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Working Paper

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Suggested Citation: Lee, Hanol; Wie, Dainn (2022) : Gone with the fire: Market reaction to cryptocurrency exchange shutdown, ZBW - Leibniz Information Centre for Economics, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/266545>

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Gone with the fire: Market reaction to cryptocurrency exchange shutdown

Hanol Lee[†], Dainn Wie^{*}

Abstract

Disruption of exchanges frequently happens in the cryptocurrency market, though their potential impacts are relatively under-investigated. This study employs a 20-hour service interruption on October 15th, 2022, at *Upbit*, the dominant cryptocurrency exchange in Korea, as an exogenous shock of service interruption on the cryptocurrency market. Event study estimation shows that the change in abnormal returns depends on how important the specific exchange is to those cryptocurrencies. Cryptocurrencies predominantly traded on *Upbit* showed sharp reactions to both service disruption and recovery, while major currencies such as Bitcoin and Ethereum presented limited reactions to service interruption only.

JEL Codes: G12, G14, G15, G23

Keywords: Cryptocurrency; abnormal return; Event study; Network service disruption.

Declaration of interest The authors declare no conflict of interest.

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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1. Introduction

During October 15th – 16th 2022, a fire at the main data center of *KakaoTalk*, the most popular messenger application in Korea, caused service disruption for *Upbit*, the dominant cryptocurrency exchange in Korea.¹ As *Upbit* users who use Android based smartphones could only access the service via *KakaoTalk* authentication, a majority of users were unable to trade during the 20-hours of *KakaoTalk*'s service disruption.²

Disruption and shutdown of exchanges are frequent occurrences in the cryptocurrency market (Feder et al., 2018; Moore et al., 2018). These service interruptions mainly arise from scheduled or unscheduled maintenance, unexpected excess network traffic, or cyberattacks. Despite their regularity, the causal impact of these interruptions on the cryptocurrency market is relatively unknown due to several empirical challenges. Most maintenance periods are pre-announced, allowing traders to respond to the platform outages in advance, reducing the impact. Service interruptions are often endogenous, driven by the cryptocurrency market's circumstances. Huge trade volume often causes network failure, which makes it difficult to estimate the impact of service interruptions separately from prior price movements and general market volatility. Government regulation and similar scale events can also significantly reduce the valuation of cryptocurrency (Okorie & Lin, 2020) making it difficult to isolate the impact of service interruptions specifically.

In this study, we overcome these estimation challenges by utilizing the unique service interruption caused by an unexpected fire at the data center of the messenger service application

¹ In 2022, *Upbit*'s market share in Korea is around 78.3%.

<https://cointelegraph.com/news/korean-crypto-exchanges-are-now-in-compliance-with-the-travel-rule>

² Apple device users could access the service through Apple identification. However, PC and Android based smartphone users needed to receive a verification code via *KakaoTalk* to access *Upbit*, which was impossible during the 20-hours of disruption. As of September 2022, the share of PC and Android users in Korea is 74.64%.

<https://gs.statcounter.com/os-market-share/all/south-korea>

KakaoTalk in South Korea on October 15th, 2022. The fire led to major interruption of *KakaoTalk*'s service, which people use for daily communication, taxi reservation, and shopping. As the event happened on a Saturday, it is unlikely that *KakaoTalk*'s service suspension had any impact on the market through disruptions in the real economy. Cryptocurrency traders are likely to be familiar with various information and communication technology platforms. It is unlikely therefore, that general communication among cryptocurrency traders was significantly affected by the *KakaoTalk* disruption. However, a substantial proportion of cryptocurrency market users could only log on to *Upbit* via *KakaoTalk*, leaving them unable to trade during this time.

Previous studies provide some evidence of the market impact of cryptocurrency exchange regulation. Chen and Liu (2022) showed the trading ban in China had almost no impact on Chinese investors' Bitcoin purchasing, while Okorie and Lin (2020) reported significant market reactions to the Chinese government's intervention on ICOs (Initial Coin Offerings). However, there has been little analysis of the impact of cryptocurrency exchange shutdowns or security breaches, even though such incidents have been well documented (Feder et al., 2018; Moore et al., 2018).

This study contributes to the literature by providing empirical evidence of the market impact of service interruption at *Upbit*, one of the world's most active cryptocurrency exchanges³. We examine abnormal returns on affected cryptocurrencies at the world's largest cryptocurrency exchange, *Binance*. Using event study methodology, we report the heterogeneous reactions of major global cryptocurrencies and *Upbit*-dominant cryptocurrencies.

The rest of paper is organized as follows. Section 2 provides a detailed description of

³ According to the *CoinMarketCap*, *Upbit* was ranked 23rd in the world in terms of cryptocurrency exchanges by value of trade as of November 6th, 2022.

the *KakaoTalk* service interruption, and other market impacting events around this time. Section 3 presents data and methodology. Section 4 presents results and our interpretation. Section 5 contains our conclusions.

2. KakaoTalk Crashes on October 15, 2022

On October 15th, 2022, *KakaoTalk*, the most commonly used mobile communication application in South Korea, and the platform required to authorize login to many other affiliated services crashed. Since its launch in 2010, *KakaoTalk* has been the leading communication platform in South Korea, recording 47 million active users there by the end of 2021 (Jobst, 2022). To put this figure in perspective, the total population of South Korea is around 52 million.

An unexpected fire started at its major data center at around 3:19 p.m. Korea Standard Time (KST). As a result, the power supply had to be suspended, causing service interruption in the *KakaoTalk* application, and preventing authentication for all affiliated services. Access to *Upbit*, a major cryptocurrency exchange in South Korea, was also interrupted because Android users⁴ could only access *Upbit* through *KakaoTalk* authorization. *Upbit* announced service interruption at around 3:46 p.m. through its customer center. However, no alternative means of service access was provided to its Android users.

Services were gradually restored on the morning of October 16th. Authentication services operating through *KakaoTalk* were fully enabled at around 11:00 a.m. At around 11:05 a.m. *Upbit* announced the recovery of authentication services, noting that other services including consultation and mobile payment would resume shortly.

Upbit's trade volume during the 20 hours of service interruption (from 3 p.m., October

⁴ According to *statcounter*, Android has more than 65% of the market share of mobile operating systems. <https://gs.statcounter.com/os-market-share/mobile/south-korea>

15th to 11 a.m., October 16th) was around 61 million, a massive 94% decrease from the 960 million trades that took place over the same period the previous day. Trade volume during the same period the following day recovered slightly to 113 million. This decline in trade volume is extreme, even after considering the day of the week effect⁵.

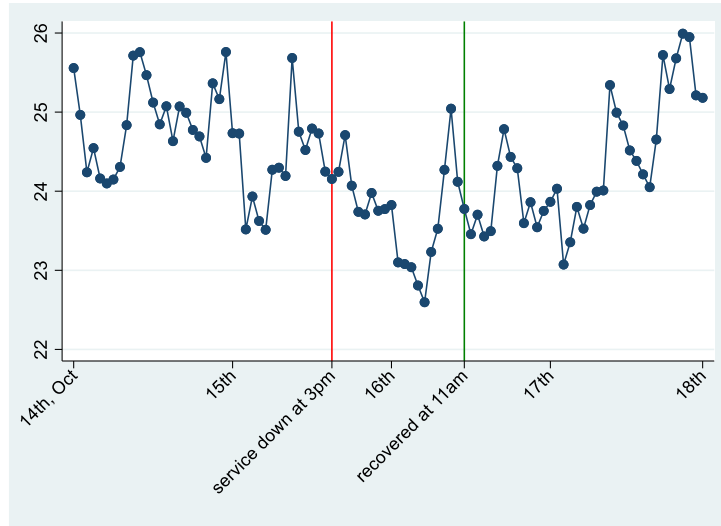


Fig. 1 Log of total traded value on *Upbit* from October 14th to October 17th 2022

In Fig. 1, we present the movement of total traded value in its logarithms around the service interruption on October 15th. The graphs clearly highlight the sharp decline in total traded value during and after the service interruption. The value of total trading began to recover gradually from early morning onward on Monday October 17th.

3. Data and Methodology

On *Upbit*, 114 cryptocurrencies are traded in Korean Won. An hour before the service interruption on October 15th, the top 16 cryptocurrencies accounted for 80% of the value of

⁵ As October 15 was a Saturday, the effect from the day of the week cannot be ruled out. So, we examined the same statistics using the previous week's data. For 20 hours from Oct 7 to Oct 8, the trade volume was around 723 million. It declined to 354 million on Oct 8, and further decreased to 160 million the next day.

the total amount traded on *Upbit*. They were WEMIX, BORA, Ripple, STEP, Bitcoin, Ethereum Classic, Ethereum, PlayDapp, Hehera, Cardano, JUST, TRON, Stratis, The Sandbox, Status, and Chiliz.

To disentangle the effects of service interruption on the abnormal returns on cryptocurrencies traded on *Upbit* from the impact of reduced trade volume, we chose to examine the 13⁶ of these 16 cryptocurrencies which were also being traded on *Binance*, the largest cryptocurrency exchange in the world. Price data was collected from Tradingview.com at every four-hour interval from 7:00 a.m. October 3rd to 3:00 p.m. October 20th.

To calculate the abnormal returns, we estimated the following equation for each cryptocurrency i :

$$R_{it} = \beta_0 + \beta_1 R_t^M + \varepsilon_{it}, \quad (1)$$

where R_{it} is log returns of cryptocurrency i at four-hour interval t . R_t^M is log market returns at time t calculated using one of the major market indices, the ‘Top 10 crypto index’ made by *Eightcap*. Log returns are employed to account for skewness and kurtosis in the financial data (Brown & Warner, 1985).

It should be noted that major economic news emerged at 9:30 p.m. KST on October 14th with the release of the consumer price index (CPI) of the United States⁷. This news, which is closely tied to the interest rate decision of the Federal Reserve shook various stock markets and cryptocurrencies. Therefore, we chose the estimation window for β_1 to be from 7:00 a.m. October 3rd to 7:00 a.m. October 10th, thereby excluding the week of the CPI release.

Once we estimated Equation (1), the abnormal return AR_{it} was calculated as the

⁶ Of these 16 cryptocurrencies, WEMIX, BORA, and Status were excluded as they are not listed on *Binance*.

⁷ The news was released at 8:30 a.m. October 14th EST (Eastern Standard Time).

difference between the predicted return and actual return as Equation (2):

$$AR_{it} = R_{it} - (\widehat{\beta}_0 - \widehat{\beta}_1 R_t^M). \quad (2)$$

The study employs event study methodology to examine the dynamic impacts of the service interruption on October 15th and service resume on October 16th, on abnormal return of those thirteen cryptocurrencies as well as prior trends on October 14th. The sample period in this estimation is from October 3rd 7:00 am to October 20th, 3pm. Then, we estimated the following specification:

$$AR_{it} = \alpha + \sum_{j=-8}^{j=-1} \gamma_j (Pre_j)_t + \sum_{j=0}^{j=4} \delta_j (D_j)_t + \sum_{j=5}^{j=11} \varphi_j (R_j)_t + C_i + dow_t + \varepsilon_{it}, \quad (3)$$

where D_j is an indicator for each four-hour interval during the service disruption. For instance, $j = 0$ denotes the first four hours of service disruption from 3 p.m. to 7 p.m. on October 15th. The set of coefficients δ_j capture the evolution of the impacts of the service disruption over the 20 hours. Similarly, R_j is a binary indicator for each four-hour interval after the service restoration at 11 a.m. on October 16th, except for R_{11} which indicates the remaining period after 11 a.m. October 17th. The market reaction to service restoration is reflected by the seven coefficients φ_j . The eight indicators denoted as Pre_j cover the 32-hour period from 7 a.m. October 14th to 3 p.m. October 15th, and its coefficient mainly captures the movement in the market attributable to the CPI release. According to the specification, each coefficient in Equation (3) captures the difference in the abnormal returns compared to the baseline period not controlled in the model; that is from 7 a.m. October 3rd to 7 a.m. October 14th. Fixed effects for each cryptocurrency, C_i , and day of the week fixed effects dow_t are all controlled to further each currency's unobserved characteristics and trends of abnormal returns, depending on the trade volume across the day of the week. Error terms are clustered within each 4-hour interval to address autocorrelation within the cluster.

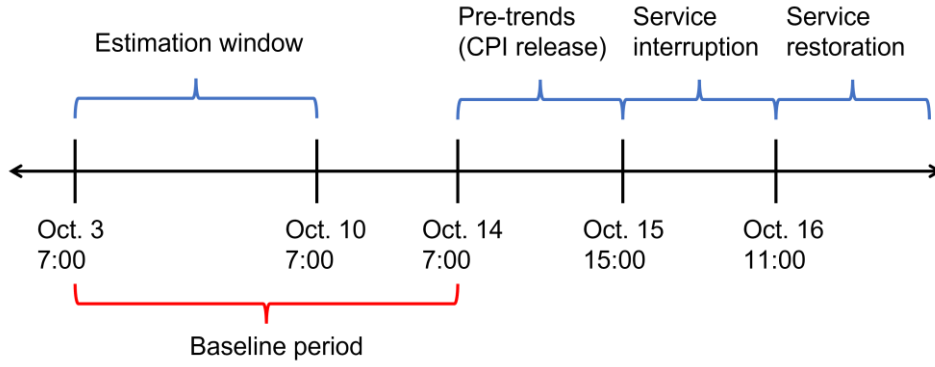


Fig. 2 Event timeline

4. Results

We estimated Equation (3) and present all the estimated coefficients and confidence intervals in Fig. 3. Abnormal returns started to plunge after the CPI release, reflecting how unexpected this news was to the market. The dip stopped when the US stock market closed at 5 a.m. KST on October 15th.

The abnormal returns on all 13 cryptocurrencies again declined sharply when service interruption began at 3 p.m. on October 15th. The magnitude of the decline was close to that generated by the CPI release, implying a huge reaction among cryptocurrency traders to the service interruption. A sharp increase in abnormal returns was again observed when *KakaoTalk* service partially resumed in the early morning of October 16th. The market even reacted before the official announcement from *KakaoTalk* and *Upbit*, when the authentication service was beginning to resume. The full resumption of the service did not prompt significant movement in abnormal returns.

We also tested the size and statistical significance of cumulative effects over several time windows. Table 1. illustrates that the considerably negative impact of the service interruption dissipated over time, becoming statistically insignificant even before service resumption.

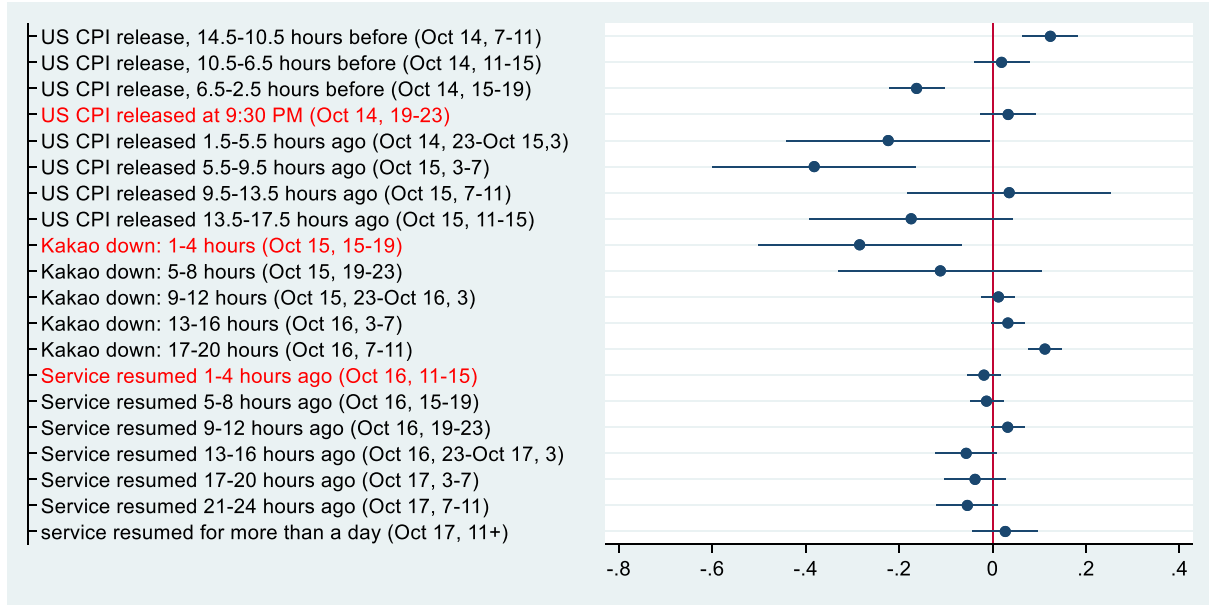


Fig. 3 Event Study Results: Abnormal Returns on 13 *Upbit*-dominant Cryptocurrencies on *Binance*

Table 1 Cumulative effects over period: 13 *Upbit* Coins on *Binance*

(1)		(2)		(3)	
Pre-event		Event: <i>Kakao</i> Down		Post-event	
14th, 7 p.m.	-0.190*	15th, 3-11 p.m.	-0.396*	16th, 11 a.m.	0.031
– 15th, 3 a.m.	(0.114)		(0.220)	– 7 p.m.	(0.036)
14th, 7 p.m.	-0.571**	15th, 3 p.m.	-0.383*	16th, 11 a.m.	0.001
– 15th, 7 a.m.	(0.222)	–16th, 3 a.m.	(0.221)	– 11 p.m.	(0.054)
14th, 7 p.m.	-0.536	15th, 3 p.m.	-0.350	16th, 11 a.m.	-0.055
– 15th, 11 a.m.	(0.331)	–16th, 7 a.m.	(0.223)	–17th, 3 a.m.	(0.063)
14th, 7 p.m.	-0.710	15th, 3 p.m.	-0.238	16th, 11 a.m.	-0.092
– 15th, 3 p.m.	(0.441)	– 16th, 11 a.m.	(0.226)	– 17th, 7 a.m.	(0.086)
				16th, 11 a.m.	-0.146
				–17th, 11 a.m.	(0.114)
				16th, 11 a.m.	-0.119
				– 20th, 3 p.m.	(0.128)

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively.

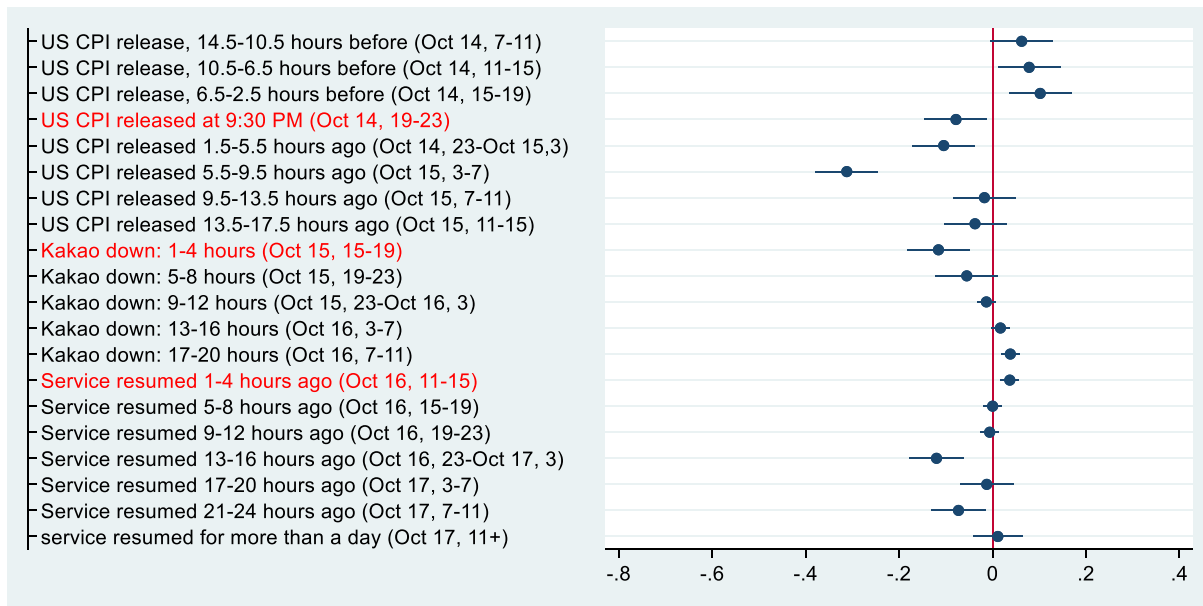


Fig. 4 Event study results: Abnormal Returns on Five Worldwide Major Cryptocurrencies Dominant on Both *Upbit* and *Binance*

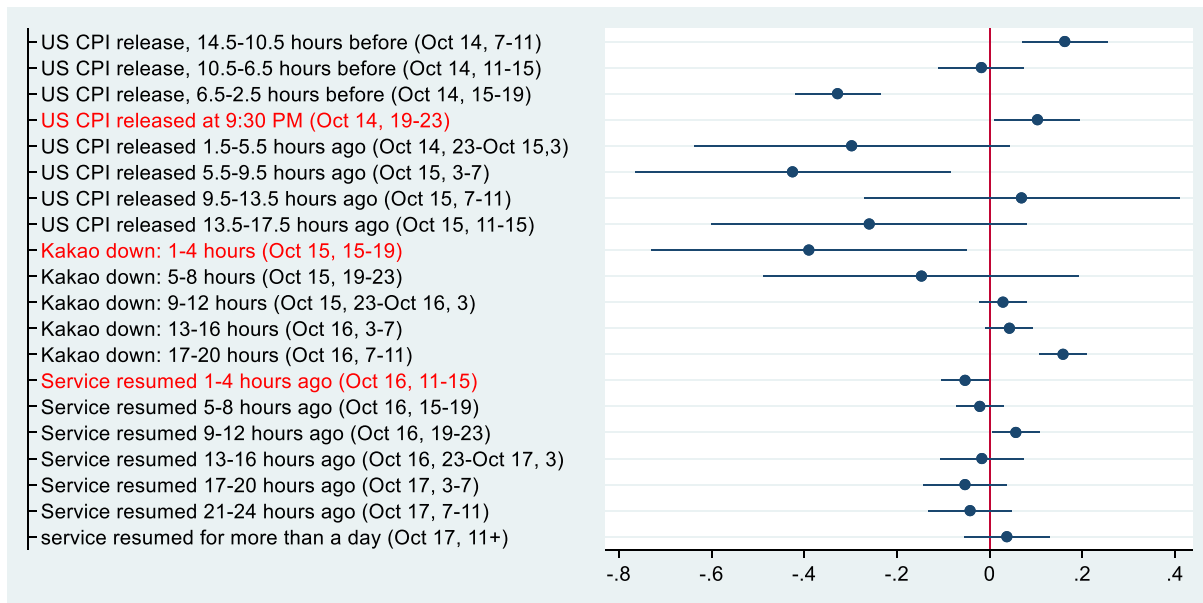


Fig. 5 Event study results: Abnormal Returns on Eight *Upbit*-dominant Cryptocurrencies on *Binance* Excluding Five Worldwide Major Cryptocurrencies

Table 2 Cumulative effects over period: Five Worldwide Major Cryptocurrencies Dominant on Both *Upbit* and *Binance*

(1)		(2)		(3)	
Pre-event		Event: <i>Kakao</i> Down		Post-event	
14th, 7 p.m.	-0.183***	15th, 3	-0.171**	16th, 11 a.m.	0.037*
– 15th, 3 a.m.	(0.048)	– 11 p.m.	(0.067)	– 7 p.m.	(0.020)
14th, 7 p.m.	-0.495***	15th, 3 p.m.	-0.184***	16th, 11 a.m.	0.031
– 15th, 7 a.m.	(0.075)	– 16th, 3 a.m.	(0.068)	– 11 p.m.	(0.030)
14th, 7 p.m.	-0.512***	15th, 3 p.m.	-0.167**	16th, 11 a.m.	-0.089**
– 15th, 11 a.m.	(0.106)	– 16th, 7 a.m.	(0.070)	– 17th, 3 a.m.	(0.042)
14th, 7 p.m.	-0.550***	15th, 3 p.m.	-0.129*	16th, 11 a.m.	-0.101
– 15th, 3 p.m.	(0.139)	– 16th, 11 a.m.	(0.074)	– 17th, 7 a.m.	(0.066)
				16th, 11 a.m.	-0.174*
				– 17th, 11 a.m.	(0.092)
				16th, 11 a.m.	-0.163
				– 20th, 3 p.m.	(0.103)

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively. These five major cryptocurrencies are Bitcoin, Ethereum, Ethereum Classic, Ripple, and Cardano.

Table 3 Cumulative effects over period: Abnormal Return of Eight *Upbit*-dominant Cryptocurrencies on *Binance* Excluding Five Worldwide Major Cryptocurrencies

(1)		(2)		(3)	
Pre-event		Event: <i>Kakao</i> Down		Post-event	
14th, 7 p.m.	-0.194	15th, 3	-0.537	16th, 11 a.m.	-0.074
– 15th, 3 a.m.	(0.178)	– 11 p.m.	(0.344)	– 7 p.m.	(0.051)
14th, 7 p.m.	-0.619*	15th, 3 p.m.	-0.508	16th, 11 a.m.	-0.017
– 15th, 7 a.m.	(0.347)	– 16th, 3 a.m.	(0.345)	– 11 p.m.	(0.077)
14th, 7 p.m.	-0.551	15th, 3 p.m.	-0.465	16th, 11 a.m.	-0.034
– 15th, 11 a.m.	(0.517)	– 16th, 7 a.m.	(0.347)	– 17th, 3 a.m.	(0.089)
14th, 7 p.m.	-0.810	15th, 3 p.m.	-0.307	16th, 11 a.m.	-0.087
– 15th, 3 p.m.	(0.689)	– 16th, 11 a.m.	(0.352)	– 17th, 7 a.m.	(0.119)
				16th, 11 a.m.	-0.129
				– 17th, 11 a.m.	(0.156)
				16th, 11 a.m.	-0.092
				– 20th, 3 p.m.	(0.174)

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively. These *Upbit*-dominant cryptocurrencies are STEPn, PlayDapp, Hehera, JUST, TRON, Stratis, The Sandbox, and Chiliz.

In Fig. 4 and 5, we divide 13 cryptocurrencies into two groups and present a comparison of movement on abnormal returns around the news. Fig. 4 shows that five major cryptocurrencies; Bitcoin, Ethereum, Ethereum Classic, Ripple, and Cardano responded more to the CPI release than the disruption at *Upbit*. Fig. 4 highlights an immediate and sharp decline in abnormal returns after the CPI release. These major cryptocurrencies also reacted to the service interruption at *Upbit*, though the reaction was much smaller, and showed no reaction to the prospect of service resumption at *Upbit* or the actual restoration of service, maintaining negative cumulative returns during the service interruption, as shown in Table 2.

In Fig. 5, we present how eight *Upbit*-dominant cryptocurrencies⁸ reacted to the CPI release, service interruption, and restoration. These cryptocurrencies exhibited larger negative abnormal returns in response to the service interruption on October 15th, with the magnitude of the change similar to that generated by the CPI release, demonstrating how important the service interruption was for these cryptocurrencies. There was also a significant bounce in abnormal returns when *KakaoTalk*'s restoration partially began. The findings reported in this study were shown to be robust⁹ when we performed price data comparison of these cryptocurrencies from other exchanges.

5. Conclusion

This study demonstrates that the magnitude of the cryptocurrency market's reaction to service interruption depends on how important this exchange is to those cryptocurrencies. We also provide suggestive evidence that even major cryptocurrencies react to a service interruption at the one of the exchanges though the impact of wider market-based news on these major

⁸ The share of their trade volume on *Upbit* relative to global trade volume is presented in Appendix Table A1 showing their considerable reliance on *Upbit* as a trade platform.

⁹ The replication data using alternative price information from exchanges such as *Upbit* and *OKX* can be provided upon request.

currencies cannot be ruled out. This study suggests that the stability of cryptocurrency exchange is crucial for the growth and profitability of the cryptocurrency market. We believe that our study makes a significant contribution to the literature, by examining risk in cryptocurrency exchange, a critical factor affecting cryptocurrencies' price movements.

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Appendix

Appendix Table A1 *Upbit*-dominant Cryptocurrencies' share of total trade value on *Upbit*
(as of October 14, 2022 in UTC)

	Traded value (\$)		Share of <i>Upbit</i>
	World	<i>Upbit</i>	
STEPN	116,890,054	8,155,716	7.0%
PlayDapp	10,960,545	7,688,387	70.1%
Hehera	62,350,939	16,408,646	26.3%
JUST	118,629,347	27,920,555	23.5%
TRON	698,236,582	18,478,575	2.6%
Stratis	69,972,143	60,657,075	86.7%
The Sandbox	135,023,303	11,595,979	8.6%
Chiliz	214,999,289	18,204,444	8.5%

Notes: Traded value of World and *Upbit* are from *Coinmarketcap* and *Tradingview*, respectively.