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COVID-19 uncertainty and Bitcoin market, linking the liquidity cost to the cryptocurrency yields

COVID-19 incertidumbre y mercado de Bitcoin, vinculando el coste de la liquidez a los rendimientos de la criptodivisa

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Abstract

The cryptocurrency market is emerging as a new asset class for the investment. As the traditional asset prices are often noted to be influenced by the liquidity risk, this study links the cryptocurrency liquidity cost to its yields. Pre-pandemic uncertainty, the Bitcoin liquidity cost was found to be priced in its returns during the same trading session. Post-pandemic crisis, the relationship was changed. The liquidity cost was reported not to be priced in the Bitcoin returns at the time of same trading session. Post-pandemic crisis, however, the liquidity cost imposed by the liquidity supplier on day $t-1$ was noted to be priced in the Bitcoin return of day t. In the cryptocurrency market, this study quantifies the effects on the Bitcoin returns of its liquidity cost, and if such effects vary pre- and post-pandemic uncertainty.

Keywords: Cryptocurrency Market; Asset Pricing; Liquidity Cost; Returns

Resumen

El mercado de las criptomonedas está surgiendo como una nueva clase de activos para la inversión. Dado que los precios de los activos tradicionales suelen estar influidos por el riesgo de liquidez, este estudio vincula el coste de liquidez de las criptomonedas a sus rendimientos. Antes de la incertidumbre pandémica, se comprobó que el coste de liquidez de Bitcoin estaba tasado en sus rendimientos durante la misma sesión de negociación. Después de la crisis pandémica, la relación cambió. El coste de la liquidez no se incluyó en el precio de los rendimientos del Bitcoin en la misma sesión de negociación. Sin embargo, después de la crisis pandémica, se observó que el coste de liquidez impuesto por el proveedor de liquidez en el día $t-1$ tenía un precio en el rendimiento de Bitcoin del día t. En el mercado de criptomonedas, este estudio cuantifica los efectos en el rendimiento de Bitcoin de su coste de liquidez, y si tales efectos varían antes y después de la incertidumbre pandémica.

Keywords: Mercado de criptomonedas; Fijación de precios de los activos; Coste de liquidez; Rendimientos

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1 Introduction

In late 2019, the rumors about a new virus, named to the coronavirus, had started to begin from China. In early 2020, the virus had surged worldwide. Due to the exceptional rate of fatality, the virus was announced as a pandemic on March 11, 2020. It led to a social distancing and home isolation across the globe. Over 1 billion people was compelled to follow immeasurable social, and economic restrictions. With regard to the easing lockdown or its associated restrictions, the common challenge for the governments was to ascertain the appropriate time. The health officials were noted to be concerned about the impact of the easing restrictions. In late Q2 2020, the lockdown was temporarily removed, but time varies to each country.

In early 2021, many countries are noted to reconsider the lockdown with numerous social, political, and economic restrictions. The pandemic uncertainty is raising concerns on the future economic perspectives. Due to the coronavirus crisis, the global financial markets are at the risk of a higher volatility (Zhang, Hu, & Ji, 2020). The pandemic is impacting the global economic development (Goodell, 2020), and yields on the assets (Al-Awadhi, Alsaifi, Al-Awadhi, & Alhammadi, 2020). Following the pandemic uncertainty, the investor pessimistic emotions caused the illiquidity and higher trading cost in the Australian Securities Exchange market (Saleemi, 2020b). The returns on the traditional stock market are more sensitive to the liquidity cost imposed by the liquidity providers during the pandemic uncertainty (Saleemi, 2021).

The cryptocurrency market is referred to a safe haven for distinct reasons: unregulated from the monetary policy, a store of value, and weak relationship with the traditional financial assets (Klein, pham thu hien, & Walther, 2018). As the recent crisis develops, the market for the Bitcoin does not act as a safe haven (Conlon & McGee, 2020). Whether the cryptocurrency market should be regulated under the government financial policy, the discussion is still active. In 2009, the Bitcoin was first introduced as a digital currency and another investment asset class. Although there are numerous cryptocurrencies, the Bitcoin has received a huge attention due to its massive price fluctuation. The Bitcoin price has highly escalated during the pandemic. However, the price shocks are still occurring in the Bitcoin market.

The market liquidity determines the asset price (Amihud & Mendelson, 1991), and its returns (Amihud, Hameed, Kang, & Zhang, 2015). The inventory holder requires to liquidate its position due to the earning incentives. The liquidity matters to redeem the position. The market liquidity is the immediacy of a transaction execution. In order words, the low trading cost is referred to the higher liquidity. The market liquidity risk can also be relevant for the Bitcoin holders. Although the liquidity risk has immediate impact on the trading, it is an active discipline of research (Guijarro, Moya-Clemente, & Saleemi, 2019). This study investigates whether the market liquidity or its associated cost is a relevant element to determine yields in the cryptocurrency market during the recent pandemic. Additionally, the work reports the impact of liquidity cost on the cryptocurrency returns pre- and post-pandemic crisis.

The liquidity cost can be referred to a conditional cost that the liquidity provider asks against providing the liquidity. The forward-looking investor tends to be protected against the provision of illiquidity and imposes a cost on the seller. The bid-ask spread is often applied to measure the entire liquidity cost. The higher spread elucidates reluctance of the liquidity supplier to invest in an asset without imposing a cost on the counterparty (Saleemi, 2020a). In this context, the liquidity provider or the spread size influences the asset prices. Although the price for the Bitcoin is noted to be massively surged in the recent pandemic, it matters to unveil effects on the cryptocurrency returns of the liquidity cost during the pandemic uncertainty.

The research paper is organized as follows. The literature is reviewed in Section 2. The

material and methods are discussed in Section 3. The empirical findings are presented and elucidated in Section 4. The main outcomes of the research paper are reported in Section 5.

2 Review of Literature

The literature in the cryptocurrency market has rapidly expanded under various avenues: the cryptocurrency's features (Wu, Pandey, & Dba, 2014), price speculation (Cheah & Fry, 2015), price formation (Dyhrberg, 2016), volatility (Katsiampa, 2017), price clustering (Urquhart, 2017), transaction cost (Kim, 2017), market efficiency (Bariviera, Basgall, Hasperué, & Naiouf, 2017), returns and volatility (Omane-Adjepong, Ababio, & Alagidede, 2019), market persistence (Bouri, Lau, Lucey, & Roubaud, 2019), and relationship between cryptocurrencies and traditional securities (Gil-Alana, Abakah, & Rojo, 2020). To the author's knowledge, however, the impact of the pandemic uncertainty on the relationship between liquidity cost and cryptocurrency returns has not been explored.

In the cryptocurrency market, this study focuses on the liquidity cost and its effects on the cryptocurrency returns pre- and post-pandemic crisis. The market for cryptocurrencies is reported to be significantly inefficient (Nan & Kaizoji, 2019). The efficiency for the market of cryptocurrencies is relevant to the certain periods (Kristoufek & Vosvrda, 2019). The cryptocurrencies are exposed to the systematic risk (Corbet, Lucey, & Yarovaya, 2018), and sensitive to various events (Tran & Leirvik, 2020). The cryptocurrencies are found to be interlinked in terms of volatility spillover, lead-lag impact, and market co-movement (Sifat, Mohamad, & Shariff, 2019).

The liquidity substantially varies among cryptocurrencies (Phillip, Chan, & Peiris, 2018). As the liquidity increases, the market for cryptocurrencies becomes more efficient (Brauneis & Mestel, 2018). Unlike in the retail foreign exchange markets, the transaction cost for the Bitcoin is substantially lower (Kim, 2017). The liquidity for the cryptocurrency is considerably related to the market efficiency (Wei, 2018). The simpler infrastructure or government free design in the cryptocurrency market causing a surge in its trading quantity, price, and volatility (Corbet et al., 2018).

The Bitcoin, in general, is held for two reasons: electronic cash and speculation. The Bitcoin holders are preliminary concerned with the future fundamental value of the Bitcoin (Cheah & Fry, 2015). The Bitcoin is sensitive to the speculative behavior and price bubbles (Corbet et al., 2018). The market for the Bitcoin is more inefficient compared to the stock, gold, or forex markets (Al-Yahyaee, Mensi, & Yoon, 2018). The market for cryptocurrencies is not cointegrated with the stock market indices (Gil-Alana et al., 2020).

In the traditional asset class, the market liquidity is often priced in the returns (Amihud et al., 2015). The liquidity provider tends to be compensated against the risk of illiquidity. In this context, a liquidity cost is imposed on the seller. This leads to a decline in the asset price. The liquidity cost or lower bid-price ensures, that a liquidity provider can possibly generate yields on the future resale of the holding inventory. The yield sensitivity to the market liquidity shocks can generate higher returns on the investment (Le & Gregoriou, 2020).

This study investigates whether the liquidity cost can be applied as a measure of yields in the cryptocurrency market during the pandemic uncertainty. The market liquidity is elucidated in various avenues: effective trading cost (Roll, 1984); asymmetric information effects (Glosten & Milgrom, 1985); market features of immediacy, trading cost, depth, breadth, and resiliency (Lybek, Sarr, & and, 2002); and price impact (Liu, 2006). The market liquidity, in general, relates to the easiness of transaction execution with bearing a low cost. The liquidity measurement is

a multidimensional subject.

In the asset pricing literature, the abundant liquidity models have been proposed over time. Although the list of liquidity cost models is huge, the two aspects are found to be common. The friction or cost in the market determines the liquidity and its impact is time varying (Degennaro & Robotti, 2007). In a market, the bid-ask spread is highly considered to estimate the cost and ease of trading (Corwin & Schultz, 2012). The spread is modelled under three major avenues: inventory immediacy cost, asymmetric information cost, and order processing cost (Huang & Stoll, 1997).

The immediacy cost model argues that the liquidity providers are compensated against the future price uncertainty. The liquidity provider reduces its risk exposure against the holding inventory and thus, imposes a cost on the seller. The asymmetric information model assumes that the informed trader drives the market liquidity. The uninformed counterparty can possibly lose in the trading (Gorton & Metrick, 2010). In this context, the liquidity provider imposes a cost on the seller. The liquidity provider also tends to be compensated against the order processing cost.

The bid and ask are the quoted prices for an asset. The bid is the maximum price that a buyer is willing to pay against the asset. The ask relates to the minimum price that a seller would accept to redeem its position. The liquidity provider would provide the immediacy of transaction at the best bid price and liquidate the investment at the best ask price. This implies, that the liquidity provider tends to generate yields on the investment. The spread is a range between the quoted prices. The size of spread elucidates the ease and cost of trading for an asset.

3 Data and Methods

The recent crisis and its damages on various aspects of the financial markets are continuing under discussion. In this study, the focus lies on the relationship between cryptocurrency spreads and its yields. Since various liquidity cost models are introduced, the common challenge for the researchers is to determine the appropriate spread proxy. A few shortcomings are reported in distinct spread models (Goyenko, Holden, & Trzcinka, 2009). This study adopts two spread proxies, namely the Effective Spread (ES) and Cost-based Market Liquidity (CBML) spread.

In the asset pricing literature, the spread proxies, in general, are examined under two avenues: intraday data and low-frequency data. The asset prices quoted numerous times once a day are reported to the intraday data. Conversely, the low-frequency data for an asset can be elucidated to daily features, such as, the opening price, ask price, bid price, closing price, and trading volume. In this study, the daily ask price, bid price, and closing price of the Bitcoin are considered in the analysis. The analysis is performed during the period March 10, 2014 – April 21, 2021.

Among the liquidity cost measures, the ES model is often applied to estimate the real cost of trading. The ES proxy is computed from the low-frequency data, and constructed as below:

$$EffectiveSpread_t = \frac{2|C_t - \eta_t|}{\eta_t} \tag{1}$$

An alternative proxy of the bid-ask spread, namely the CBML, is proposed by (Saleemi, 2020a). In this study, the CBML method is constructed from the low-frequency data. The analytical expression of the CBML proxy is given as below:

$$CBML_t = \sqrt{\left(S_{t-1} - v_t^s\right)^2} \tag{2}$$

For the previous trading-day session, S_{t-1} is a ratio of the asset range to its closing price, and estimated as below:

$$S_{t-1} = \frac{H_{t-1} - L_{t-1}}{C_{t-1}} \tag{3}$$

Where, H_{t-1} is the highest price of the Bitcoin; L_{t-1} refers to the Bitcoin lowest price; and C_{t-1} denotes to its closing price for the past trading-day session. The CBML model looks at past prices by a logic that the liquidity supplier tends to be compensated against the price fluctuation, return uncertainty, and order processing expenses. In the following trading-day session, the CBML method estimates the information effects on the buyer-initiated trade and seller-initiated trade. In this context, the ratio of an informed asset range to its closing price is estimated on day t at:

$$v_t^s = \frac{v_t^{ask} - v_t^{bid}}{C_t} \tag{4}$$

Assuming risk neutrality in the future trading-day session, the asset is valued at:

$$\eta_t = \frac{1}{2}\left(H_t + L_t\right) \tag{5}$$

Where, η_t is the mean value of day t. The model assumes equal presence of the informed buyer and seller in the market. In this context, the ask value is assumed conditional at:

$$v_t^{ask} = H_t\pi + \eta_t\pi \tag{6}$$

Meanwhile, the estimated bid value is assumed conditional at:

$$v_t^{bid} = L_t\pi + \eta_t\pi \tag{7}$$

To understand the relationship between cryptocurrency spreads and its yields, the return on the Bitcoin is calculated as below:

$$BR_t = \frac{p_t}{p_{t-1}} - 1 \tag{8}$$

Where, BR_t is yield on the Bitcoin for day t; p_t denotes to its closing price of day t; and p_{t-1} refers to its previous trading-day closing price. The Bitcoin yields are computed on a daily basis.

3.1 Benchmark model

The study is performed by means of a multiple linear regression analysis. In the benchmark model, the Bitcoin liquidity cost acts as an explanatory variable and return on the Bitcoin refers to a response variable. In this study, the benchmark model is constructed as below:

$$BR_t = \alpha + \beta_1 SP_t + \beta_2 SP_{t-1} + \epsilon_t \tag{9}$$

Where, BR_t is the Bitcoin return of day t; SP_t refers to the Bitcoin spread of day t; SP_{t-1} denotes to the Bitcoin spread of day $t-1$; and ϵ_t is the error term. The control variable is not considered to perform the regression analysis. As earlier mentioned, a liquidity supplier

V	N	Min	Median	Mean	Max	SD	S	K
ES	2600	3.07E-16	0.01602	0.0261	0.456877	0.0308	3.5836	29.1771
CBML	2600	0.0000219	0.0202	0.0304	0.523060	0.0344	3.7014	30.3997
BR	2600	-0.391816	0.00181	0.0025	0.272286	0.0391	-0.1621	12.0922

Note: Variables: V; Observations: N; Effective Spread: ES; Cost-Based Market Liquidity: CBML; Bitcoin Return; BR; Standard Deviation: SD; Skewness: S; Kurtosis: K.

Table 1. Descriptive Statistics

reduces its risk by imposing a cost on the seller. The Bitcoin buyer can also redeem its position in the following trading day. Therefore, the study investigates whether the cost imposed by the liquidity supplier on day $t-1$ is relevant to determine the return of day t at the time of Bitcoin redemption.

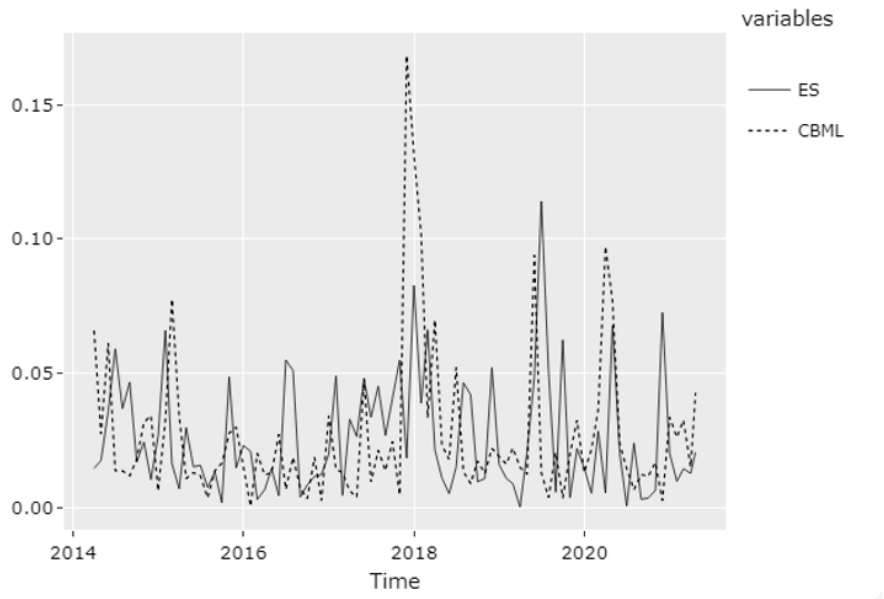

Figure 1. The Bitcoin spreads are graphed on a monthly basis

4 Results

The descriptive statistics are estimated on a daily basis, and reported in Table 1. It is noted that the Bitcoin spreads are positively skewed with fat-tailed distribution. This implies, that the spread measures have the right-skewed distributions with most values to the right of their mean. Conversely, the Bitcoin return is negatively skewed with fat-tailed distribution. The negative skewness for the return indicates the left-skewed distributions with most values to the left of mean value. The fat-tailed distributions or higher kurtosis values for the spread proxies and return are indicating the extreme values in the corresponding dataset. On a monthly basis, the fluctuation in the Bitcoin spreads and its yields are graphed in Figure 1 and Figure 2, respectively. It is vividly noted that the liquidity cost and returns are time-varying in the Bitcoin market.

It matters to unveil whether the liquidity cost is an appropriate measure to estimate yields

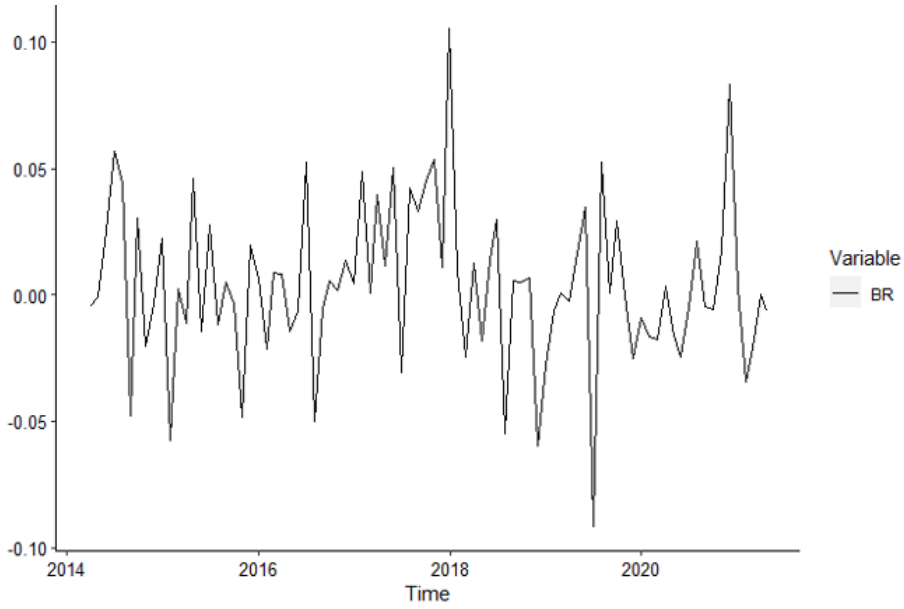

Figure 2. The Bitcoin returns are graphed on a monthly basis

in the cryptocurrency market. The analysis is separated in two avenues: the impact on Bitcoin returns of the liquidity cost pre-pandemic crisis; and if the pandemic uncertainty influences the relationship between Bitcoin liquidity cost and its returns. At the first stage, the study performs a multiple linear regression analysis during the period March 10, 2014 – March 10, 2020. On a daily basis, the Bitcoin returns are examined as a linear combination of liquidity cost imposed by the liquidity supplier on day t and day $t-1$.

Pre-pandemic crisis, the regression relationship is quantified in Table 2. On the same trading day, the Bitcoin returns are positive and significantly associated with its liquidity cost, estimated by ES and CBML measures. This implies, that the liquidity suppliers tend to be compensated against the provision of illiquidity in the Bitcoin market. The higher spread or liquidity cost compensates the liquidity providers with higher returns on the Bitcoin resale. Pre-pandemic crisis, hence, the Bitcoin liquidity cost is priced in its yields during the same trading session.

The study also considers if a buyer of the Bitcoin or the Bitcoin liquidity supplier chooses to redeem its position in the following trading session. In this context, the study investigates whether the liquidity cost imposed by the buyer on day $t-1$ is relevant to determine the return of day t at the time of Bitcoin redemption. It is noted, that the Bitcoin return of day t is positive and insignificantly associated with its liquidity cost of day $t-1$. Pre-pandemic uncertainty, thereby, the liquidity cost imposed by the investor on day $t-1$ is not priced in return of day t during the following trading session.

The following experiment is performed during the period March 10, 2014 – April 21, 2021. The subperiod studies the pandemic effects on the relationship between Bitcoin spreads and its returns. For the subperiod, the Bitcoin returns are studied as a linear combination of its liquidity cost imposed by the liquidity provider on day t and day $t-1$. Post-pandemic crisis, the relationship is reported in Table 3, and quantified by means of a multiple linear regression analysis. On the same trading session, the Bitcoin returns are found to be negatively associated with its liquidity cost. However, the relationship is noted not to be statistically significant. Post-

Variables		Estimate	p-value
BR (a)	Intercept	-0.0008168	0.5050
	ES	0.0726563	0.0113*
	ES_{t-1}	0.0367245	0.2001
BR (b)	Intercept	-0.0002699	0.83034
	CBML	0.0706449	0.00715**
	$CBML_{t-1}$	0.0045626	0.86198

Note: a) Adjusted R-squared: 0.003816; F-statistic: 5.158; p-value: 0.005823; (b) Adjusted R-squared: 0.002836; F-statistic: 4.088; p-value: 0.01691; Significance codes: '***' < 0.001; '**' < 0.01; '*' < 0.05

Table 2. The analysis is performed pre-pandemic crisis

Variables		Estimate	p-value
BR (a)	Intercept	0.002540	0.3895
	ES	-0.018083	0.7673
	ES_{t-1}	0.130377	0.0333 *
BR (b)	Intercept	0.006991	0.0142 *
	CBML	-0.081079	0.1345
	$CBML_{t-1}$	0.044001	0.4162

Note: a) Adjusted R-squared: 0.006602; F-statistic: 2.349; p-value: 0.09675; (b) Adjusted R-squared: 0.0007322; F-statistic: 1.149; p-value: 0.3181; Significance codes: '***' < 0.001; '**' < 0.01; '*' < 0.05

Table 3. The analysis is performed post-pandemic crisis

pandemic crisis, therefore, the Bitcoin liquidity cost is not priced in its returns during the same trading session.

Post-pandemic crisis, the study also investigates the relationship between the liquidity cost imposed by the liquidity supplier on day $t-1$ against accepting the inventory and the return on day t at the time of inventory redemption. Table 3 reports, that the Bitcoin return of day t is positive and significantly explained by the effective spread of day $t-1$. This implies, that the liquidity cost imposed by the investor on day $t-1$ is relevant to determine the Bitcoin yield in the following trading session. Post-pandemic crisis, thus, the Bitcoin liquidity cost of day $t-1$ is priced in its return of day t. Conversely, the Bitcoin returns are also positively related to its liquidity cost of day $t-1$, estimated by the CBML model. Nevertheless, the relationship is not statistically significant. Since the adopted spread proxies are based on distinct analytical assumptions, the spread measures are expected to impact the analysis.

5 Conclusions

In the cryptocurrency market, this study examines the effects of liquidity cost on yields pre- and post-pandemic uncertainty. Using distinct measures of the liquidity cost, the study is based on the Bitcoin. If the same trading session was analyzed pre-pandemic crisis, the Bitcoin returns were positive and significantly explained by its liquidity cost. Pre-pandemic uncertainty, the Bitcoin liquidity cost was found to be priced in its returns during the same trading day. When the following trading session was examined pre-pandemic crisis, the liquidity cost imposed by the investor on day $t-1$ was not priced in return of day t during the Bitcoin redemption.

Post-pandemic uncertainty, the results were changed. With regard to the same trading session, the Bitcoin returns were negative and insignificantly associated with the liquidity cost. Thereby, the liquidity cost was not priced in the Bitcoin returns during the same trading session. If the following trading session was studied in the cryptocurrency market, the return of day t was positive and significantly explained by the effective spread of day $t - 1$. Post-pandemic crisis, the liquidity cost imposed by the investor on day $t - 1$ was found to be priced in the return of day t at the time of Bitcoin redemption.

Since huge price fluctuations are reported in the Bitcoin market, this study helps to understand the market liquidity risk associated with the Bitcoin trading. Following the study results, the Bitcoin holders can better manage the market liquidity and its associated cost at the time of Bitcoin trading. Although various cryptocurrencies are operating in the market, this study cannot be generalized in the market for cryptocurrencies. The findings encourage other researchers to study the relationship between various cryptocurrencies' liquidity cost and their yields during the pandemic uncertainty.

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