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Are Blockchain Limitations Stifling Arbitrage Opportunities? Part 1



Are Blockchain Limitations Stifling Arbitrage Opportunities?

Cryptocurrency exchanges have grown exponentially since 2017, catering to retail, institutional, and an ever-growing crowd of sophisticated calibre traders who have set up high-frequency algorithmic strategies. Notably, in the past few years, spot exchanges have taken markets by storm, adding leveraged derivatives to their suite of trading products. Derivative products have given traders an array of markets from futures and options to better hedge and access market discrepancies for profits across multiple exchanges. But global exchange growth sharing liquidity comes at a fixed cost of parking capital across numerous venues to take advantage of arbitrage opportunities. This is primarily due to blockchain transfer times that will remain slow for the foreseeable future. In this latest in-depth feature, Copper weaves together the potential effects and missed opportunities resulting from slow blockchain transfer speeds.

Blockchain transfer speeds, especially for Bitcoin, have been an inherently slow process compared to traditional technological infrastructure. This design feature of the Bitcoin blockchain has resulted in massive waiting times and potentially exorbitant fees to protect the network from attacks as blocks fill to the brim during times of extreme price action seen quite often.

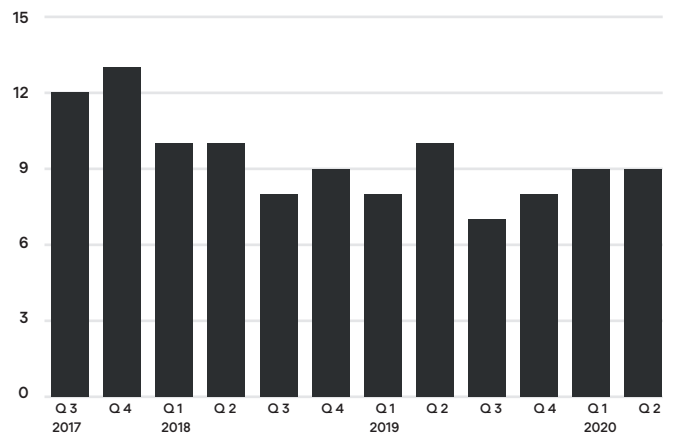
With median transaction confirmation times ranging between 4 and over 19 minutes in 2020, an important question lingers for market participants; how efficient can arbitrage traders be in times of increased activity and volatility?

Importantly, blockchain confirmation times don't account for the trading venue's own number of confirmations required for traders to have access to their assets and capital. Due to blockchain speed and security, such required policies suppress the potential of speedy trades and, in effect, hamper market liquidity at the time it's most clearly needed from both buyer and seller.

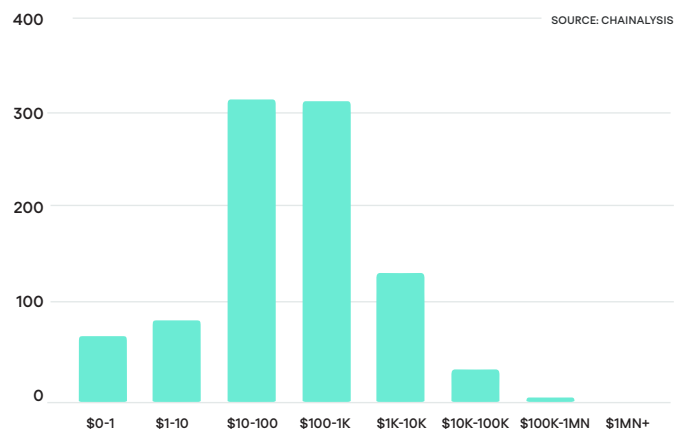
With such waiting times for Bitcoin to reach an intended exchange where algorithms may have spotted market inefficiencies, arbitrage opportunities decline unless capital has been parked across multiple trading venues in order to take advantage.

Holding assets on an exchange is an optional tactic that can be employed by High-Frequency Traders as the volatile asset whose fervent price swings have become the expected norm. The alternative would be to miss the window of opportunity that

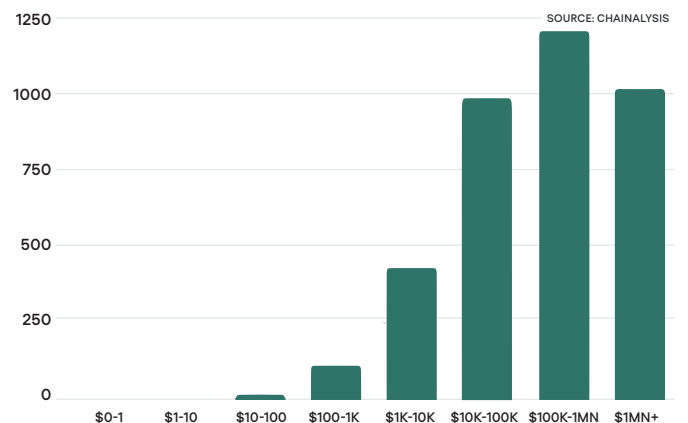
1: Bitcoin Median Transaction Times (Minutes)



2: Weekly Avg. Number of Exchange Transfers Received by Size of Transfer ('000)



3: Weekly Avg. USD Exchange Flows Received by Size of Transfer (\$mn)





might close due to slow transfer speeds or other traders who let their assets sit on an exchange ready at a seconds notice.

Parking assets and capital are increasingly looking like the norm too. Blockchain analytics firm Chainalysis estimates that 60% of Bitcoins (that are not assumed to be lost) are held by a Virtual Asset Service Provider (VASP) (see chart 4). This trend is growing.

Chainalysis has also established that only 3.5million Bitcoins are being used for active trading. That accounts for less than 20% of all mined Bitcoins. Notably, while retail traders account for a whopping 96% of all transfers sent to exchanges, these transactions only represent 15% of the total US Dollar value sent on-chain (see charts 2 & 3).

Such data gives insights into professional traders that effectively hold the liquidity and are still required to move in and out of different exchanges to capture potential gains. What they must contend with, however, are slow blockchain times and confirmations. This means fewer arbitrage opportunities as competition increases against traders with already parked assets.

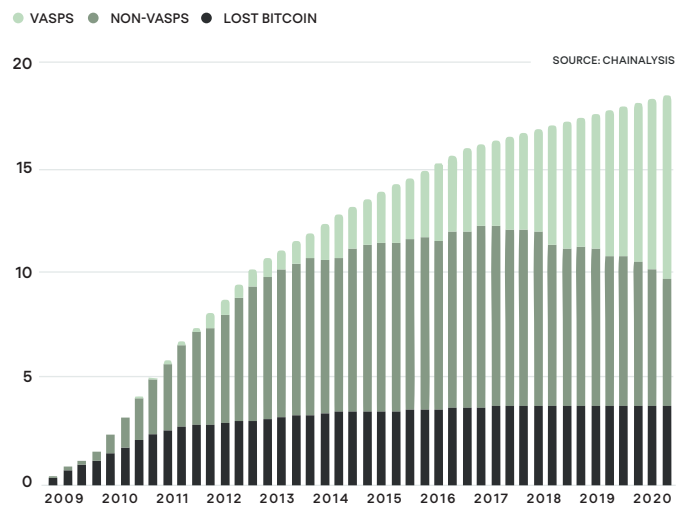
Where are the opportunities?

Research conducted by the University of Vienna concludes that “settlement latency implies limits to arbitrage as it exposes arbitrageurs to price risk.” The assessment coming out of the university’s Department of Statistics and Operations Research concluded that “trustless markets come at substantial costs with potentially far reaching implications” and that “limits to arbitrage implied by settlement latency may harm price efficiency, as the lower activity of arbitrageurs reduces the information flow across markets.”

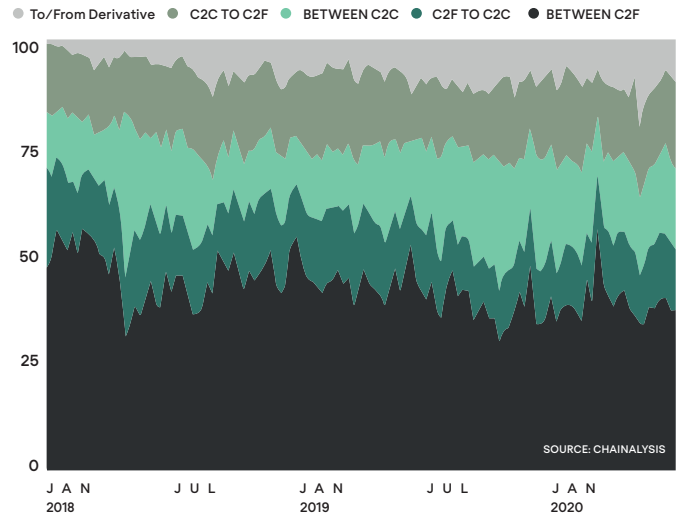
Lead-Lag analysis data shows that most arbitrage opportunities are found in spot exchanges, while derivative markets lead price discovery. This further establishes why on-chain statistics by Chainalysis show that the majority of Bitcoin flows are, to and from spot exchanges (see chart 5). This volume into spot markets comes despite derivative exchange trading volume dwarfing what is seen on predominantly retail and semi-professional exchanges.

While arbitrage opportunities arise, on-chain transfers might not be the best tactic afterall. A study conducted by asset management firm Bitwise shows that markets are fairly efficient in closing arbitrage opportunities quickly. Data shows that the chances to take arbitrage profits across different spot exchanges is an extremely small window, and in most cases gone within seconds (see chart 6). These price movements may happen multiple times during volatile periods, however should assets require to move into the exchange through on-chain routes, the opportunities dwindle fairly quickly.

4: Bitcoins Holdings (By Custodian Type) - Millions

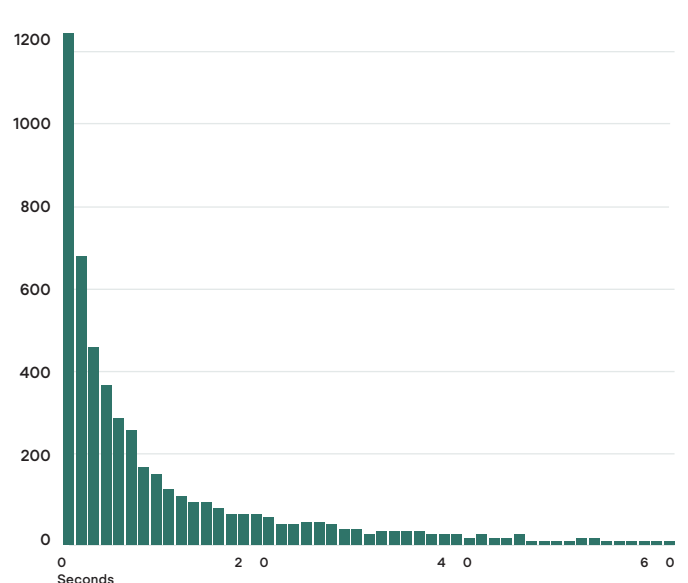


5: Bitcoin Flows Between Types of Exchanges



NOTES: C2C = CRYPTO-TO-CRYPTO EXCHANGE. C2F = CRYPTO-TO-FIAT EXCHANGE.

6: Duration/Number of Occurrences with 1% Deviation from Consolidated BTC Price





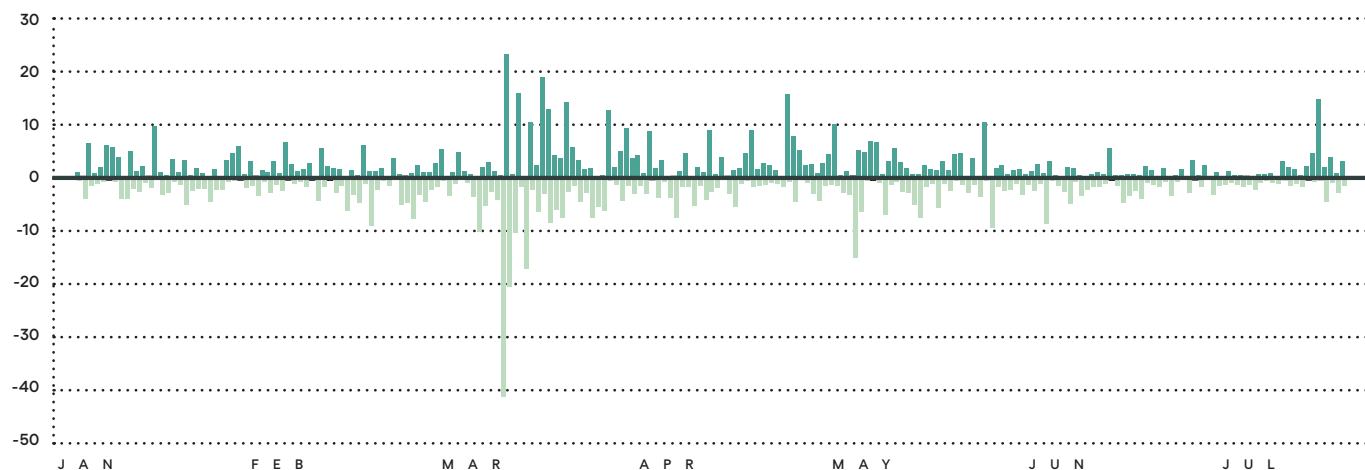
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Are Blockchain Limitations Stifling Arbitrage Opportunities? Part 2



Are Blockchain Limitations Stifling Arbitrage Opportunities?

1: 2020 Bitcoin Daily Percentage Change From Open to High and Open to Low (%)



Recap

In the first part of this series, Copper showed that slow blockchains are still heavily utilised for cross-exchange Bitcoin movement that continue to see massive inflows daily. A Bitcoin transaction from one exchange to another is taking nearly 10 minutes on the average - and that's just blockchain time, not accounting for exchange delay procedures. And the majority of transfers aren't happening from the smaller retail trader, but professional outfits with deep pockets (or what the industry continues to dub as 'whales'). This trend is growing. Part and parcel is the fact that with more exchanges, liquidity is further decentralised and diluted. And with the popularity of derivative products growing, the opportunities range even further for professional traders.

Having completed the on-chain research for this series, Copper, now seeks to provide an even deeper analysis of exchanges looking into price movements and volatility, trading volumes, and order books to best assess the effects of timing on arbitrage opportunities. This latest series looks at how much opportunity, if any, is missed during the 10 minutes it takes to move Bitcoin from one wallet to an exchange.

The surge in the number of cryptocurrency exchanges since mid-2017, just before Bitcoin began stealing global headlines, has led to an onslaught of ingenious product structures. Bitcoin futures, options and market-maker rebates have all become popular methods of attracting liquidity from competing exchanges.

Blockchain analytics firm Chainalysis has previously provided Copper with data, indicating that approximately 4 million Bitcoins sit on exchanges at any given time, with a vast majority circulating from one exchange to the next in a perpetual loop (See Copper Research - Why Bitcoin Fundamentals Are Hard?).

Boom or Bust?

The underpinnings of trading remain the same across spot and derivative markets - Bitcoin needs to be 'physically' traded on the exchange. And cryptocurrency allows users such freedom in a grand style unseen by any other asset class.

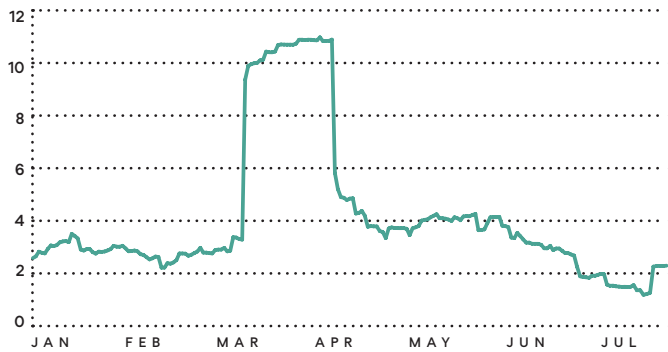
In short, the blockchain feature of speedy transfer and ownership of assets is one that bodes well for traders. But it can act as a double-edged sword for exchanges, which are a few clicks away from losing that liquidity to another exchange.

The blockchain transfer speed of 10 minutes for ultimate final ownership is a unique feature not found in traditional finance.

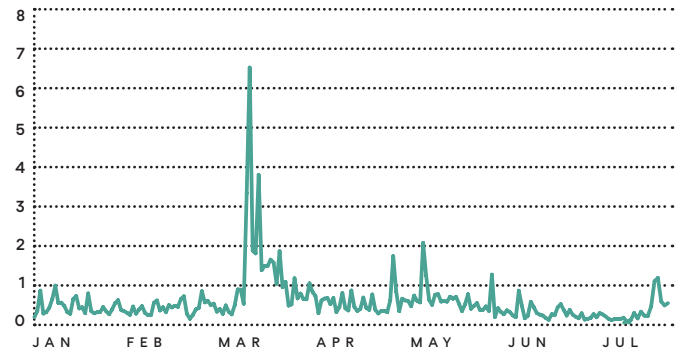
But in the realm of Bitcoin trading, the transfer speed might fall short of groundbreaking when assessed alongside the volatility swings that cryptocurrency is renowned for and traders seek to take advantage of.



2: 2020: Bitcoin 30-Day Rolling Volatility (%)



3: 2020: Bitcoin 8-Hour Rolling Volatility (Daily Average) (%)



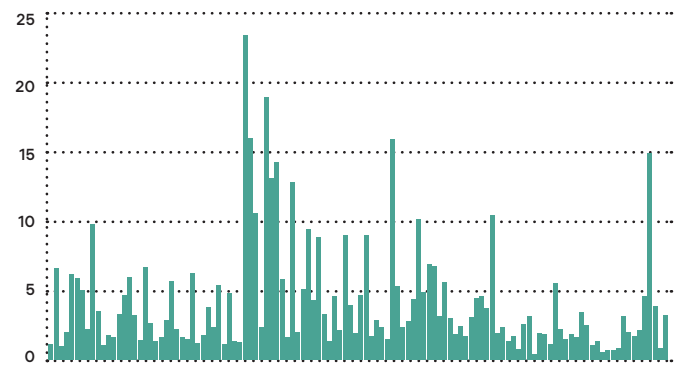
Bitcoin's 30-day rolling volatility had held between 2-4% outside of April and March this year when global markets took a significant turn in both directions fairly sharply (see chart 2). But volatility had hit new lows going well under 2% at the end of July 2020. But that assessment might not be all that meets the eye. Daily swings from Open to High and Open to Close (defined within 24 hours UTC) still show plenty of opportunities.

Up until the end of July, Bitcoin has closed the day higher than it started 55% of this year. The cryptocurrency saw a 4% average uptick on days where the market had bullish sentiment (see chart 4). Most notably, when Bitcoin had positive traction, the price swings can be reasonably significant and enough to persuade traders to begin shifting liquidity to find better bidders across multiple exchanges combined with rebate and leverage tools.

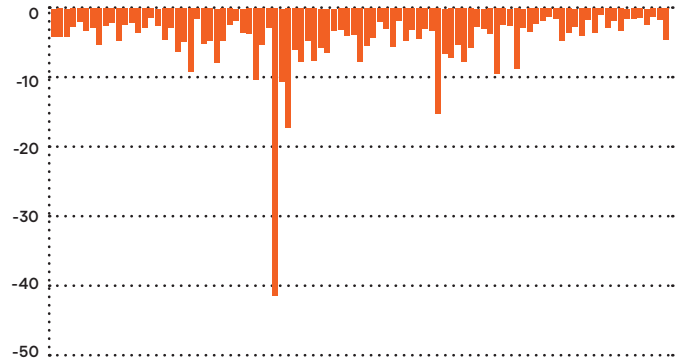
But shorting seems to be amiss in replicating the similar bullish pattern. Bearish sentiment fares evenly across the board, for the most part, on days that Bitcoin closed lower than its opening price (see chart 5). The majority of opportunities remained with percentage changes between 0 and 2% regardless of direction (see charts 6 & 7).

The question that comes to mind is, how long do price movements more significant than the 2% norm last for?

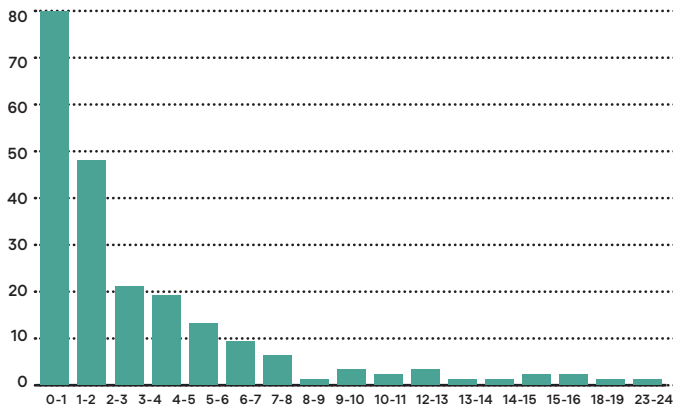
4: Bitcoin % Change to the High on Days that Closed Positive in 2020



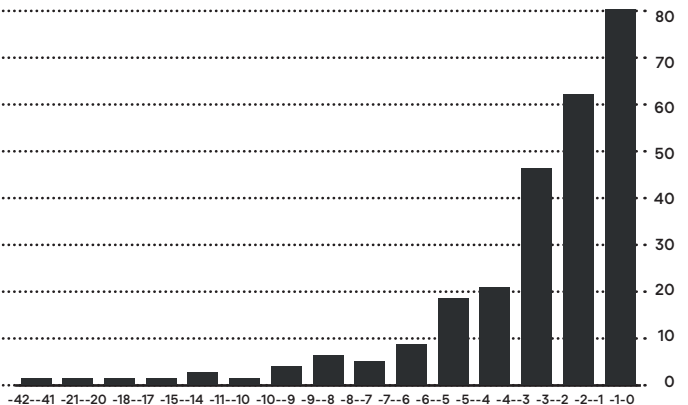
5: Bitcoin % Change to the Low on Days that Closed Negative in 2020



6: # of Days Bitcoin's Price Moved by Percentage Change From Open-High (%)



7: # of Days Bitcoin's Price Moved by Percentage Change From Open-Low (%)





Gone In 10 Minutes

Copper looked at the most vicious days when Bitcoin's price experienced swings even the best of traders would have been concerned about.

In 2020, the majority of volatility, what traders are indeed hungry for, happened during March.

Black Thursday, as it came to be called, saw Bitcoin's price drop from nearly \$8000 to a low as little above the \$4600 mark, with derivative traders suffering massive liquidations along with it. But what should be noted is that Bitcoin's price change does not come in gradually but rapidly and with force.

In fact, looking at price change movements every 10-minutes, a time frame purposefully chosen to account for the minimum time to transfer Bitcoin onto an exchange on a non-congested blockchain shows that the opportunity goes away within this confirmation period the majority of the time.

On Black Thursday, within 20 minutes, Bitcoin's price had plunged over 15% (see chart 8). And such rapid scenarios reemerge the next day when Bitcoin's price rocketed back up over 20% from \$4500 up to \$5750 within a 10-minute timeframe (see chart 10).

Importantly, the total volume captured by market makers and takers is quite small (see charts 9 and 11). The pattern that continuously seems to appear is where liquidity runs dry quickly, and opportunities become less available on **any** exchange.

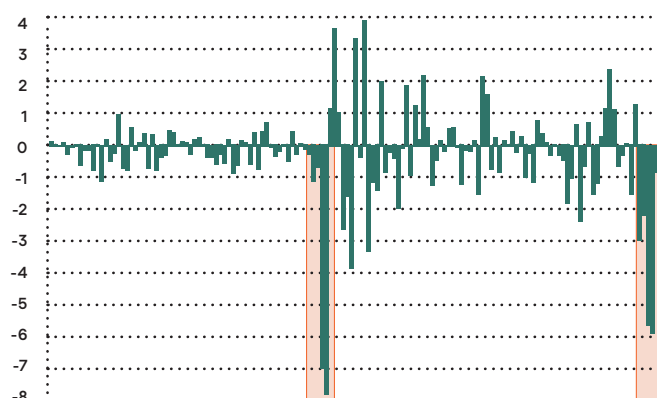
Market Makers Missing Takers

Even during the most volatile days, Bitcoin's significant movements happened within a short period. Anyone who had already parked their assets on the exchange was able to either earn or protect their assets from quick depreciation. And the pattern can be seen across the board on multiple days during high volatility (see charts overleaf).

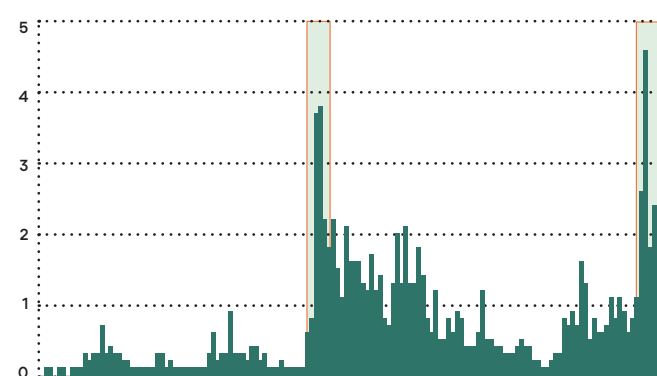
Outside of these massive spikes, Bitcoin continues to trade as usual within its normal bands as if there was no price shock. But what is becoming clear, as far as blockchain transfer speeds are concerned, is that the more significant opportunities in Bitcoin's price movements might be missed waiting for miner confirmations.

In the next series of this report, Copper will dig into the effects of blockchain times on bid-ask spreads and order-books to determine if these conditions make markets run inefficiently.

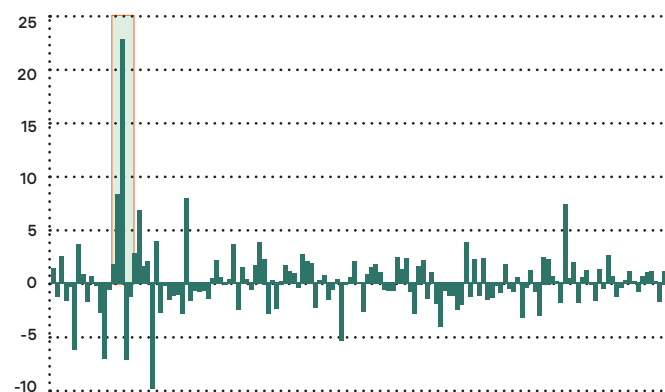
8: 2020-03-12: % Change Open-Close Every 10-Minutes



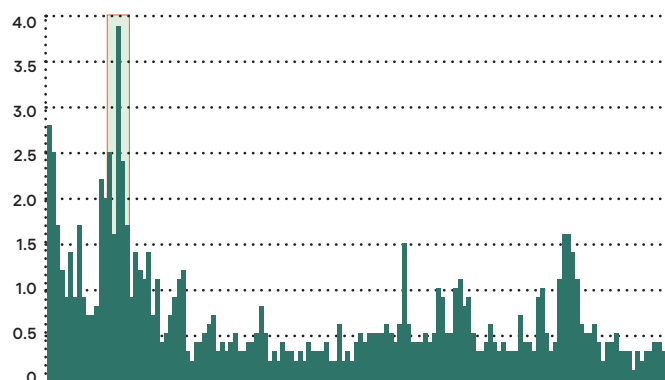
9: 2020-03-12: % Trading Volume Percentage of Day Total Every 10-Minutes



10: 2020-03-13: % Change Open-Close Every 10-Minutes



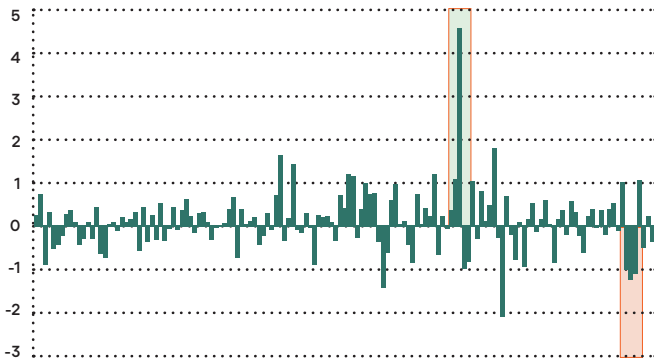
11: 2020-03-13: % Trading Volume Percentage of Day Total Every 10-Minutes



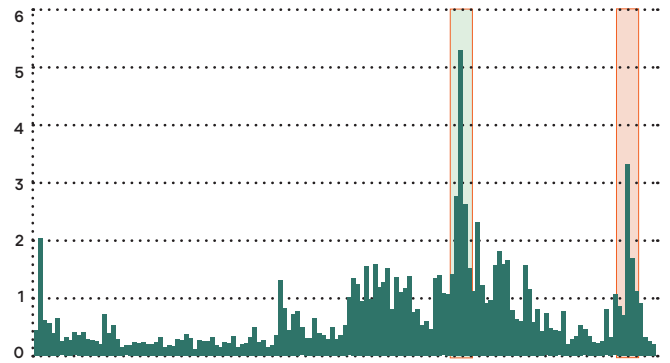


CONTINUED CHARTS
BITCOIN'S MOST VOLATILE DAYS DURING 2020

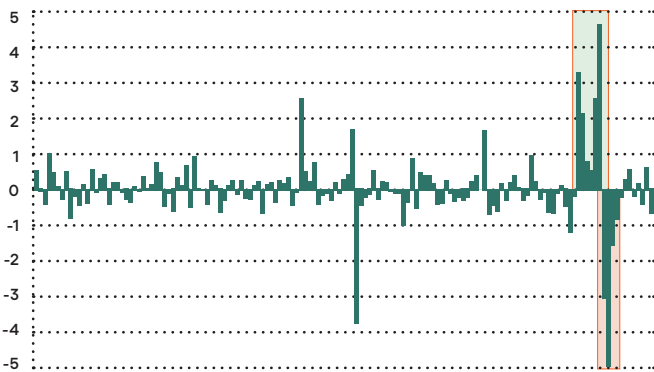
12: 2020-03-19: % Change Open-Close Every 10-Minutes



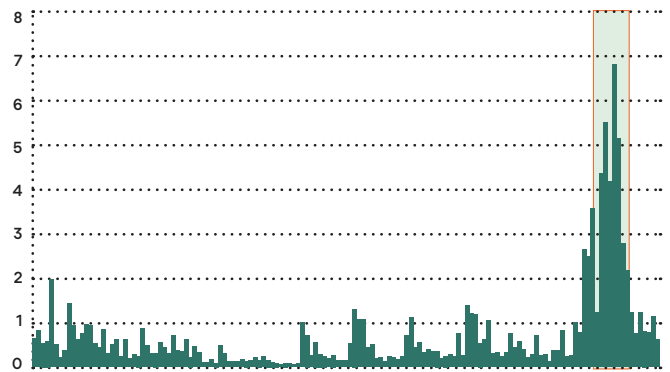
13: 2020-03-19: % Trading Volume Percentage of Day Total Every 10-Minutes



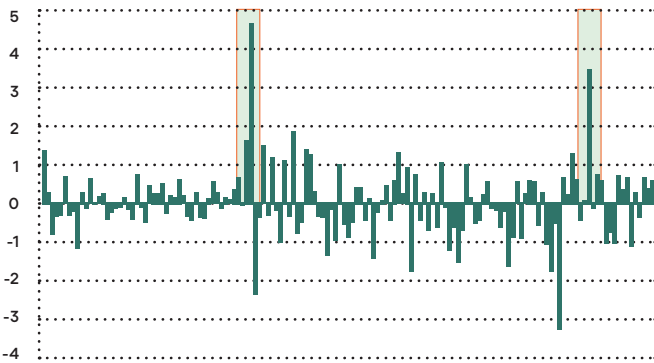
14: 2020-03-15: % Change Open-Close Every 10-Minutes



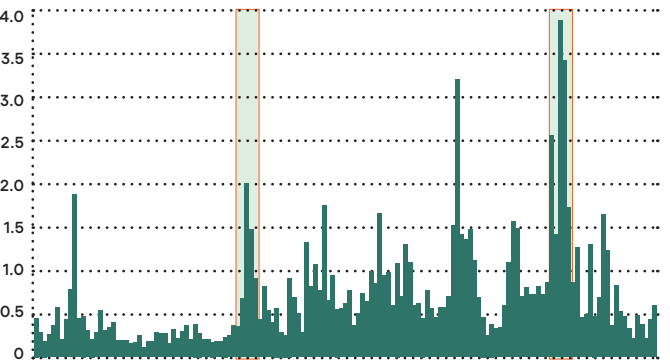
15: 2020-03-15: % Trading Volume Percentage of Day Total Every 10-Minutes



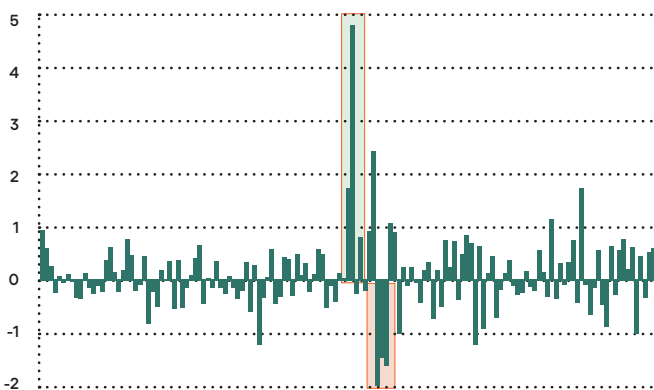
14: 2020-03-20: % Change Open-Close Every 10-Minutes



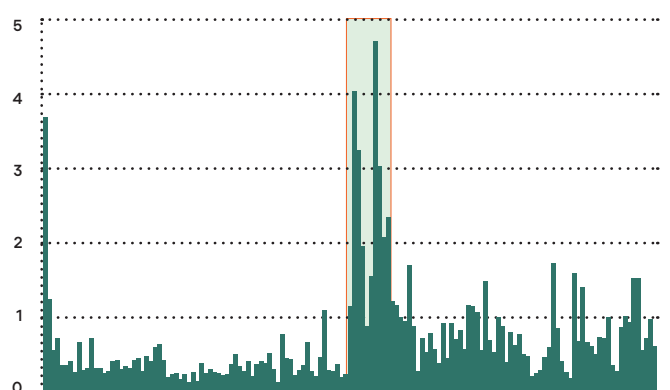
15: 2020-03-20: % Trading Volume Percentage of Day Total Every 10-Minutes



16: 2020-03-23: % Change Open-Close Every 10-Minutes



17: 2020-03-23: % Trading Volume Percentage of Day Total Every 10-Minutes





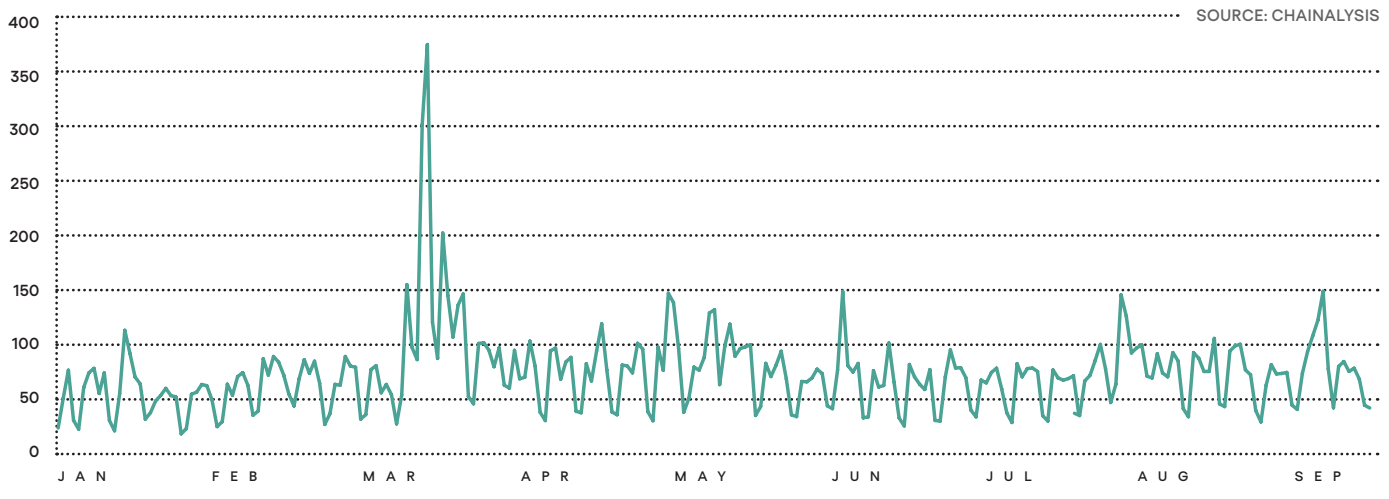
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Are Blockchain Limitations Stifling Arbitrage Opportunities? Part 3



Are Blockchain Limitations Stifling Arbitrage Opportunities?

1. 2020 Bitcoin Daily On-Chain Exchange Inflows (Bitcoin, '000)



Recap

In the first two parts of this series (see [part 1](#), [part 2](#)) on whether blockchain times are a driver of inefficient markets, Copper showed that traders are extremely self-reliant with moving their assets on and off exchanges, both during times of stability and high volatility.

However, it is evident that the opportunity fast dwindles in times of big swings as market participants with assets readily available to trade on an exchange are prepared to take advantage.

As seen in the second part of this series, the highest price swing from daily open prices happens within a 10 minute window - unlikely to be a coincidence with Bitcoin's block time, which also aims to be 10 minutes. But as traders rush assets onto an exchange, the opportunity decreases.

In this report, Copper marries on-chain times with price movements and liquidity to assess whether markets are inefficient or functioning as expected. An advantage of a public blockchain is the live data that can potentially spur on great expectations and set the tone for potential price activity.

Looking at the data and exchange-traded volumes together can be an indicator of real market depth, and whether traders will be credited with their assets in time to take advantage of the sharp price swings.

Chainalysis Chief Economist, Philip Gradwell, says that "most trading occurs Monday to Friday, and large traders often take their assets off exchanges into self custody either daily or at the end of the week." Data provided by Chainalysis [markets intelligence platform](#) shows this very linear trend outside of days of high volatility (see chart one above).

But...why?

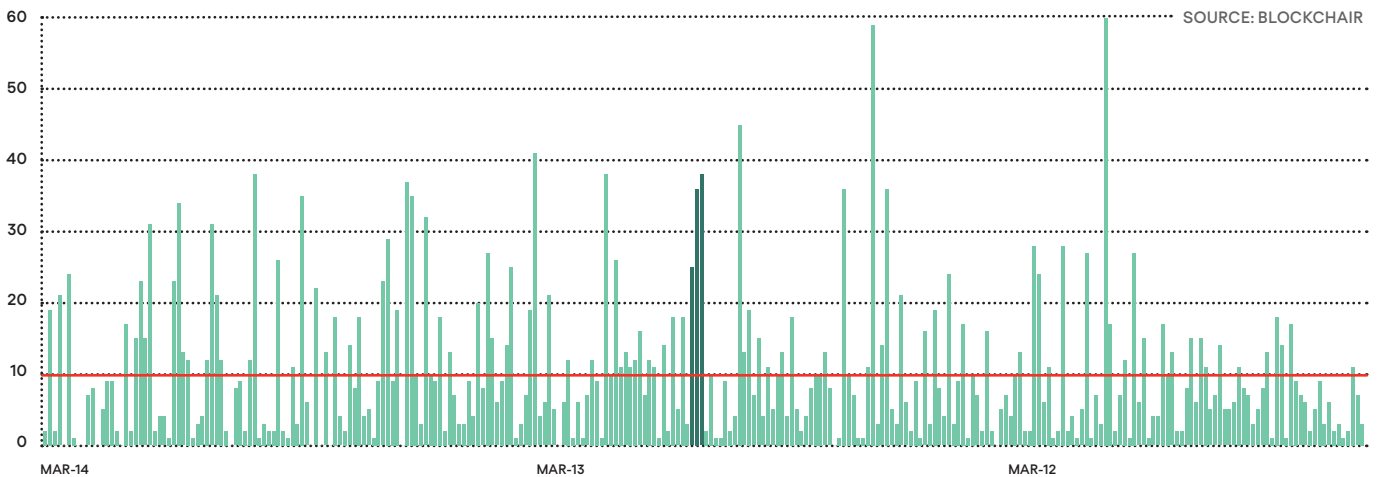
Market participants have several factors to consider when trading and opt to custody their assets off an exchange at more secure facilities (i.e. custody, wallets). A primary reason for going through the process of sending back and forth from a private wallet has been due to security issues that have plagued cryptocurrency exchanges in the past.

But nothing is without a trade-off, and confirmation times required by each exchange become a key hindrance in achieving the best market execution with peak liquidity during times of high volatility. On-chain inflows to exchanges outside of times when Bitcoin's price is stable average to around 50-70k. But during times of high volatility, the blockchain swells and sees double that. In 2020, this even reached a whopping 374k Bitcoins moved on-chain into exchanges on a single day - nearly \$2bn in value.

Confirmation times, the number of blocks required to be mined by exchanges from the time the transaction is sent differ. Some exchanges require 6 blocks - virtually a minimum of 60 minutes - to credit traders before being able to access their assets.



2: 'Black Thursday': Bitcoin Block Times Durings Times of High Price Volatility (Min) **Average Block Time**

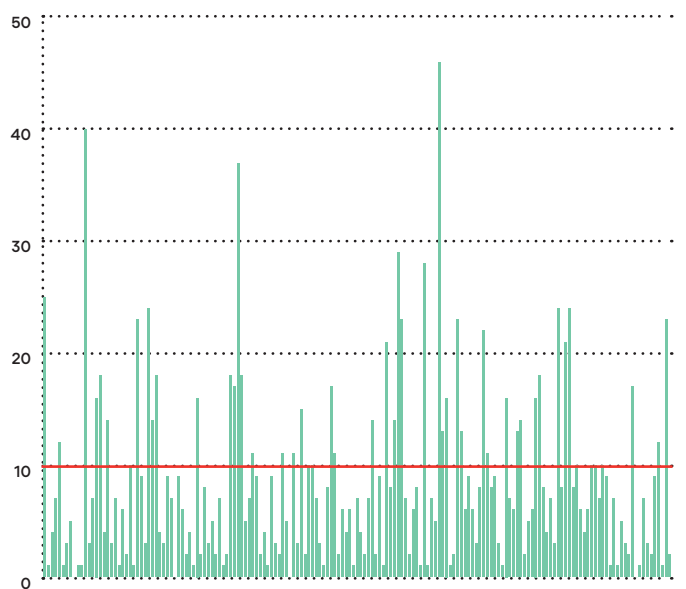


But confirmation times during peak demand become highly unpredictable, deviating far from the norm. When Bitcoin's price dramatically dropped during 'Black Thursday' of 2020, traders couldn't get their assets on to an exchange fast enough. In fact, blockchain confirmation times took as long as an hour. And the average time of blocks that didn't take 10 minutes was more than double at 21 minutes. At peak, 3 blocks took as long as 99-minutes (see highlighted bars in chart).

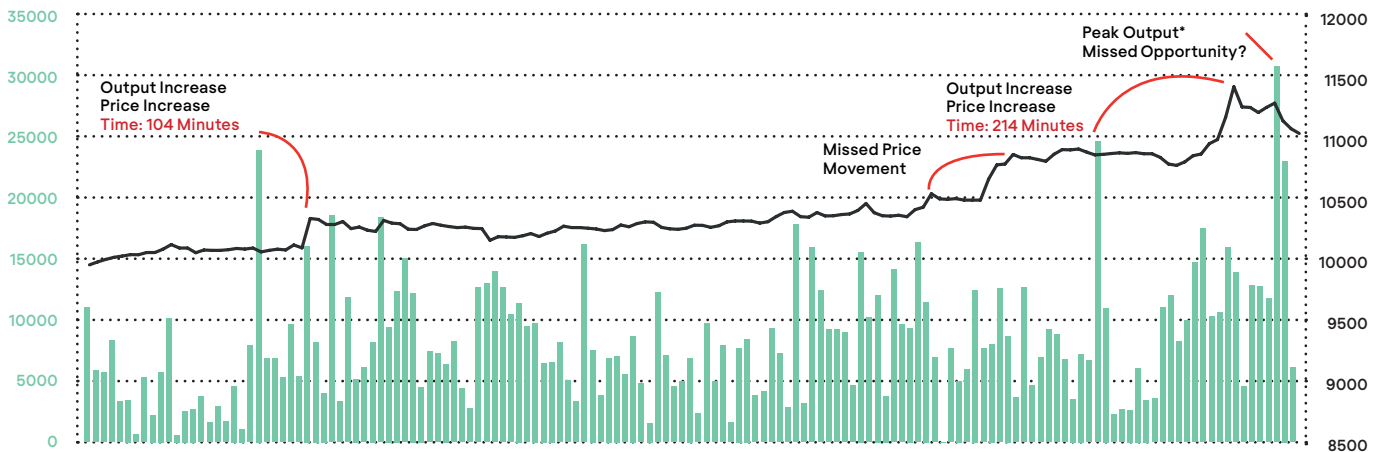
Such confirmation times aren't phenomena during times of high price activity. In May, when Bitcoin's price fell to a low of \$8100 and peaked at \$9560, the blockchain once again took its time for blocks to be mined (see chart 3).

Further marred by long confirmation times are the individual requirements of each exchange. Some exchanges (mainly derivative exchanges) have recognized this opportunity and taken on the risk to credit traders' accounts with one confirmation. But even that single confirmation can take precious time during times of high activity.

3: 2020-05-10: Blocks Not Mined Within 10 Minutes Averaged 19 Minutes



4: 2020-07-27: Blockchain Moving Markets? (On-Chain BTC Output (LH-Axis) vs. Price (RH-Axis))



* BTC Output is not a clear cut indicator of actual sums moved as it includes change.



Which came first? Bitcoin price or Blockchain activity?

Asset movement on-chain is undoubtedly proving to be an indicator of price movement (see chart four above). The chart (and the day chosen) is when Bitcoin's price breached the psychological \$10k barrier and saw one of the most massive price upswings in 2020. What is notable is the time between on-chain activity and price movements going into the hours.

Such large movements have become a vital notification for market participants as "Whales" are often tracked. In fact, a social media account that notifies people on such activity has over a quarter-million followers.

Sometimes, however, there are big on-chain transfers that shouldn't be cause for alarm but are seen as such due to the pseudonymous nature of the transactions. Mr. Gradwell says that "there is some flow where we [Chainalysis] don't know instantly whether it is an internal flow within an exchange or a genuine flow out of the exchange to an external third party."

The current market setup of blockchain times, information and exchange requirements setup an asymmetric opportunity for traders who have parked their assets on the exchange against those who have to go through the blockchain process. While opportunities may continue to arise during day-trading, the largest swings happen within a limited window of time (see part 2 for in-depth analysis of price change movements).

Tie-up

The series has established multiple critical points about how Bitcoin's price and on-chain transfer can go hand-in-hand.

Ultimately, the blockchain is functioning as intended, **and** markets are inefficient, given locked-up capital yet to be confirmed during times of high price volatility. This increases uncertainty for traders as other traders sweep up the demand within the short-time frame available.

While the blockchain and off-exchange custody offer increased security instead of an exchange that can be the target of attacks, the result could also mean missed opportunities should traders not be part of the first-mover advantage.

While Bitcoin remains a small industry compared to other traditional assets, when the times comes the blockchain might very well exacerbate these market inefficiencies. Particularly for traders who do not have access to off-exchange settlement.

Research by Copper

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Why is Blockchain fundamental analysis difficult?

Across Timezones: How does Bitcoin correlate to key market indexes & futures?

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Part 2: Are Blockchain limitations stifling arbitrage opportunities?

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