) as a proxy for equity market volatility. Unlike other equity market volatility measures, the IDEMV captures solely volatility induced by COVID-19 related news (infections and deaths) and the resultant response of investors in the equity market (Li et al., 2020).

Table 1 about here

We explore the tail dependence between crypto market sentiment and equity market volatility utilizing the Quantile-on-Quantile Regression (QQR) approach. Proposed by Sim and Zhou (2015), this approach provides a scope to explore the relationship between the quantiles of two variables. The QQR approach blends the quantile regression approach and the local linear regression, allowing for the dimensionality difficulty linked with the nonparametric model to quantify potential heterogeneity at different quantiles.

In this study's framework, the QQR model can uncover the link between the crypto market sentiment and equity market volatility. The model is expressed as:

$$IDEMV_t = \beta^{\emptyset}(CF\&GI_t) + \alpha^{\emptyset} IDEMV_{t-1}\varepsilon_t^{\emptyset} \quad (1)$$

[1]Recently employed by Gurdgiev and O'Loughlin (2020); find more at https://alternative.me/crypto/fear-and-greed-index/.
[2]Read more at https://www.policyuncertainty.com/infectious_EMV.html.

where $\emptyset$ denotes the quantiles of each variable, $IDEMV_t$ and $CF\&GI_t$ are as defined above, and $\varepsilon_t^{\emptyset}$ is the error term whose conditional $\emptyset th$ quantile equals zero. In the spirit of Sim and Zhou (2015), $\beta^{\emptyset}$ (.) is allowed to be unknown, given that we are unable to associate any prior information for the CF&GI and IDEMV link. With $\beta^{\emptyset}$ (.) unknown, the first-order Taylor expansion around quantile $CF\&GI^{\tau}$ results in:

$$\beta^{\emptyset}(CF\&GI_t) \approx \beta^{\emptyset}(CF\&GI^{\tau}) + \beta^{\emptyset'}(CF\&GI^{\tau})(CF\&GI_t - CF\&GI^{\tau}) \quad (2)$$

$\beta^{\emptyset'}$ represents the marginal effect and a partial derivation of $\beta^{\emptyset}(CF\&GI_t)$ relating to $CF\&GI$. It is equivalent to the slope coefficient in a linear regression setup. Both $\beta^{\emptyset}(CF\&GI^{\tau})$ and $\beta^{\emptyset'}(CF\&GI^{\tau})$ are functions of $\emptyset$ and τ and can be stated as $\beta_0(\emptyset,\tau)$ and $\beta_1(\emptyset,\tau)$ respectively. With this in mind, Eq. (2) can then be rewritten as:

$$\beta^{\emptyset}(CF\&GI_t) \approx \beta_0(\emptyset,\tau) + \beta_1(\emptyset,\tau)(CF\&GI_t - CF\&GI^{\tau}) \quad (3)$$

We replace the derivation from Eq. (3) into Eq. (1), resulting in:

$$IDEMV_t = \beta_0(\emptyset,\tau) + \beta_1(\emptyset,\tau)(CF\&GI_t - CF\&GI^{\tau}) + \varepsilon_t^{\emptyset} \quad (4)$$

We adopt the Gaussian Kernel approach, commonly used in the application of the QQR in financial and economic investigations for its simple computation and efficiency (Sim & Zhou, 2015). With the QQR approach, we assume the absence of homogeneity between quantiles of crypto market sentiment and equity market volatility.

3. Empirical Findings

Figure 1 plots the CF&GI and IDEMV series from January to August 2020. We observe heightened volatilities in equity markets starting late February and peaking in mid-March, following the onset and prevalence of COVID-19 infections and death rates. At about the same time, sentiment falls, to around mid-March, signifying near-extreme fear.

Figure 1 about here

Table 1 reports the correlation and Granger causality test statistics. The correlation (-0.535) is negatively significant, implying an inverse relationship between crypto market sentiment and equity market volatility. The Granger causality test statistic suggests that underlying market volatility is useful in understanding investor sentiment in the crypto market.

Since we assume that a high (low) CF&GI can be interpreted as a high (low) risk aversion, we expect this relationship to only be true when the index is already at an extreme value (close to either '0' or '100'). This is because fearful (greedy) investors will tend to be more risk-averse (risk-seeking), and therefore, a negative (positive) shock is more likely to generate significantly more volatility than if investors had normal risk-aversion. In the end, an index indicating extreme fear/greed should correlate with more volatility in the equity market.

Figure 2 depicts the structural dependence between crypto market sentiment and equity market volatility. We note a predominantly negative association across different quantiles of volatility and sentiment. The results suggest that COVID-19 triggered volatilities produce negative investor sentiment (fear). However, the absence of significant heterogeneity at lower (0.05) and, to some extent, the middle quantiles (about 0.50) provide interesting insights. Particularly, we note that investor sentiments are mostly neutral towards minimum volatilities; high to extreme (0.7 to 1) volatilities yield significant fear. With the reported impact of COVID-19 on financial markets and economies, we can infer that investors tend to tolerate reasonable (expected) volatilities in equity markets during the COVID-19 pandemic and respond only to high volatilities.

Figure 2 about here

Figure 3 shows the results from the wavelet coherence[3] analysis of the crypto market sentiment's lead-lag interactions with the equity market volatility in a time-frequency dimension as a robustness check. We observe strong interactions throughout the evolution of the pandemic. The significant phases alongside arrows signify an inverse relationship, with the volatility in the

[3]See Balli et al., (2020) for the morphological derivation.

equity market, causing the underlying sentiment in the crypto market. Notably, we find that high volatility in the equity market triggered investors' fear in the crypto market at the onset of the prevalent pandemic in March and lasted until April at various frequencies (4~32 days). Then there is a repeated episode during June and July when most countries experienced the second wave of the noxious virus. However, we also detect some short intervals of analogous movement when modest market volatility is aligned with investors' greed in the crypto market. One can argue such tangled relationships as a consequence of policy responses, such as stimulus packages and subsequent rate cuts, and the explosion in commodity markets pushing investors to reallocate their investments. Our results are largely in consonance with Gurdgiev & O'Loughlin (2020), suggesting a deep connection amongst market sentiment, volatility, and crypto market movements.

Figure 3 about here

4. Conclusions

The onset and prevalence of COVID-19 present an opportunity to explore the relationship between investor sentiment and market volatility. The current study investigates how COVID-19 induced equity market volatility influences investor fear and greed in the crypto market. We adopt two contemporary approaches, quantile on quantile and continuous wavelet coherence, to investigate the interdependences between market volatility and investor sentiments (i.e., fear and greed). Our results show that high to extreme COVID-19 induced equity market volatility triggered fear among investors, with low to medium volatility yielding greed. Our results reecho the negative impact of the ongoing pandemic and the vital role of government intervention in restoring market confidence.

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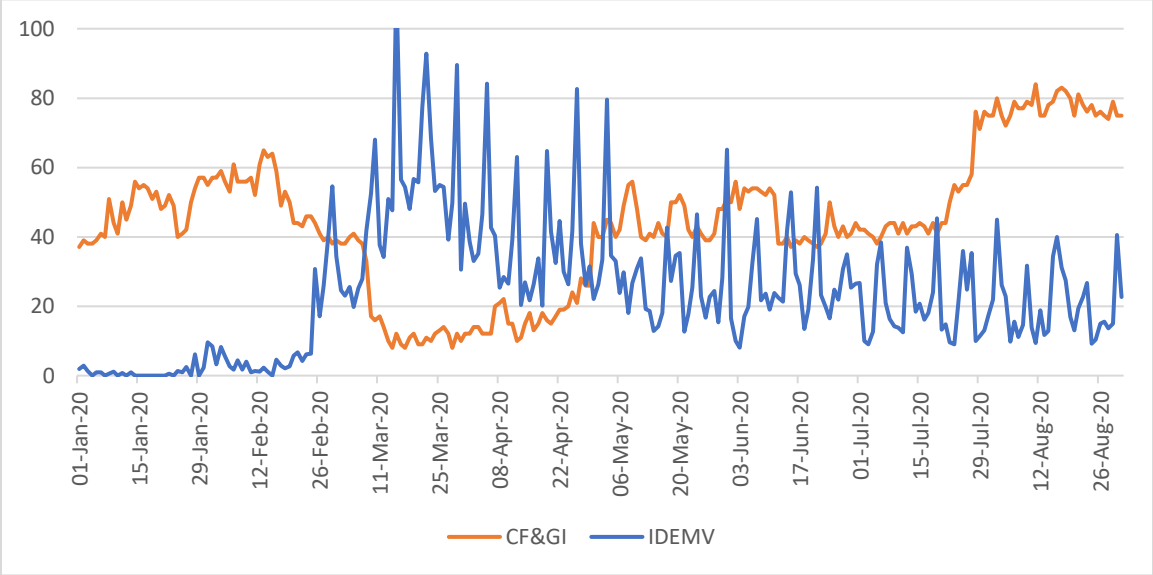
Figure 1: Evolution of CF&GI and IDEMV



Notes: Orange and blue trajectories refer to Crypto Fear & Greed Index (CF&GI) and COVID-19 Induced Equity Market Volatility (IDEMV), respectively.

Table 1: Correlation and causality test statistics

Correlation

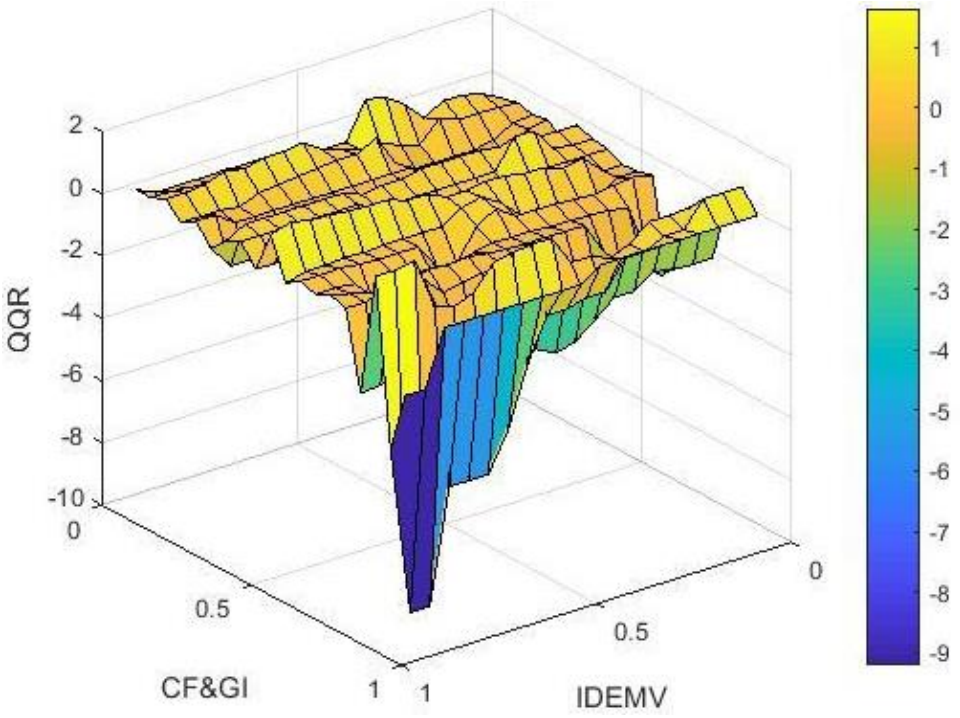
	CF&GI	IDEMV
CF&GI	1	
IDEMV	-0.535***	1

Granger Causality

Null Hypothesis:	F-Statistic
IDEMV does not Granger Cause CF&GI	0.21523
CF&GI does not Granger Cause IDEMV	6.31377***

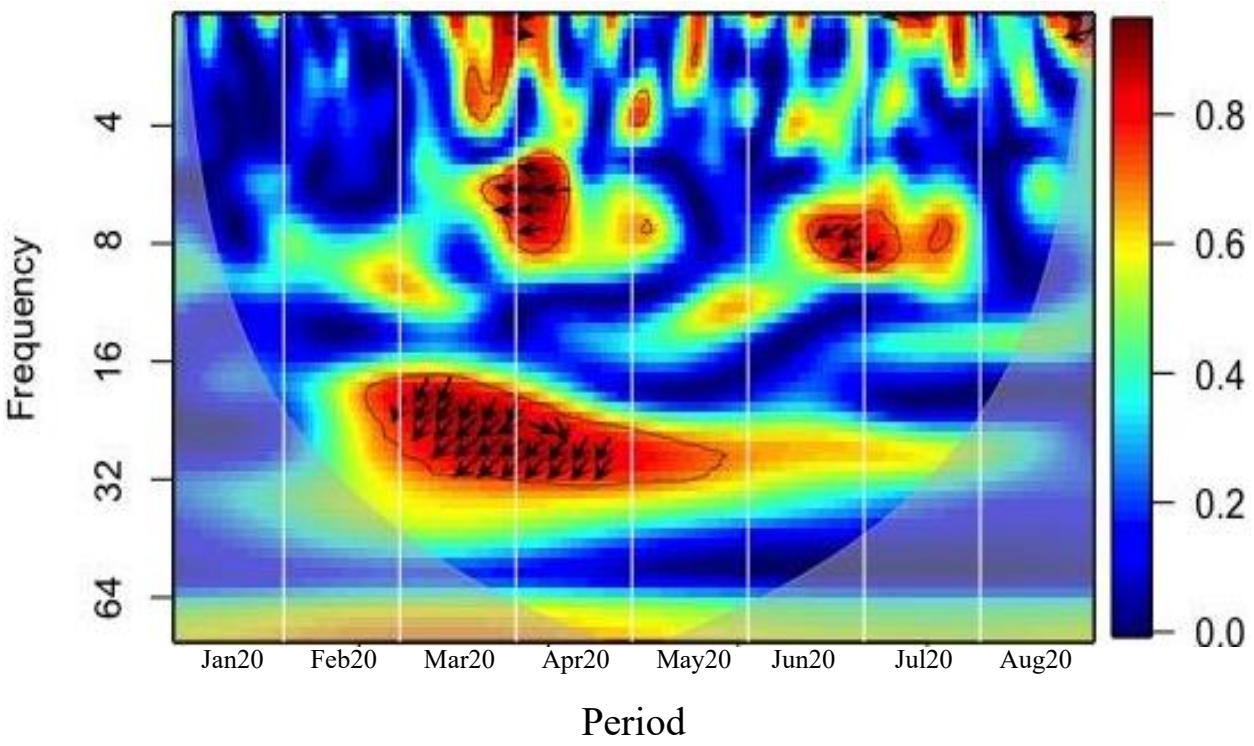
Notes: Superscripts are symbolizing *** p<0.01.

Figure 2: Quantile-on-Quantile interactions between IDEMV and CF&GI



Notes: IDEMV: COVID-19 induced equity market volatility, CF&GI: crypto fear and greed index. Deep blue areas infer negative dependence while bright yellow regions suggest positive dependence across Øth quantiles of CF&GI and IDEMV.

Figure 3: Continuous wavelet coherence between CF&GI and IDEMV



Notes: Horizontal axis refers to the period of January 2020 - August 2020, while the vertical axis refers to the frequency of 4 ~ 64 days. Warmer colors 'reddish' signify regions with higher coherence while colder colors 'bluish' imply lower coherence. The white contour's statistically significant (5%) region is detected using the Monte Carlo simulation. The black arrow specifies lead/lag phases. A zero-phase means 2 series move together. If 2 series are in phase, i.e., →, it means that they have positive coherence and if in anti-phase, i.e., ←, it means that they have negative coherence. Accordingly, arrows pointing ↗ or ↙ imply equity market volatility leads crypto market sentiment while arrows pointing ↘ or ↖ imply otherwise.