

How Cryptocurrency Exchange Interruptions Create Arbitrage Opportunities

DECISION: accept

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Summary of Reviews

- Review 1: 1 (3)
- Review 2: 1 (3)
- Review 3: 1 (2)

Reviews

Review 1

TOTAL SCORE: 1 (weak accept)

Overall evaluation: 1 (weak accept)

Reviewer's confidence: 3 (medium)

This paper studies the impact of interruptions to cryptocurrency exchanges on trading. The authors consider 40 interruption events for the Bitfinex exchange, of which 12 are DDoS attacks and the remainder are delays or service outages due to other causes. Market manipulation to enable arbitrage is considered as one possible explanation for DDoS attacks on exchanges.

The authors examine Bitfinex pricing during and around interruption events to identify when the price differential from Bitfinex to CoinMarketCap exceeds the arbitrage band, making arbitrage profitable. In non-event periods, five-minute periods where arbitrage is possible appear slightly less than 50% of the time. During interruption event periods, these arbitrage periods appear close to 70% of the time, a significant difference. Arbitrage opportunities during DDoS and delay interruptions are also extended. The authors calculate the sum of possible profit during interruptions as being large, though do not establish that this arbitrage actually occurs, and there are some reasons (e.g., large principal risk) to doubt that the total possible gains would be realised.

The authors are not able to clearly demonstrate the nature of a relationship between attacks on exchanges and arbitrage. There are many questions remaining here: do attackers wait for arbitrage conditions to arise and then expand those periods for profit? Or do traders look for interruptions due to any cause and seize on the opportunity for arbitrage? Some combination of these, and perhaps also more innocent explanations, could be at play here. The relatively small number of definitely-malicious events (just 12 in 6 years) limits the conclusions that can be drawn. Nonetheless, the data the authors present is suggestive and worthy of further discussion.

Minor notes:

- The caption to Figure 2 refers to what I would describe as an orange line as being red.
- Regarding Table II and the associated discussion, the authors should clarify that the non-event comparison data underlying Table II is the complete dataset from 2015-2022, and not just the 6-hour windows surrounding events that were mentioned earlier in this section (I was initially confused about the figures presented).
- Typo, pg. 5, Fig. 6 caption "blue dahsed"
- Typo, pg. 6 "ripe for criminally exploitation" -> "ripe for criminal exploitation".

Review 2

TOTAL SCORE: 1 (weak accept)

Overall evaluation: 1 (weak accept)

Reviewer's confidence: 3 (medium)

I think this paper presents a relevant and timely topic for the workshop. The paper is well written, although in some parts it probably tries to be a little bit too dramatic (moving the language away from what someone could expect on a scientific paper). As an example, statements such as "produces as many problems as it solves" are probably too valorative and are giving away conclusions before performing a more rigorous analysis.

Some questions I have:

- Why do you multiply the initial arbitrage band calculation by 2 and let's say, not 3? Is this part of the risk appetite defined when aiming for an arbitrage opportunity? Was this defined with experiments? More details on why 2 was selected could be helpful, if not it looks like you simply want to be extra safe.
- When you specify missing data, do you refer to the data offered by the exchange in the 5 min interval?
- I am curious about how the start of an event is defined. It may be the case that the issue that is triggering the event is already happening, but Bitfinex takes some time to detect it and then announce the event is happening. This would make the differences shown in Figure 5 before the event more normal.
- I am not sure the potential profit is calculated correctly. I understand that would be the theoretical maximum profit available. Still, without knowing too much about economics, I can expect that if someone tries to gain much profit very early on (to maximise it), the window will probably close sooner than if you try to take advantage of the arbitrage opportunity without optimising profit that much (the market will react sooner).

Overall, I like how the paper is presented, and the topic seems quite relevant. My main worry concerns the economics and market modelling that may be needed to properly understand some of these phenomena. This may result in a calculation of the theoretical profits that are far from the actual possible profits (as the market would react differently to different operations).

Review 3

TOTAL SCORE: 1 (weak accept)

Overall evaluation: 1 (weak accept)

Reviewer's confidence: 2 (low)

This paper addresses a defined topic, which is of interest, and is well written. The authors seem engaged and knowledgeable about the topic, and the nature of the data collection. They are clear on what they are trying to achieve. Overall, it is a useful contribution and should probably be published.

There are some points for improvement:

- 1) There is a cybercrime connection to the subject matter, but perhaps the connection to WACCO could be played up (and more explicitly stated).
- 2) There are a number of aspects of the introduction which could be improved:
 - a) For when there is an interruption, can it be explained more within the introduction why some can still trade?
 - b) Section II is not mentioned in the introductory outline of sections, and should be.
 - c) The core of the paper's contribution could be made more obvious. Is it simply that no one has studied arbitrage and exchange interruptions on Bitfinex or a similar market? If so, this could be more clearly stated. The overall point of the paper could be sharpened, with some kind of short summary in the introduction to help guide the reader.
- 3) There are quite a lot of figures. Perhaps a smaller more focussed selection of figures might be appropriate.