Exchange Benchmarking

2019 June

CryptoCompare Research
research@cryptocompare.com

Mission Statement

The existing processes for evaluating crypto exchanges are failing; **metrics such as volume are frequently misleading**, **methodologies are unclear** and **preparatory due diligence is lacking** across the board.

We are committed to providing the **highest level of insight** into a typically opaque and abstruse marketplace. To do so, our approach combines expert data collection and analysis with **clearly stated methodologies and practices**.

We believe that **'fake volume analysis' must be preceded by considered due diligence** on exchanges.

We recommend an innovative ranking methodology that utilises a combination of **qualitative** (due diligence) and **quantitative** (market quality based on order book and trades) metrics, **without using volume directly** in the ranking.

Our ranking serves as a **guide for investors and traders** who want to identify the best venues for their risk appetite.

We assign a grade to each exchange which will help **identify trust and reliability**.

Content

Why is Volume Misleading?

Why Is Volume Misleading?

When an investor/trader enters a trading venue, his or her concerns might be:

- Can I trust the data reported by this exchange?
- Is there potential market manipulation on this exchange?
- Are my funds secure and insured?
- Does the exchange have a good API?

Choosing the best exchange therefore should not be based on the trading volume but the quality and trust in the services of the exchange.

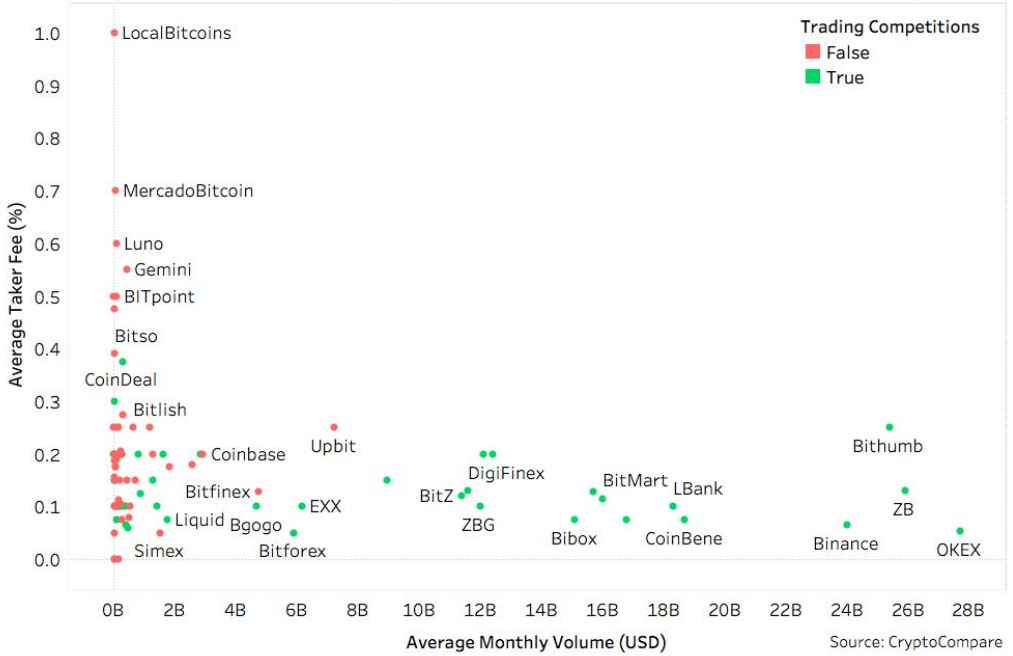
Volumes can be easily manipulated, any untrusted exchange can provide data.

Why Is Volume Misleading? - Trading Incentives

Trading competitions, airdrops and trans-fee mining are popular ways of incentivising trading activity.

Exchanges on the right end of the chart use incentives to boost their volumes and gain status.

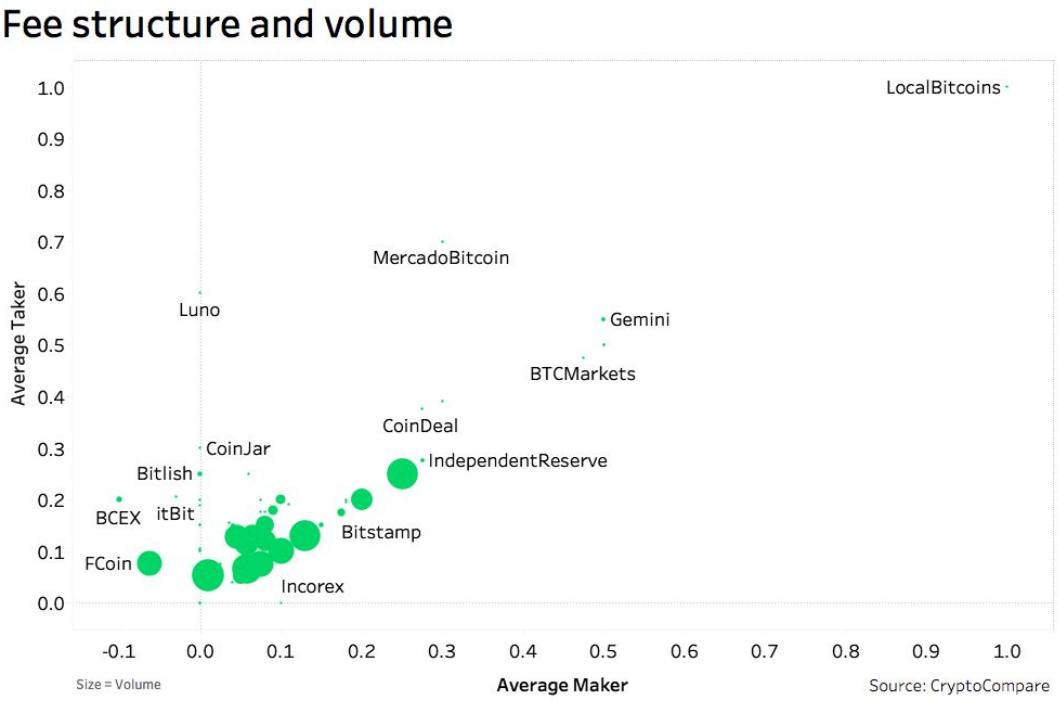
Trading competitions influence volume



Why Is Volume Misleading? - Fee Structures

Exchanges operate with different fee structures that drive their volumes in different ways.

Zero or negative maker fee markets attract and reward liquidity providers, while other exchanges have balanced fee structures that might be as expensive as 1%.



Ranking Methodology Overview

Methodology Overview - Scope

Scope and Objectives. CryptoCompare's Exchange Ranking methodology utilises a combination of 34 qualitative and quantitative metrics to assign a grade to over 100 active spot exchanges. Each metric is converted into a series of points based on clearly defined criteria. Metrics were categorised into several buckets and distributed fairly to arrive at a final robust score, ensuring that no one metric overly influences the overall exchange ranking. Each exchange grade is derived from a broad due diligence check using qualitative data, followed by a market quality analysis that uses a combination of order book and transactional data.

Due Diligence Check. Our due diligence check comprises of 6 main categories that attempt to qualitatively rate each exchange on the basis of geography, legal/regulatory metrics, calibre of investment, team/company quality, quality of data provision, and trade surveillance.

Market Quality. We measure the market quality of each exchange using a combination of 5 metrics (derived from trade and order book data) that aim to measure the cost to trade, liquidity, market stability, behaviour towards sentiment, and "natural" trading behaviour. Exchanges were rated based on a combination of 9 of the most liquid BTC and ETH markets. Points were distributed using a rating system that compares each exchange with its peers for each metric, on each applicable market. We then arrive at an overall ranking that is robust across several markets for each exchange.

Grading. A relative grading system was implemented to assign each exchange a grade (AA, A, B, C, D, E, F) based on its total cumulative score in comparison to the entire pool of exchanges in the ranking.

For further information on our methodologies, and a full breakdown of all available data metrics collected (90 available), please see Appendix.

Methodology Overview - Data Collection

Due Diligence

Time Period: 15 March - 15 May 2019

Sources: World Bank (2017 Data)
LinkedIn Profiles
Crunchbase Profiles
Exchange Websites
Github API Documentation
Companies Houses
Media websites (Coindesk, Bloomberg)
Various MSB Registries

Method: Manual Data Collection

Market Quality (Trade)

Time Period: 01 May - 30 May 2019

Sources: Exchange REST APIs (Trade Endpoint)

Method: REST API polling on exchanges

Frequency: At exchange rate limits

Market Quality(Order Book)

Time Period: 01 May - 30 May 2019

Sources: Exchange REST APIs (Order Book)

Method: REST API polling snapshots

Frequency: ~ Every 5 seconds where possible

Markets: BTC-USD, BTC-USDT, BTC-ETH, BTC-KRW, BTC-JPY, ETH-USD, ETH-USDT, ETH-KRW, ETH-JPY

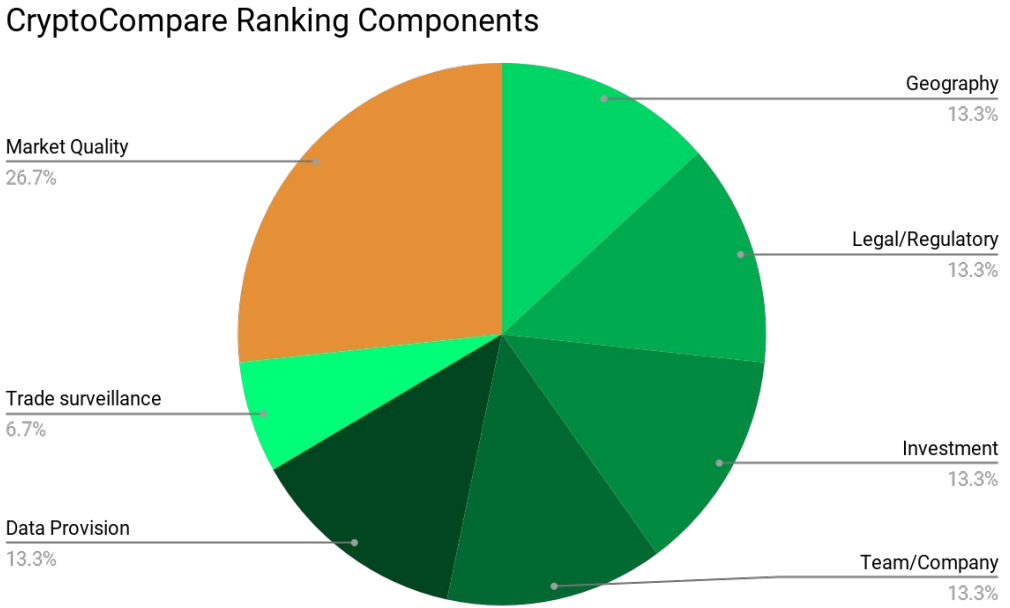
Number of Exchanges: 100+

*We have made our best effort to collect data accurately, but appreciate that certain data points might be outdated or incomplete due to lack of public availability. We are committed to updating and correcting any data point proven to be outdated or incorrect on a timely basis, and will update our Exchange Ranking accordingly.

Methodology Overview - Ranking Components

The overall ranking consists of the following components and subsequent weightings:

1. Geography
2. Legal/Regulatory Assessment
3. Investment
4. Team/Company Quality
5. Data Provision Quality
6. Trade Surveillance
7. Market Quality



Methodology Overview - Components I.

Geography

13.3%

- Country Rating
- Cryptocurrency Regulatory Stringency

Legal/Regulatory

13.3%

- Legal Company Name
- Registered as an MSB
- Subsidiary Exchange Registered as MSB
- Licensed
- Subsidiary Exchange Licensed
- KYC/AML
- Part of Regulatory/Industry Group
- Insurance Against Losses

Investment

13.3%

- Funding by Large VC or Non-Crypto Established Company
- Funding by Smaller VC Companies

Methodology Overview - Components II.

Team/Company

13.3%

- Public vs Private
- Identity of CEO, CTO, COO/CFO (or equivalent)
- Education - Masters Degree/Formal Post-Graduate Certification
- Experience in years
- Exchange Age Since Launch

Data Provision

13.3%

- API Average Response Time (ms)
- Ability to Query Historical Trades
- Offers Websocket Connection
- Provides Order Book API Endpoint
- API Rate Limits

Trade Surveillance

6.7%

- Has market surveillance system in place

Methodology Overview - Components III.

Market Quality

26.7%

- Market cost to trade (average spread)
- Liquidity (average depth of 1% price impact)
- Stability (minute volatility)
- Behaviour towards sentiment (volatility and volume correlation)
- Natural trading behaviour (volume standard deviation)

Trading Incentives (Inflation Score)

*Not Included in Overall Ranking

- Trading Competitions
- Airdrops
- Transaction-Fee Mining
- Zero Transaction Fees
- Margin Trading

Methodology Overview - Aggregation and Grading

Scores from each category were aggregated to form a total cumulative score. The **maximum score is 75.**

These scores are then re-scaled to 0 - 100 based on the score of the exchange that scored the highest (Exchange Max). Therefore, this is a relative grading system.

Exchange Re-Scaled Score =
Exchange Score/Exchange Max * 100

This process was repeated for each exchange. Grades are then assigned based on various thresholds.

Category	Maximum Points
Geography	10
Legal	10
Investments	10
Management/Company	10
Data Provision	10
Trade Surveillance	5
Market Quality	20
Total Cumulative Points Available	**75**

Threshold	Grade
90-100	AA
80-89	A
70-79	B
55-69	C
45-54	D
30-44	E
<30	F

Exchange Ranking Toplist

Exchange Ranking Top 10

View the full list here.

Rank	Exchange	Grade	Total Score	Geography	Legal	Investment	Company/ Management	Data Provision	Market Surveillance	Market Quality
1	Coinbase	AA	60.3	6.76	9.4	10	8.3	6.4	2.5	8.5
2	Poloniex	AA	59.9	6.76	6.7	10	7.4	8.8	5.0	7.7
3	Bitstamp	AA	59.6	9.16	7.8	7.5	8.8	6.8	5.0	7.3
4	bitFlyer	AA	57.2	8.87	10.0	10	7.4	8.4	0.0	6.3
5	Liquid	AA	56.3	6.12	6.7	10	7.6	8.4	5.0	6.2
6	itBit	AA	56.0	6.76	8.9	10	9.0	6.8	0.0	7.3
7	Kraken	A	54.1	6.76	5.0	10	9.4	8.4	0.0	7.3
8	Binance	A	54.0	6.12	1.1	10	8.5	8.0	5.0	7.7
9	Gemini	A	53.2	6.76	6.7	2.5	8.1	8.4	5.0	7.9
10	Bithumb	A	53.1	7.31	4.4	10	8.0	6.4	2.5	7.2

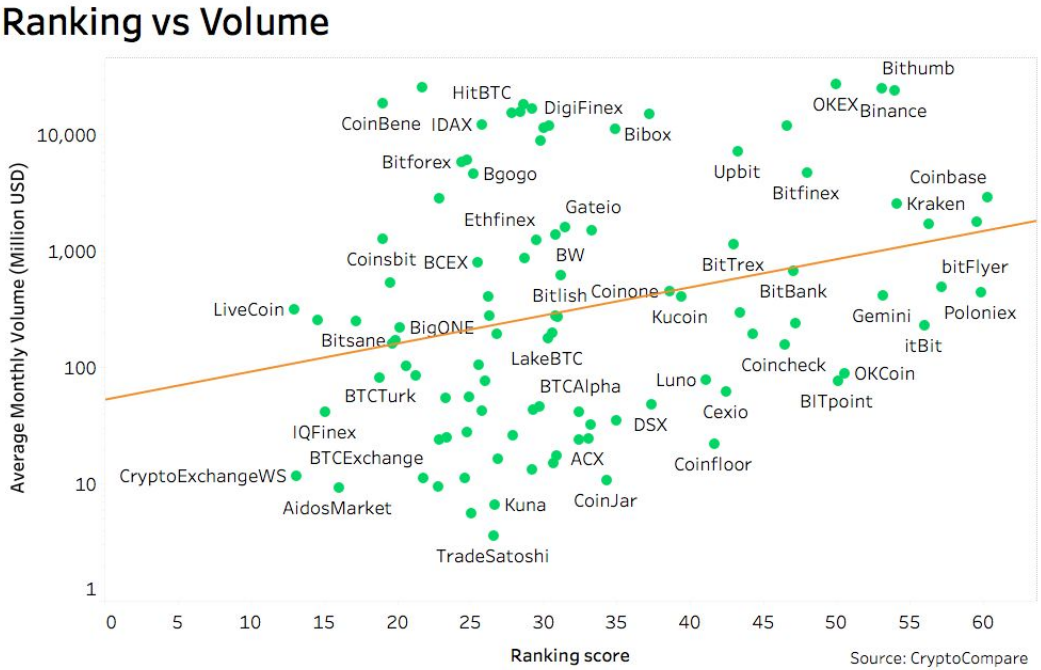
Key Results

CC Exchange Ranking vs Volume Ranking

There is an exponential relationship between the CryptoCompare ranking (which did not use volume directly to rank exchanges) and the monthly average volume of exchanges.

This means naturally we expect higher volume for higher quality exchanges.

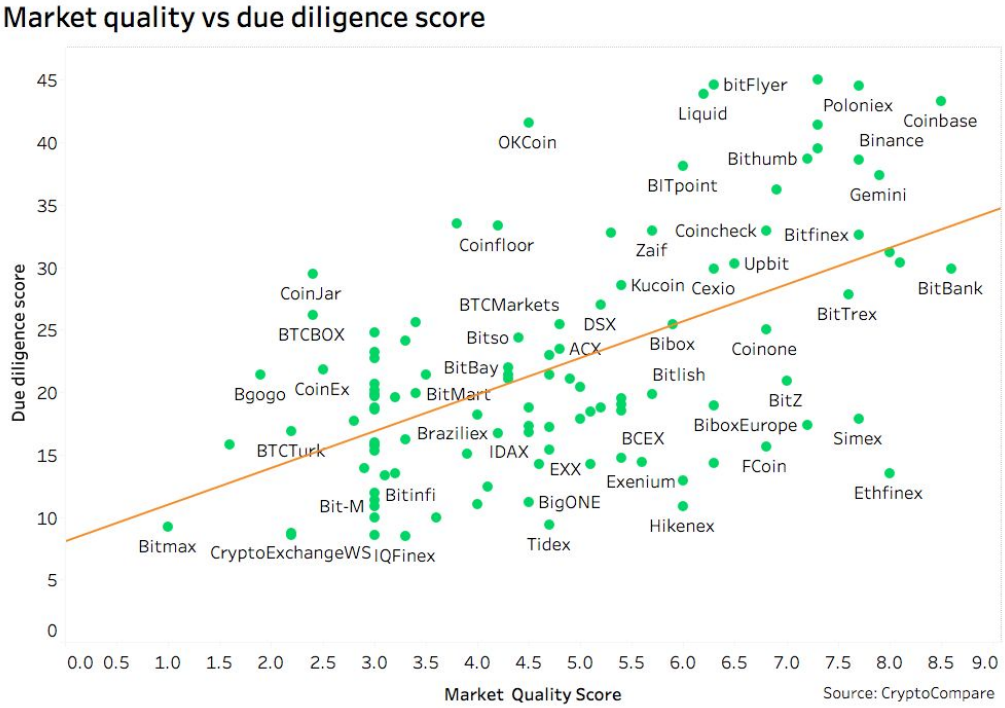
However, exchanges in the center top area of the chart are the ones dominating volume rankings whereas their market quality and business quality does not justify their position.



Due Diligence vs Market Quality Ranking

There is a positive correlation between due diligence scores and market quality scores.

Causality is to be analysed, but potentially via a **due diligence process one can infer the quality of the market itself.**



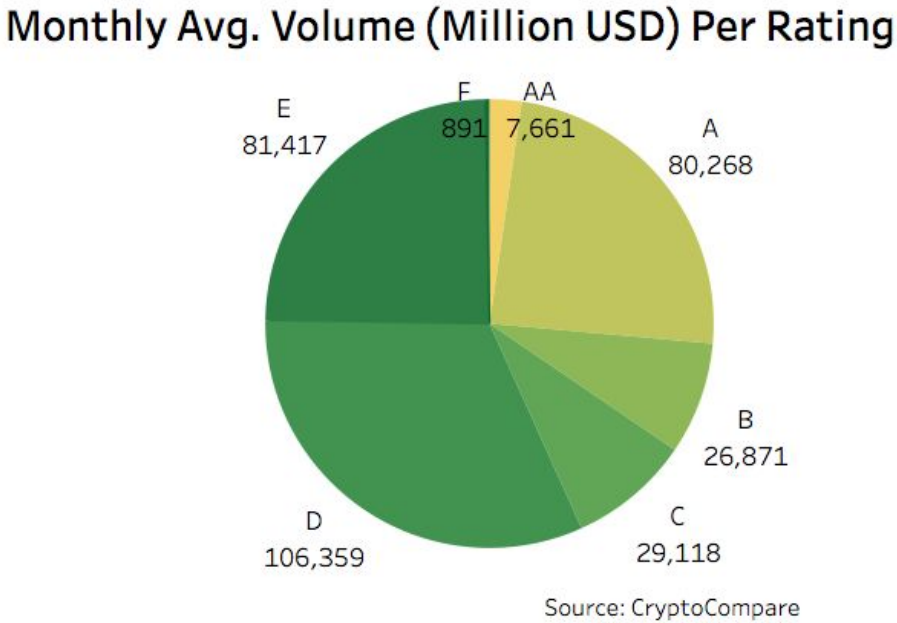
New Notion: Trusted Volumes Based On Risk

CryptoCompare is establishing the notion of **trusted volumes** whereby investors can calculate market volumes **based on their risk appetites**.

Here, an investor is able to only take the best rated exchanges into account or to accept lower rated ones into his or her portfolio.

Example:

A low risk investor's market (AA) would only include 3% of all reported volumes.



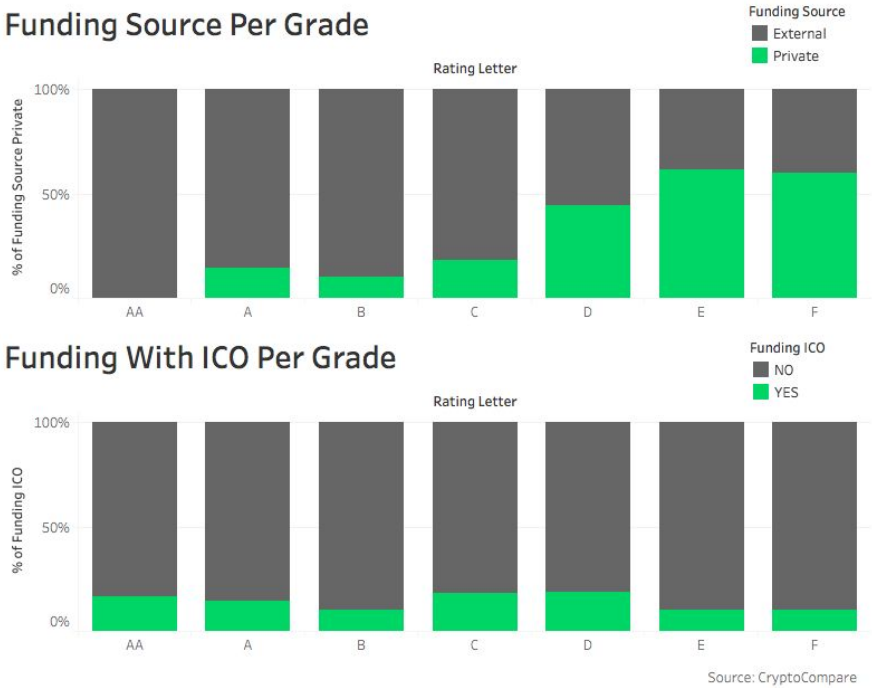
Macro Findings

Funding Type Per Rating Grade

There is significant VC funding flowing into the industry, with some of the VCs investing in multiple exchanges. Acquisitions are becoming increasingly common, as is crowd sourced funding.

Being funded by a well recognised VC is a great indicator for the high quality of an exchange, with acquisition and crowd sourced funding being good signs too.

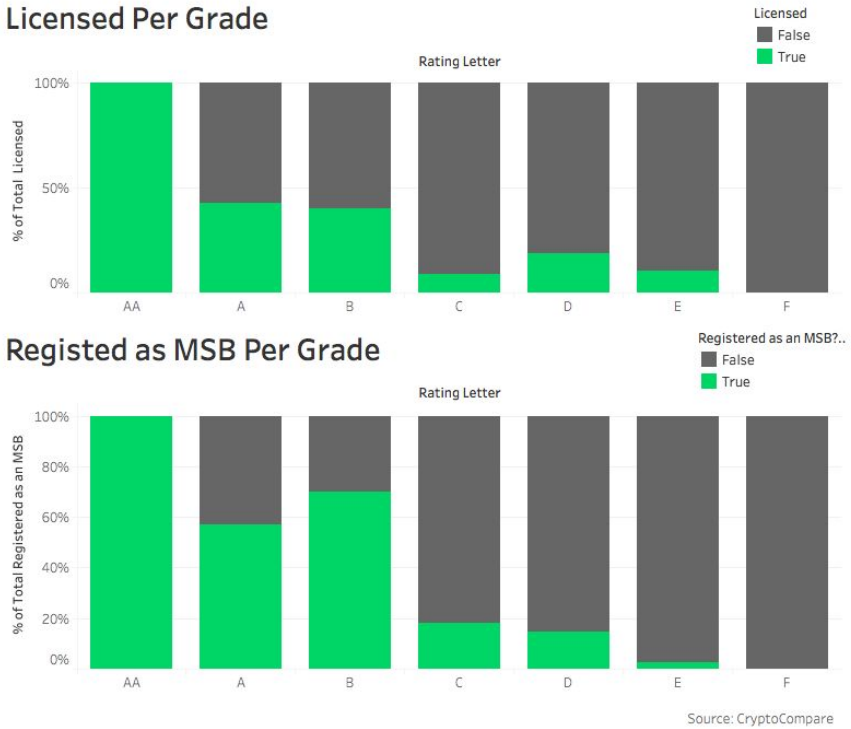
ICO has been a popular way to fund exchanges, their presence is equally likely throughout grades AA-F, many exchanges use exchange tokens.



Licensed & MSB Per Rating Grade

All AA rated exchanges are registered as MSB and licensed as money transmitter/money services company/exchange operator/similar

Only 5.6% of total trading volume happens on licensed exchanges, and 7% of volume on exchanges registered as MSB.

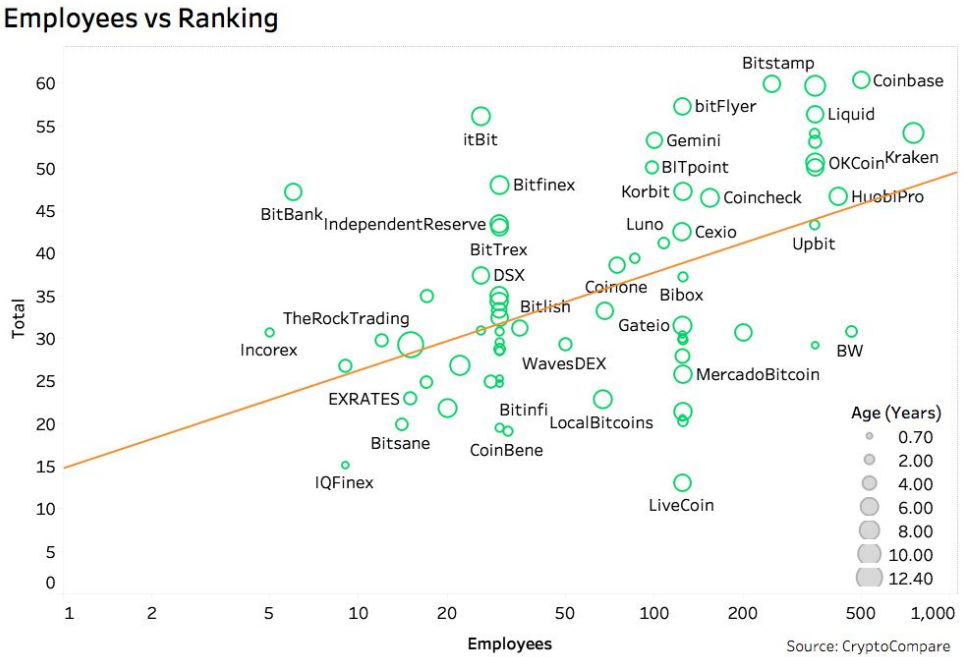


Employees vs Ranking

There is a log relationship between number employees and total ranking scores.

Note that employee count was not used in the ranking.

Better ranking exchanges tend to have more employees to support their customers, and most probably have more budget to hire as well.

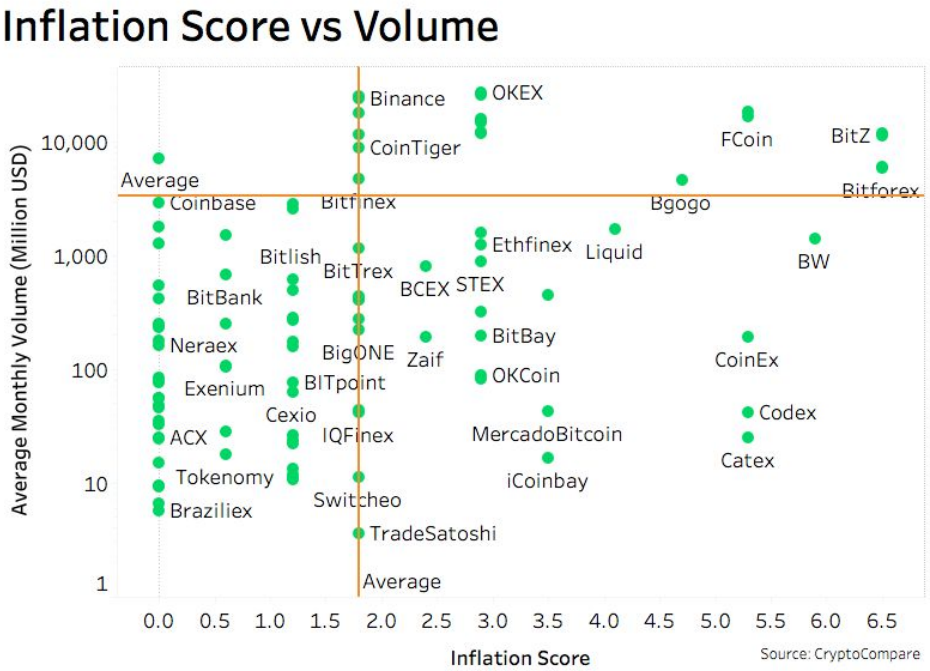


Inflation Score vs Volume

Inflation score is an index indicating whether an exchange is using trading competitions, airdrops, trans-fee mining that result in their volume being inflated.

This chart helps understanding the relationship between volume and their trading incentive schemes.

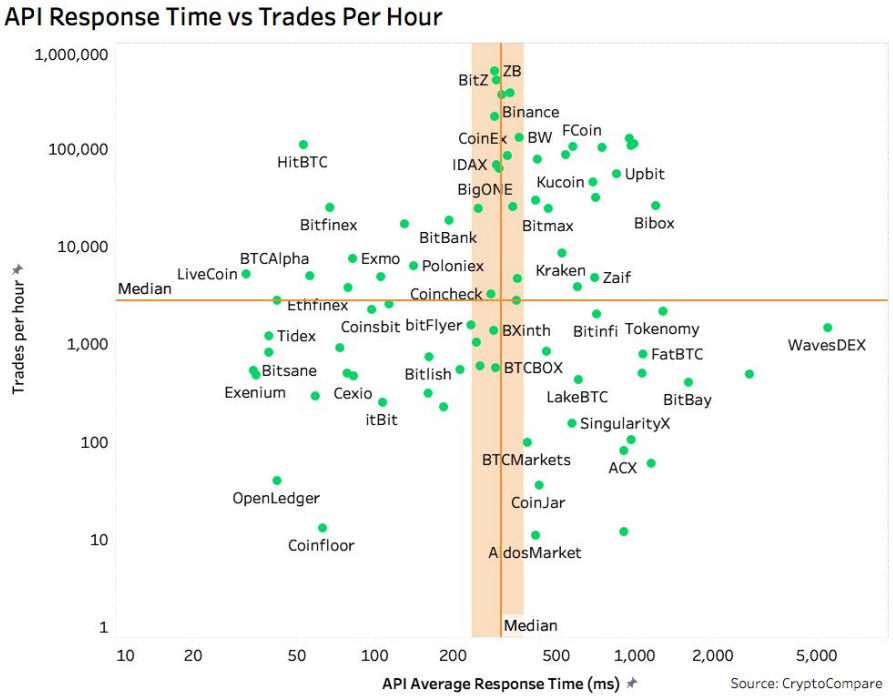
Exchanges in the top right corner of the chart are exchanges that most probably have high volumes due to their trading incentive schemes.



API Response Time vs Trade Count

Average API response time is around 300 ms with some taking as long as a few seconds to respond.

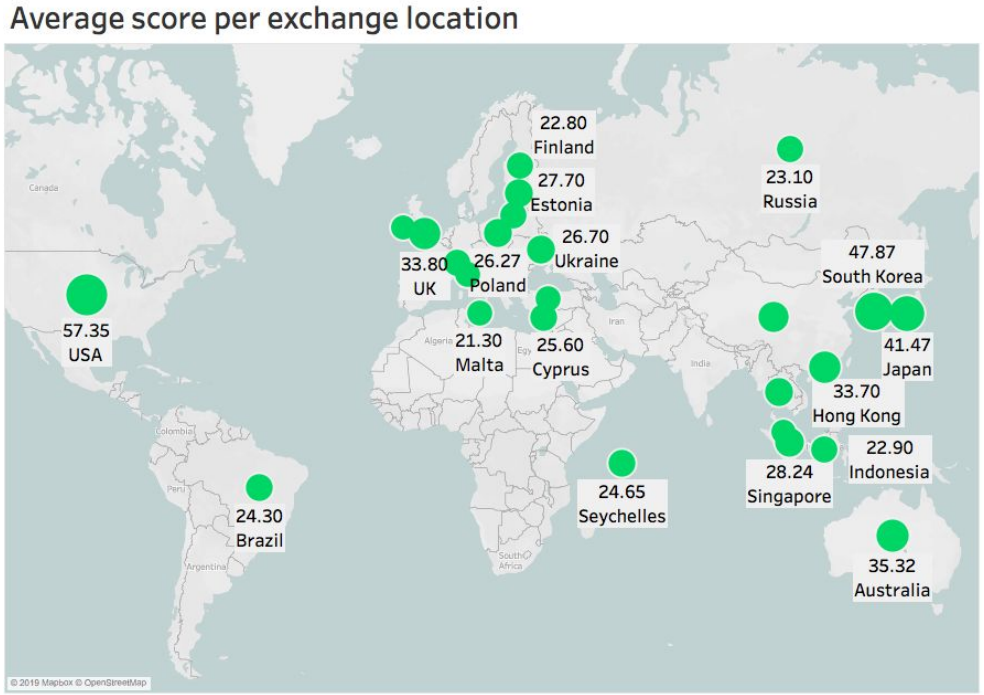
One might want to avoid exchanges on the top right corner of the chart, where APIs are slow and high trading activity means the market moves quickly while the time it takes for a trade to be executed is long resulting in an unwanted slippage.



Average Ranking Score Per Location

Top exchanges reside in the US followed by South Korea and Japan. Malta is noteworthy for it's underperforming resident exchanges.

Whilst location forms part of the overall ranking, those exchanges that reside in jurisdictions with stricter regulations tend to perform better across many metrics.



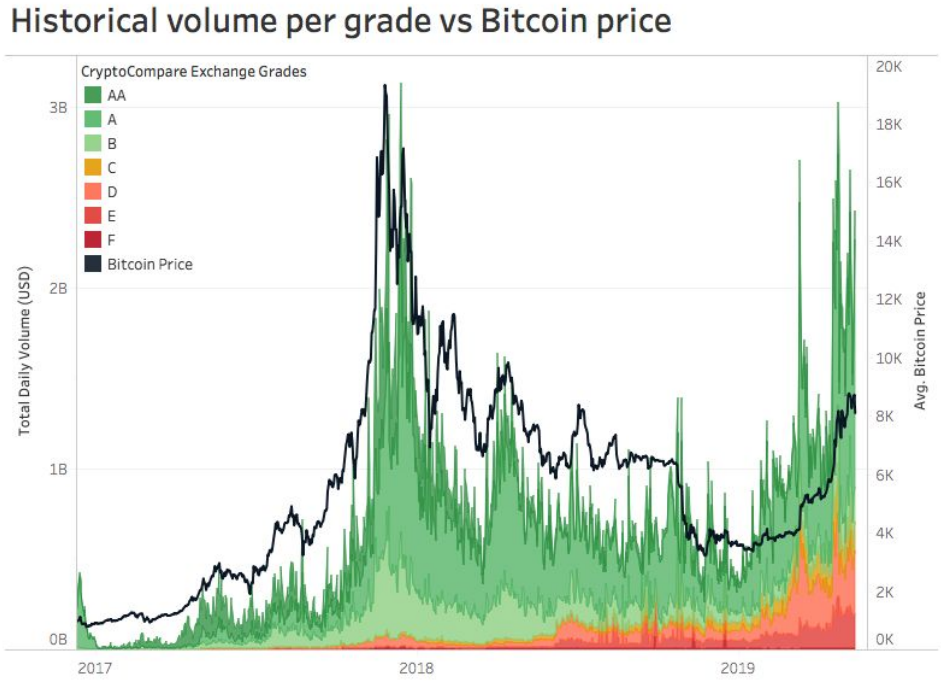
Lower Quality Exchanges Gained Market Share

By applying our current exchange grading system to historical volumes, we can show that lower quality exchanges have gained market share in the last year.

As a result of the 2018 bear market, organic trading volume decreased, which may have forced some exchanges to consider new strategies in order to compete in an industry with a dwindling customer base and chronic over supply.

New incentivised trading schemes - such as Trans-Fee Mining (TFM) - allowed exchanges to quickly boost volumes, gain status and justify charging projects substantial fees to list their tokens.

The ‘Fake Volume’ narrative has become a growing trend and in recent months research has been conducted to better understand the digital asset exchange market.



A Note On Fake Trading Reports

A Note On Fake Trading Reports

CryptoCompare wanted to explore the anomalous trading patterns pointed out in several reports.

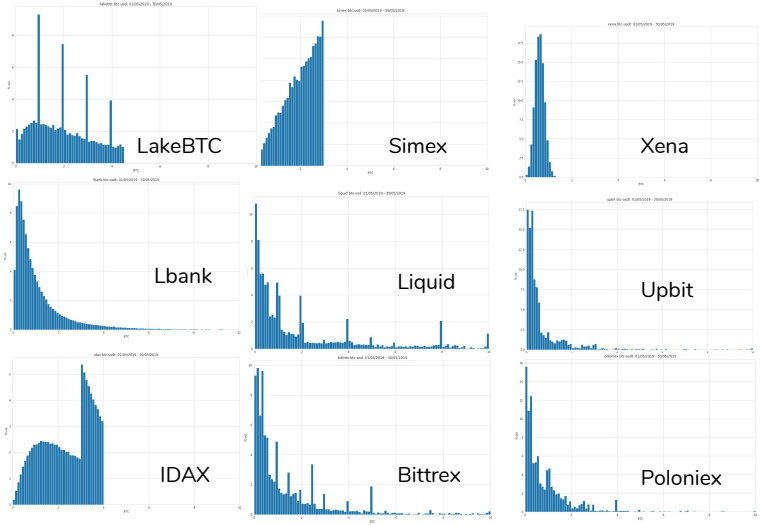
It was found that measuring an exchange's quality by focussing on trading patterns is still very challenging.

Some of our concerns with this approach:

- Trade patterns can easily be manipulated
- Trade pattern normality by itself does not assess exchange quality as a whole
- Previous reports have truncated histograms, which omits potentially important information

For the above reasons, trading patterns are only analysed but not included in the CryptoCompare Exchange Ranking.

Trade size distributions



Collected 1-30 May 2019
Source: CryptoCompare

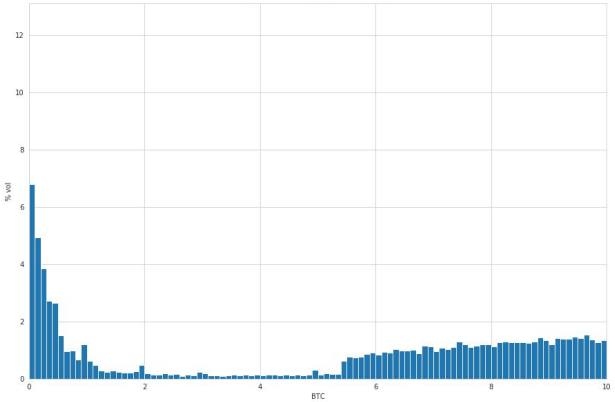
Trade Patterns Can Be Manipulated

Multiple sources pointed out the recent change in trading patterns on the Huobi Pro BTC-USDT market - as shown below in the March and May trade size histograms. Huobi Pro explained this by its efforts to stop market makers from wash trading.

This has raised concerns that market makers are trading with different patterns to avoid detection instead of ceasing their wash trading activities (total BTC volume for each month is similar for March and May). We believe that due to the ease at which trade distribution patterns can be altered they do not represent a sufficiently robust indicator of market quality.

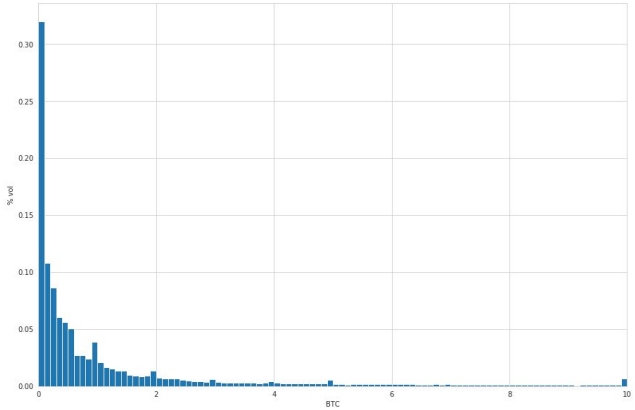
Huobi Pro
BTC-USDT

March 2019



Total Volume: 693k BTC

May 2019



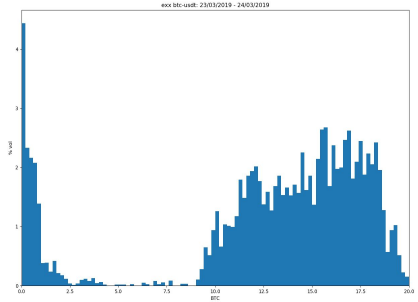
Total Volume: 696k BTC

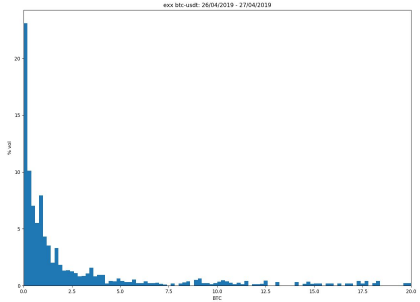
Source: CryptoCompare

Trade Patterns Can Be Manipulated

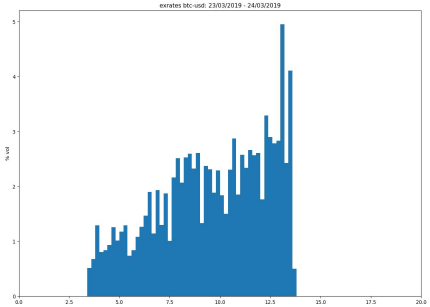
This behaviour is not unique to Huobi Pro - comparing exchange volume distributions over time on other exchanges reveals similar changes to trading patterns.

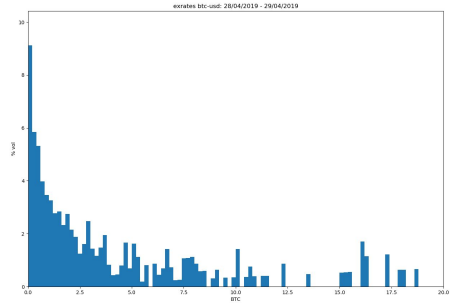
EXX
BTC-USDT
2019-03-29 vs 2019-04-26





Exrates
BTC-USD
2019-03-29 vs 2019-04-28





Source: CryptoCompare

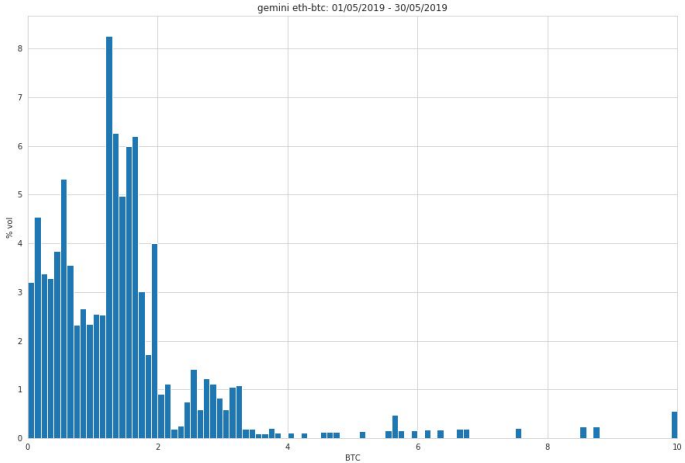
Trade Pattern Does Not Assess Exchange Quality

Using trade size patterns to evaluate an exchange can result in both false positives and false negatives.

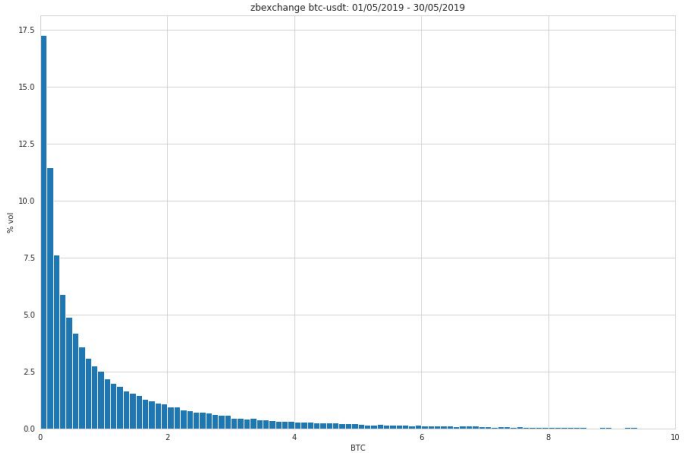
Gemini is a top tier exchange, it's ETH-BTC market clearly does not match the expected distribution.

On the other hand, ZB exchange shows a perfect distribution on its BTC-USDT market. However, the CryptoCompare Exchange Ranking rated it as an E tier exchange due to its lack of transparency, market quality and further aspects described in our methodology.

Gemini ETH-BTC



ZB BTC-USDT

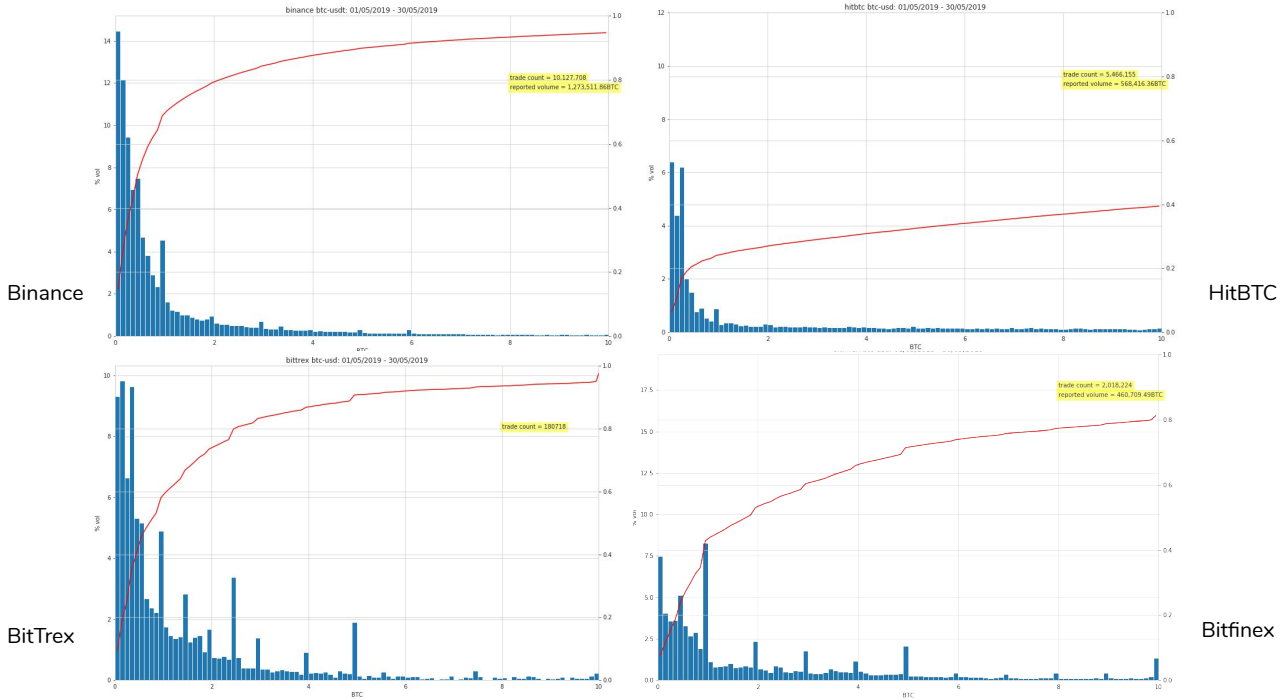


Lost Information By Truncating Histogram

One vector of analysis which is overlooked in the final histogram dataset is the cumulative sum of volume.

Here we plot the trading distributions for some exchanges in the Bitwise report, alongside their cumulative density functions.

This gives a much clearer idea of the percentage of the trades which are being accounted for in the 0-10 BTC period.

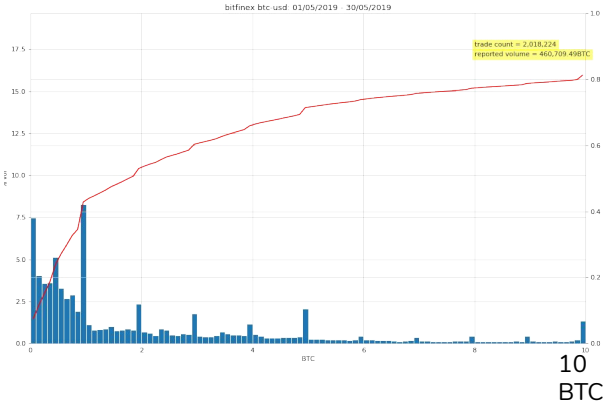


Lost Information By Truncating Histogram

Bitfinex was one of the exchanges Bitwise chose as part of its 10 most trusted exchanges. However, when we look at the cumulative density function of the trading distributions we can see that only about 80% of trading is accounted for in the period 0-10 BTC.

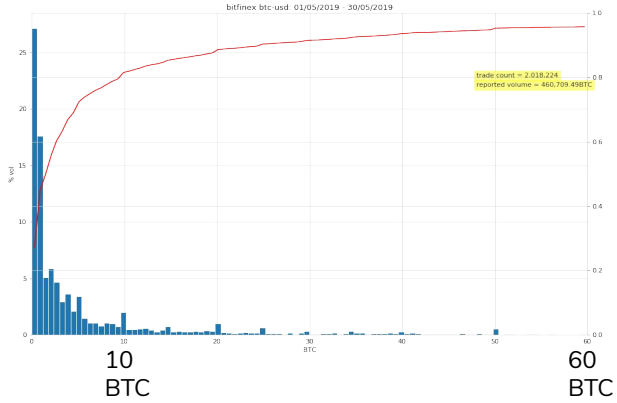
Extending the period to 0-60 BTC we now can see 95% of trading activity. Bitfinex has many more trades at high volume than other exchanges in the Bitwise 10.

Whether this is unusual is a matter of judgement, but it demonstrates that the methodology is at best qualitative, and potentially easily gameable (a few very large wash trades would never appear in the truncated histogram).



0-10 BTC
CDF 0.8

10 BTC



0-60 BTC
CDF 0.95

10 BTC

60 BTC

Conclusion

As previous research has shown, “fake” or “suspicious” exchange volume methodologies centred upon volumes, web traffic and trade histograms can be incomplete and sometimes misleading. We believe that a transparent methodology that evaluates exchange quality based on a broad due diligence check and a variety of quantitative metrics across markets is the best approach.

We have shown that the our current ranking correlates with volumes, which is an expected behaviour, but also points out outlier exchanges that have surprisingly high volumes relative to their ranking. Due diligence scores tend to correlate with market quality scores, meaning that one can potentially infer market quality from an exchange’s transparency, legal compliance, investors, geography and API quality.

We have introduced alternative market quality metrics to volume, focussing on trade and orderbook data across several markets to measure the cost to trade, liquidity and ‘natural’ trading behaviours. Our current exchange benchmarking methodology therefore serves as a robust guide, such that investors can identify more trustworthy exchanges that can satisfy their risk appetites.

Appendix

Appendix Contents

Appendix A - Due Diligence Methodology

Qualitative Data Metrics

1. Trading Incentives
2. Geography
3. Legal
4. Investment
5. Team and Company
6. Data Provision
7. Formal Trading Surveillance

Data Collection. Qualitative data was collected manually between **15 March - 15 May 2019**. The metrics within each category were collected from a variety of sources, which include but are not limited to: the World Bank (2017 Data), LinkedIn Profiles, Crunchbase Profiles, Twitter, Exchange Websites, Github API Documentation, Companies Houses, Media websites (Coindesk, Bloomberg), and Various MSB Registries.

An effort was made to collect each metric as accurately as possible. However, we acknowledge that due to restrictions in terms of public data availability and transparency from certain exchanges, data may be outdated or not fully complete. For those who are unhappy with the current ranking, or feel that any data is not up to standard we are committed to providing the most reliable dataset and will ensure that any errors are dealt with quickly and the exchange ranking updated accordingly.

Data Fields Available. A surplus of metrics were collected for each exchange, and only a subset were converted into points to be used in the exchange ranking. For those interested, a full list of all available metrics for each category can be found in Appendix D - Full Metrics List.

1. Trading Incentives

Exchanges will implement various incentive schemes for several reasons, which might include: **attracting additional users** to the platform, **incentivising trading** to drive fee income, or **raising the profile** of the exchange or of certain coins via high volumes to top the volume rankings tables.

Incentive Schemes. In the context of the current study, we have compiled a list of five main **incentive schemes** that we believe encourage additional trading,and are often implemented by several exchanges:

A. Trading Competitions
B. Airdrops
C. Transaction-Fee Mining
D. Zero Transaction Fees
E. Margin Trading

Inflation Score. The presence of any of these incentive schemes **does not penalise** exchanges in the current ranking system, but only serves as a means of identifying the extent of potential **"volume inflation"** relative to volumes without such models in place. The reason for this is that incentive schemes do not necessarily imply a lower quality exchange. Each metric acts as a flag for "inflated volume", and contributes to a final "inflation score".

1.A Trading Competitions

Trading competitions are sometimes implemented by exchanges to **attract additional users** to the platform, to **incentivise trading** and hence drive fee income, or to **raise the profile** of the exchange via volume rankings.

The exchange will reward participants with cryptocurrencies such at BTC or ETH or other lower profile tokens based on their performances in each competition. Bithumb for example has implemented a number of events known as “Super Airdrop Festivals” in the past, which had an obvious effect on trading volumes for the duration of each competition.

Competitions vary considerably by structure, and by exchange, and can result in **erratic trading** behaviour. Once a competition is over, this can cause a **drop in volumes** to “normal” levels.

The occurrence of competitions does not penalise exchanges in our current ranking system, however their presence is used to flag potential “volume inflation”. We add 5 points to the current “inflation score” if a competition has occurred in the last year. Please note that this metric does not serve to detect **current** inflation given that a competition may not necessarily be ongoing, but rather serves as an indication of **potential** and **past inflation** as a result of competitions.

In the top for transaction amount	Reward
Ranked #1 (1 members)	3 BTC
Ranked #2 (2 members)	50 ETH
Ranked #3 (3 members)	4,000 XRP

Competitions	Inflation Points
YES	5
NO	0

1.B Airdrops

An airdrop is a **token distribution mechanism** in which tokens are deposited into a users wallet based on several requirements. Most airdrops are deposited to users based on their holdings of a particular cryptoasset such as BTC at the time of a designated “snapshot” of holdings. However, some airdrops are only offered to users provided that they trade a minimum quota of a given market volume per day.

Airdrops can therefore be used as an **incentive mechanism**. We assume that exchanges that enable the airdrops of various tokens for whatever reason, whether as a competition reward or as a promotional event will **encourage users to trade** on markets they may not have traded had there not been an airdrop offering.

For this reason, we designate 2.5 “inflation points” to exchanges that offer airdrops. We do not penalise exchanges for the presence of airdrops in our current ranking system.

Offers Airdrop Events	Inflation Points
YES	2.5
NO	0

1.C Transaction-Fee Mining

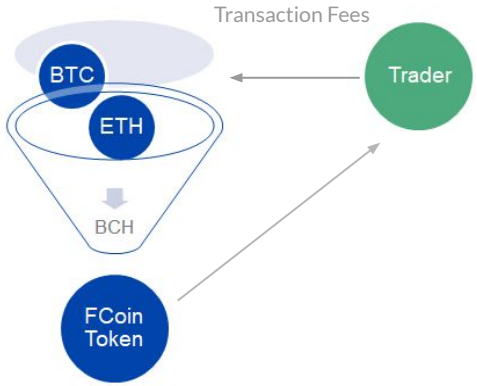
An exchange that implements a transaction-fee mining model, will **distribute** their proprietary **exchange token** in **exchange for trading fees**. In other words, they offer up a trading fee rebate, paid back in the form of their own token.

This is very similar to an ICO in terms of structure given that users pay fees in the form of BTC, ETH, USDT etc and receive a specific quantity of exchange tokens in return.

This trading incentive scheme first rose to prominence in mid 2018 and used by exchanges such as FCoin, BigONE and CoinBene whose volumes topped the exchange rankings overnight due to this model.

The **more trading** that occurs, the **more tokens can be earned** by individual traders. There is therefore an incentive to trade more, given that these tokens have particular properties.

This metric is therefore used as an additional proxy for “exchange inflation”. Given the clear impact on volumes that we have seen with this model, exchanges that operate under this model will be assigned an additional **15 inflation points**.



Implements a Transaction-Fee Mining Model	Inflation Points
YES	15
NO	0

1.D Zero Transaction Fees

Several exchanges might implement a zero trading fee model, whose ultimate aim is to **incentivise additional trading** activity and attract users. With fees eliminated, the costs of trading are effectively eliminated and therefore traders are inclined to trade more.

It is common for exchanges to offer a zero fee model to market makers, whose presence adds important liquidity to a given market. This effectively makes a market more active and stable. However, for market takers this is far less common. Hence, in our model, **zero transaction fee models refer to fees offered to takers** rather than makers.

Given that transaction fees are eliminated, an exchange must earn revenue by some other means which may include charging listing fees for new coins, offering margin trading and earning interest on leveraged funds or implementing paid marketing campaigns for certain projects.

In our rankings points system, exchanges are not penalised for offering zero fees. However, a zero fee model will be reflected in a general “trading inflation score” for each exchange.

Implements a Zero-Fee Trading Model	Inflation Points
YES	5
NO	0

1.E Margin Trading

Margin trading is a method of trading cryptoassets using **borrowed funds** provided by a third party.

This enables traders to trade with **much larger sums of capital** such that they are able to leverage their positions and realize larger profits on successful trades. As a result, this tends to **inflate volumes** to levels that would not have been realized had there been no margin trading in place.

Borrowed funds can either be provided by other users on the platform, and in many cases exchanges themselves offer such lending services. This model can offer an additional revenue stream for exchanges that offer particularly low fees and choose to make up the shortfall with interest earned from margin traders.

Given that margin trading tends to increase the amount of capital that can be traded and hence overall trading volumes, 5 “inflation score” points were given to exchanges that offer this service.

Offers Margin Trading	Inflation Points
YES	5
NO	0

2. Geography

Geography ratings were constructed based on the sum of the following two main metrics:

A. Country Rating

A **country rating** is a proxy for the **institutional quality** of the jurisdiction in which an exchange is based. It provides an indication of the likelihood of corruption as well as how strong a country's legal systems are. An exchange based in a high quality jurisdiction is subject to the standards and legal systems of that country.

B. Cryptocurrency Regulatory Stringency

Cryptocurrency exchange **regulatory stringency** relates specifically to the legal frameworks related to cryptocurrency **exchange regulation**. This captures the possibility that certain jurisdictions may possess high quality institutions but may not necessarily impose strict regulation on crypto exchanges. Exchanges that operate in jurisdictions with tough regulations have worked to meet certain standards.

The assumption is that **high quality institutions** combined with **high regulatory stringency** will produce **higher quality exchanges**.

2.A Country Rating

Country Rating Based on World Bank Worldwide Governance Indicators (WGI Ratings)

The Country Rating is based on **six dimensions of governance** (rated -2.5 to 2.5):

> **"Rule of Law, Regulatory Quality, Government Effectiveness, Political Stability and Absence of Violence/Terrorism, Control of Corruption, Voice and Accountability."**

For the purpose of the current Exchange Ranking, an average of each indicator (re-scaled to 0-5) was used to lead to a single WGI index rating per country. I.e. CCC Governance Ranking = AVERAGE(WGI Governance Indicator Ratings)

Exchanges operate from various jurisdictions. Our assumption is that the quality of a country's institutions will influence exchange standards positively. I.e. **Higher quality institutions enforce higher standards on the businesses based there**.

World Governance Indicators

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

Min Points: 0
Max Points: 5

2.B Country Regulatory Rating

Regulatory ratings are based on the **extent** and **stringency** of any crypto exchange-related **legislation** is in each exchange jurisdiction.

Exchanges might choose to locate themselves in jurisdictions that have clear rules regarding cryptocurrency exchange activity, or in those that generally impose very lax/non-existent regulations.

This metric is based on the assumption that exchanges located within jurisdictions that impose more **defined/stringent** controls on crypto exchange activity (license or registration requirements etc), will work to abide by those rules and hence maintain certain **operational standards**.

Conversely exchanges that operate in areas with **lax regulation** or no defined requirements will operate as they please and are more likely to **take shortcuts**.

Rating	Basic Criteria
5	Exchanges are regulated, licensed and must register with the relevant regulatory authority. Legislation is comprehensive.
4	Exchanges must register with the relevant authority, legislation is comprehensive, exchanges are regulated.
3	Regulatory stance is a grey area, some crypto exchange legislation, and some form of registration/licensing may be required.
2	Relatively unregulated, no licensing or registration required with financial/regulatory authorities. Minimal/no legislation.
1	No regulation or crypto exchange legislation to be found.

3. Regulatory/Legal

A. Legal Exchange Name
B. Registered as an MSB
C. Subsidiary Exchange Registered as MSB
D. Licensed
E. Subsidiary Exchange Licensed
F. KYC/AML
G. Part of Regulatory/Industry Group
H. Insurance Against Losses

3.A Legal Exchange Name

It is important that the **legal name** of each exchange is available publicly. This firstly enables the search of relevant company **documents**, country/regulatory **registrations** and **licenses**. It also allows one to **identify which legal parties** to file a complaint/legal dispute against and who is legally accountable if there is such an issue.

Ultimately, if no legal name can be found it can also be difficult to assess the quality of an exchange, where it is based, and who runs the company etc.

Therefore, our ranking takes into account whether a legal operating name for each exchange can be found. If so, it is awarded 5 points. If no name can be found, it receives 0 points.

Legal Exchange/Operator Name Found	Points
YES	5
NO	0

3.B Registered as an MSB (Money Services Business)

Several exchanges are registered as **money services business (MSBs)**. Although not obligatory in many jurisdictions, exchanges that are registered are normally subject to stricter reporting standards to those that are not.

For instance, those registered with **Financial Crimes Enforcement Network** (FinCEN) must identify ownership roles and controlling stakes within the company, establish a formal Anti-Money Laundering (AML) policy, enforce strict KYC procedures, and file any suspicious activity reports among several other obligations. Those registered with the **Japanese FSA** or the **UK Financial Conduct Authority (FCA)** may have similar reporting obligations.

Although we realise the not all jurisdictions will require this form of registration or may have different standards, we attempt to **reward exchanges that are registered with a regulatory authority** that maintains oversight over exchange activities. We attempt to provide a **general gauge** as to which exchanges have reporting obligations to regulatory authorities over how strict or comprehensive those reporting obligations are at this time. We also note that this metric may be biased in favour of fiat to crypto exchanges, given that crypto to crypto exchanges are generally less exposed to such requirements.

We make the assumption that when exchanges are licenced with a regulatory authority, this is also equivalent to being “registered as an MSB”. We do not assume the reverse however.

Ultimately, our main assumption is that exchanges that are **registered as MSB or equivalent**, are imposed to **stricter reporting standards** and **hence higher operational quality**. Exchanges that are registered, regardless of the regulatory authority are designated 10 points. Those that are not, receive zero points.

Registered as an MSB or Equivalent	Points
YES	10
NO	0

3.C Licensed Exchanges

Although not required in many jurisdictions, obtaining an exchange license firstly indicates that the exchange must maintain certain reporting, legal, and monitoring standards. It secondly indicates that an exchange is most likely compliant with local regulations.

The **State of New York** requires that cryptocurrency exchanges register with the New York State Department of Financial Services (NYSDFS) to obtain a **BitLicense**. This is contingent upon maintain specific operational standards and passing various reviews.

Similarly, **Japan** requires exchanges to register with the FSA such that they can obtain a license to operate. Other jurisdictions such as **Luxembourg** licenses exchanges via the Commission de Surveillance du Secteur Financier (CSSF) with a "payment institution license".

Not all exchanges must be licensed, however those that are licensed are assumed to operate under higher standards than those that are not. I.e. **A license implies a higher quality exchange**.

Licensed	Points
YES	10
NO	0

3D. Subsidiaries/Partners of Registered and/or Licensed Exchanges

Cryptocurrency exchanges have begun to expand to other jurisdictions as part of a wider growth strategy such that they can access additional markets overseas. It is therefore more common to see exchanges that **operate under similar partner names**, but in different jurisdictions.

We have seen this with Huobi Global (Huobi Korea, Huobi Japan, Huobi US), OKCoin(OKEx), and bitFlyer (bitflyer USA, bitFlyer Europe etc) among others.

Partner and/or parent exchanges, which **represent separate legal entities** from those at home, may in fact be registered and licensed in certain jurisdictions and not in others.

The assumption we make here is that despite exchanges being separate legal entities, the compulsory **reporting standards** imposed by the licenses of one partner exchange, may indicate and perhaps **influence the quality of another partner exchange across a jurisdiction** that may not impose such strict standards.

For this reason, we award 2.5 points to exchanges whose subsidiaries and/or parent exchange is registered as an MSB. We repeat this in the case of those that possess a license to operate.

Subsidiary/Parent Registered as an MSB	Points
YES	2.5
NO	0

Subsidiary/Parent Licensed	Points
YES	2.5
NO	0

3.E KYC/AML

As part of most anti-money laundering regulations, it is important that exchanges **identify users** before they are able to trade.

Many exchanges now implement **strict know your customer policies (KYC)** as a means of verifying identity such that any illicit activity can be monitored and tracked effectively.

As part of our ranking system, exchanges that require identification verification before trading is enabled, are awarded 5 points, while those that do not are awarded 0 points.

Data collection is based predominantly on terms and conditions pages of various exchanges. If no policy can be found from these pages, the exchange is assumed to implement a policy that does not require identity verification to trade.

Requires ID to Trade	Points
YES	5
NO	0

3.F Insurance Against Losses

Several exchanges have now started to offer insurance for certain funds held in custody by the exchange. Gemini and Coinbase are two such exchanges that have offered insurance via FDIC (Federal Deposit Insurance Corporation) for USD amounts up to $250k per user.

It is assumed that for exchanges to seek to offer such a service to their customers, they must first prove that they have met certain standards such that they can solicit the services of an insurer. Second it serves as a declaration of taking responsibility for unexpected losses that occur on the part of the exchange.

Exchanges that guaranteed coverage in terms of lost funds will ultimately expose users to a relatively lower risk service than exchanges that are yet to offer such a service. We consider the offering of such a service to be highly indicative of the quality of an exchange.

For this reason, exchanges that offer a form of insurance services for funds in custody are awarded 10 points, while those that do not offer insurance are awarded zero points.

Insurance	Points
YES	10
NO	0

3.G Member of Regulatory/Industry Group

Several cryptocurrency exchanges are regular members of cryptocurrency industry groups. Their respective purposes vary between developing a code of conduct within the industry, assisting in terms of innovation, or offering a form of self-regulation and advice to other cryptocurrency exchanges.

Examples include Japan's Virtual Currency Exchange Association (JVCEA), the Australian Digital Commerce Association (ADCA), and the Digital Currency Group (DCG).

We assume that if an exchange is a member of an industry group such as the above, their intentions are to generally **improve the space**, they are known in the industry and thus more **transparent**, and they importantly **maintain a code of conduct** their industry group in order to maintain their member status.

5 points are awarded when exchanges are a member of **at least one** industry group.

ADCA
AUSTRALIAN DIGITAL COMMERCE ASSOCIATION

DIGITAL CURRENCY GROUP

一般社団法人
日本仮想通貨交換業協会
JVCEA - Japan Virtual Currency Exchange Association

Member of a Cryptocurrency or Blockchain Industry Group	Points
YES	5
NO	0

4. Investment

In order to expand and develop, many cryptocurrency exchanges have attracted investments from large well-known venture capital firms or prominent technology companies.

We assume that the **calibre of the investor** can provide us with an indication of the quality of the exchange in three ways.

1. High quality investment banks, tech companies or professional VC firms invest in firms that meet a certain standards.
2. VC firms might invest in companies based on a selection of conditions or milestones that must be met moving forward. As result, exchanges may be required to operate to a certain standard in order to meet these conditions. Effectively, high quality investors might impose their quality standards on exchanges that they invest in.
3. Finally, exchanges that receive investments from prominent investors have larger sums of capital with which to improve their operational and legal standards.

Large Institutional/Professional VC/Prominent Tech Investment. We only award points based on investments from investors that have been operating for a minimum of 5 years and predominantly invest in non-crypto related industries. Exchanges that have received investments from these types of investors are awarded 10 points.

Smaller High Quality Investors. Similarly to the above, exchanges that have received investments from smaller well-known investors (VC/tech companies) are awarded 5 points.

For each investment category, if no investors could be found, they recieve zero points.

High Quality Investment Large Investor	Points
YES	10
NO	0

High Quality Investment Smaller Investor(s)	Points
YES	5
NO	0

5. Executive Management & Company Quality

The **calibre of the executive management team** and their level of **transparency** can be a clear proxy for how well an exchange is managed and accountable to any problems. Furthermore, the **age of an exchange** can provide us with a second gauge of infrastructure quality based on the assumption that older exchanges may have had the time to develop a more robust technical and legal infrastructure.

The first two metrics relate to **identity/transparency**, while the subsequent three metrics relate to **team/exchange quality**:

A. Identity of Executive Team
B. Public vs Private
C. Post-Graduate/Professional Degrees
D. Professional Experience
E. Exchange Age

The assumption here is that the **more transparent** and **experienced/educated** an exchange's executive team, and the **older** an exchange is, the **higher the quality** of the exchange.

5.A-B Identity and Transparency

A. Identity of Executive Team. The identity of the CEO, CTO and COO/CFO is registered in our dataset. If no such title is available, the closest match is noted (e.g. VP of Engineering vs CTO). Those responsible for each position are searched for via company pages and linkedin. Each Identity that is found will receive 5 points. Those that cannot be found receive 0 points. The maximum points available are 15 points.

Identity of Exec Member (CEO/CTO/CFO)	Points
Found	5
Not Found	0

B. Public vs Private. Several exchanges make it very difficult to find the identity of those responsible. For those that are not transparent and clear about those that run the company via public web pages, we designate to them a “private” tag (0 points). Exchanges whose executive staff are publicly and easily available will receive a “public” tag (10 points).

Transparency	Points
Public	10
Private	0

5.C-E Executive Quality and Exchange Age

C. Post-Graduate/Professional Degrees. As a measure of executive quality for each position, those that have attained either a masters degree or an additional professional qualification (e.g. CFA) will receive 5 points. Those that have not, will receive 0 points.

Post-Graduate/Professional Degree	Points
YES	5
NO	0

D. Professional Experience. This metric assumes that executives with more experience will be better at their respective roles. For the CEO, we gauge the number of years of experience at manager/director to c-level. For the CTO we gauge the number of years of experience in software related roles. For the CFO/COO we measure the number of years of experience in general. Points are scored used a threshold system.

Professional Experience	Points
Years = 0	0
0 < Years≤ 2	1
2 < Years≤ 5	3
5 < Years≤ 10	7
Years>10	10

E. Exchange Age. The number of years of operation since launch can provide us with a measure of infrastructure quality based on the assumption that older exchanges may have had the time to develop a more robust technical and legal infrastructure. Ages are measured in years and scored using a tiered system. Older exchanges are scored higher than younger exchanges.

Exchange Age	Points
Years ≤ 1	1
1<Years ≤ 3	3
3 < Years≤ 5	5
5 < Years≤ 7	7
Years>7	10

6. Data Provision

This section assesses the quality of the API of an exchange. The following metrics were collected:

A. API Average Response Time (ms)
B. Ability to Query Historical Trades
C. Offers Websocket Connection
D. Provides Order Book API Endpoint
E. API Rate Limits

6.A Average API Response Time

API Response Time: Defined as the average time taken for an exchange to begin responding to a request once they have received it. This was designed to measure the efficiency of an exchanges infrastructure.

It is measured across four publicly available endpoints, each polled five times consecutively, 2000ms apart.

For high frequency traders, this metric is particularly important as it forms the basis of being able to react to new market information swiftly and to place orders at low latency.

The **lower** the average response time, the **better the rating**. This metric was scored using the basic threshold system on the right.

Threshold	Points
0 < Time ≤ 150	5
150 < Time ≤ 400	4
400 < Time ≤ 700	3
700 < Time ≤ 1000	2
1000 < Time ≤ 2000	1
2000 <Time	0

6.B Ability to Query Historical Trades

Ability to Query Historical Trades: refers to whether an exchange offers any public API endpoints that allow users to query for historical trades at any point in the past.

This is an important metric in terms of transparency and accountability as it allows users or authorities to cross-check any calculated values at certain points in time.

Ratings were assigned based based on a YES or NO response. Exchanges that offer the ability to query historical trades were awarded 5 points, while those that do not were awarded 0.

Response	Points
YES	5
NO	0

6.C Websocket Connection

Websocket Connection (WS): A websocket connection provides a standardized way for an exchange server to send data to a user without being first requested by the client (i.e. REST API).

Instead of a client requesting data from an exchange via an API, a user can maintain an open connection that “listens” for data, allowing a stream of data to pass back and forth between the user and the exchange. Web sockets are capable of much larger quantities of data transfer and at higher rates than REST APIs.

Ratings were assigned based based on YES or NO response. Exchanges that offer a WS connection were awarded 5 points, while those that do not were awarded 0.

Response	Points
YES	5
NO	0

6.D Order Book API Endpoint

Order Book: An order book contains a list of orders that an exchange uses to record the interests of buyers and sellers. A matching engine uses the order book to determine which orders can be filled.

The provision of an order book API endpoint provides users with the ability to gauge current order book depth, likely pricing consequences and risk of placing a market order at a given time, as well as signs as to where price might move next. Exchanges that do not offer this endpoint effectively hide important information regarding the characteristics of a market and how this changes over time.

Ratings were assigned based based on YES or NO response. Exchanges that offer an order book endpoint were awarded 5 points, while those that do not were awarded 0.

Response	Points
YES	5
NO	0

6.E API Rate Limits

Exchanges make their data public via an API (Application Programming Interface). Users are able to query data using various API endpoints.

Exchanges will vary in terms of the amount of **data requests per minute** (times a users can query data) they offer publicly to users. If a user exceeds the allocated rate limit (number of maximum requests per API endpoint), they will be unable to access data via the API.

In terms of data provision, exchanges that offer **higher rate limits** per minute are given a **higher score** than those that offer fewer rate limits.

Threshold (minutes)	Points
0 < Rate Limit ≤ 100	1
100 < Rate Limit≤ 400	2
400 < Rate Limit≤ 700	3
700 < Rate Limit≤ 1000	4
Rate Limit>1000	5

7. Trade Surveillance

Several high profile exchanges have employed the services of **third party trade surveillance providers** to monitor and flag any **suspicious trading activity**. Examples of these providers include Irisium Market Surveillance, Nasdaq SMARTS, and NICE Actimize.

In the current exchange ranking model, we make the assumption that exchanges that engage with a formal external market surveillance provider are more **transparent** and able to **detect** and **report** any illicit trading activity, and are therefore of **higher quality in terms of trade monitoring**.

There are exchanges that implemented their own “internal” trade monitoring systems. Given that this process is not conducted as independently, we assume that it is less of a quality signal than a formal system that is independently administered by a known surveillance provider.

For the above reasons, we award 5 points to exchanges that implement external formal trade surveillance provision, and 2.5 points to those that have formally stated the use of their own internal monitoring systems. Exchanges that do not explicitly mention any formal trade monitoring system are awarded 0 points.

Formal Trade Surveillance Provision	Points
YES - EXTERNAL	5
YES - INTERNAL	2.5
NO	0

Appendix B - Market Quality Methodology

Introduction

As part of providing an assessment of exchanges, it is important to also include a representative picture of what trading looks like on their markets.

The metrics defined here are designed to separate exchanges which behave differently to the average exchange. Metrics are converted into ranking scores which are aggregated into the total exchange ranking.

We first present common metrics often used to describe a market, followed by metrics which can be shown to isolate specific unusual trading behaviours.

1. Market Cost to Trade (spread)
2. Liquidity (depth)
3. Stability (volatility)
4. Behaviour Towards Market Movement - (volatility & volume correlation)
5. “Natural” Market Behaviour (standard deviation of volume)

Data Collection

Pairs	BTC-USD, BTC-USDT, BTC-ETH, BTC-KRW, BTC-JPY ETH-USD, ETH-USDT, and ETH-KRW, ETH-JPY
Time Period	1st - 30th May 2019
Trade Data	Transaction level data which provides insight into matches between two parties. It is used to calculate minute volatility and to measure an exchanges volume. Collection method: REST API polling on exchanges at exchange rate limits.
Order Book Data	Provides a view of all limit orders (offers to trade) on a particular market at any given moment. It is used to calculate spread and depth. Collection method: REST API polling snapshots.*

*CryptoCompare streams order books for the most notable exchanges via websocket connection; however, for the purposes of this report and to allow for the collection of the broadest dataset possible we scaled out using the more widely available REST APIs.

Scoring Market Quality

Comparative

Used when a metric varies greatly between different markets, so we rank each exchange and market combination relative to its peers on a market by pair basis.

Following an ordered sort (direction is specific to each metric), a score of 0-10 is distributed across the group.

$$score(i) = \left\lfloor \frac{10i}{n} \right\rfloor \quad where\ i\ = position\ in\ the\ list$$

- Average spread
- 1% depth
- Minute volatility

Threshold

Used when a metric is completely market agnostic, so a threshold can be applied to fairly rank it across any market.

Pearson's correlation is one such measure which we can assign a fixed score to any given value.

- Volatility & volume correlation

Comparative + Threshold

Used when a metric varies greatly between different markets, but also when a logical threshold can be applied.

A threshold might be a fixed figure or one based on a group average or median.

- Standard deviation of trading volume

Each **exchange** receives an **aggregate score** based on an average of the markets we tested.

A Note on Aggregate Scoring

The pairs that were chosen for this report capture the majority of volume of crypto trading, and as such should give a fairly representative picture of exchanges.

A possible implication of focusing on just the specific markets considered in this report is that exchanges whose primary purpose is to cater to a specific jurisdiction (e.g. an exchange whose most liquid trading pairs are in GBP) may appear to have descriptive market metrics which under-represent the true liquidity on these exchanges. These exchanges will not, however, be penalised by other metrics unless the markets show particularly unusual trading behaviour.

1.a Market Cost to Trade - Average Spread

Spread is the difference between the best bid (the highest price at which someone is willing to buy) and the best ask (the lowest price at which someone is willing to sell).

Spreads are tight when markets are liquid. While they may widen in times of volatile price movements, the average spread gives an idea of the liquidity of the market, and quantifies how risky market makers believe the exchange is.

Higher spreads make it costlier to trade and increase market friction.

$$spread = \mathbb{E}(ask - bid)$$

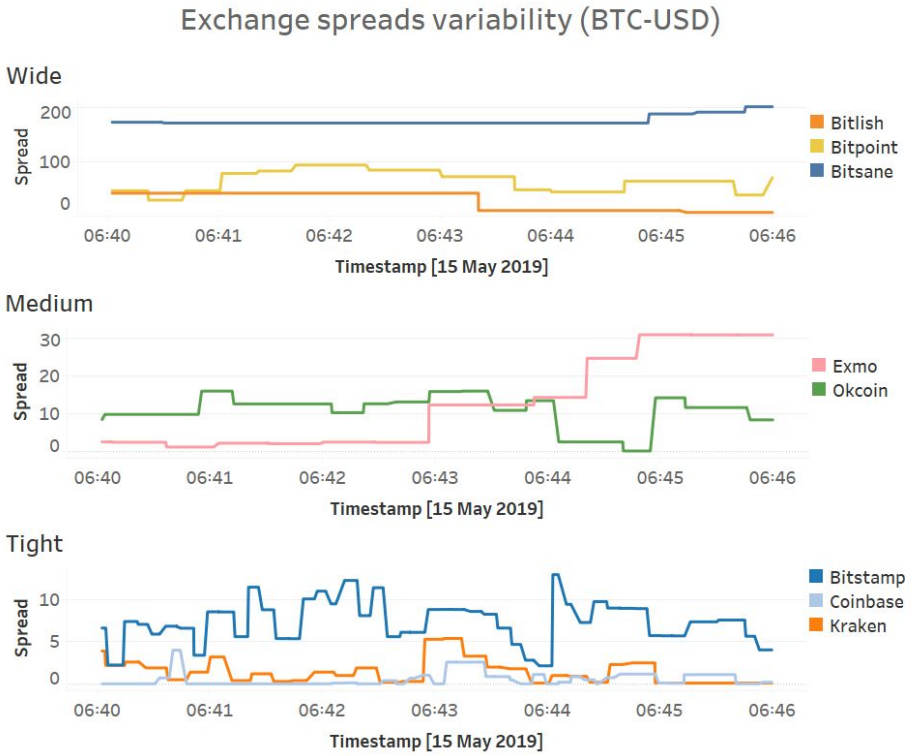
Bid and ask values were collected every 5 seconds (subject to exchange rate limiting) and averaged across 1 - 30 May. The long time period used for data collection was chosen to allow for accurate average spread values to be estimated even in the presence of API downtime and differing rate limits.

1.b Spread Overview

Generally, those exchanges which offer incentives to provide liquidity through either low or negative maker fees will achieve the tightest spreads.

Due to the spread being calculated using the best bid and offer, it is misleading to use it as a sole gauge of liquidity and therefore as the market cost to trade; it must be used in conjunction with a depth measurement to find the likely transaction price for any given size of transaction.

The spreads on some notable exchanges are shown on the right hand chart to display their variability even on relatively short time horizons (5 mins).



1.c Scoring Average Spread

Define metric | Score across each market | Aggregate

Higher spread = Lower score
Lower spread = Higher score

Comparative

We rank each exchange and market combination relative to its peers on a market by pair basis.

Following an ordered sort (direction is specific to each metric), a score of 0-10 is distributed across the group.

$$score(i) = \left\lfloor \frac{10i}{n} \right\rfloor \quad where\ i\ = position\ in\ the\ list$$

Exchange	Market	Metric	Metric Score
Exchange A	BTC-USD	40	0
Exchange B	BTC-USD	28	0
Exchange C	BTC-USD	20	1
Exchange D	BTC-USD	15	1
Exchange E	BTC-USD	12	2
...	...	...	...
Exchange R	BTC-USD	3	8
Exchange S	BTC-USD	2.3	9
Exchange T	BTC-USD	1.5	9
Exchange U	BTC-USD	0.9	10
Exchange V	BTC-USD	0.8	10

Exchange	Markets	Aggregated Metric Score
Exchange B	BTC-USD ETH-USD ETH-BTC	8.4
Exchange C	ETH-USD ETH-KRW ETH-JPY	8.0
Exchange A	BTC-USD BTC-KRW ETH-BTC	6.5
Exchange D	BTC-JPY ETH-BTC	6.2
Exchange E	BTC-USDT ETH-USDT ETH-BTC	5.9

2.a Liquidity - Average 1% Depth

Market depth is the total volume of orders in the order book. It provides an idea of how much it is possible to trade on an exchange, and how much the price is likely to move if large amounts are traded.

An exchange with greater average depth is likely to be more stable (i.e flash crashes are much less likely) and allows trading of greater amounts at better prices.

We consider the depth up to 1% either side of the mid price.

$$depth = \mathbb{E}\left(\frac{depthUp + depthDown}{2}\right)$$

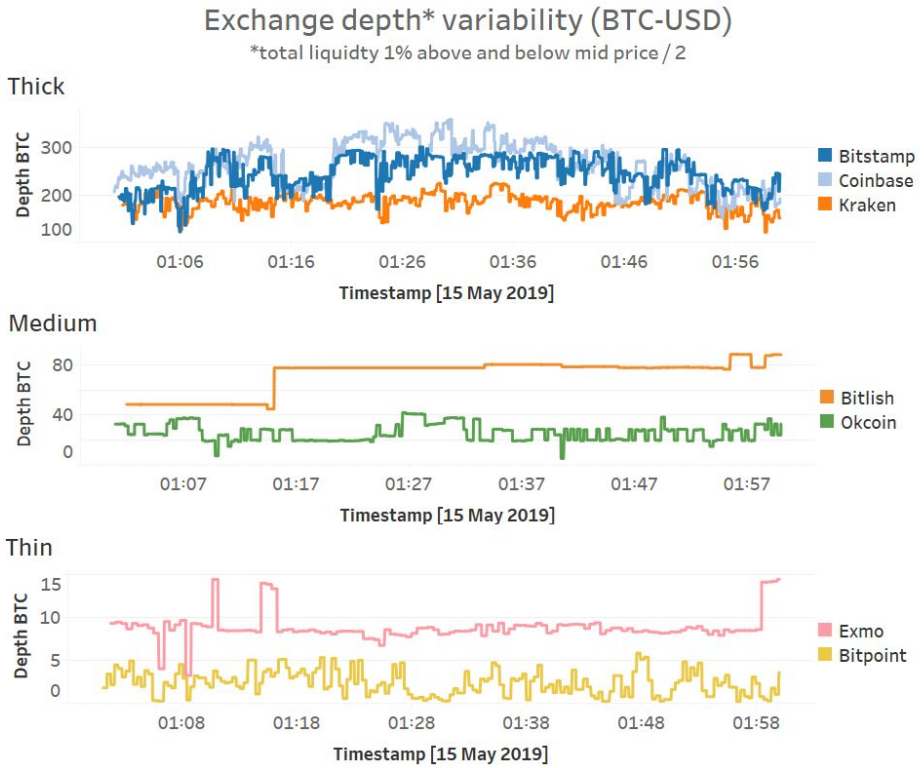
Where depthUp is the total volume that would be required to move the price by 1% upwards from the mid price, and depthDown is the total volume that would be required to move the price by 1% downwards from the mid price.

2.b Depth Overview

Generally, those exchanges which offer incentives to provide liquidity, through either low or negative maker fees, will achieve the deepest order books.

Exchanges that attract the most trading activity will naturally have more orders resting on their book at larger sizes, increasing the depth.

There are stark differences in the depth between exchanges, as shown on the right hand chart. Depth tends to stay relatively constant throughout any given day, but news and other price impacting events can cause sharp changes.



2.c Scoring Average 1% Depth

Define metric | Score across each market | Aggregate

Less depth = Lower score
More depth = Higher score

Comparative

We rank each exchange and market combination relative to its peers on a market by pair basis.

Following an ordered sort (direction is specific to each metric), a score of 0-10 is distributed across the group.

$$score(i) = \left\lfloor \frac{10i}{n} \right\rfloor \quad where\ i\ = position\ in\ the\ list$$

Exchange	Market	Metric	Metric Score
Exchange A	BTC-USD	6	0
Exchange B	BTC-USD	12	0
Exchange C	BTC-USD	16	1
Exchange D	BTC-USD	56	1
Exchange E	BTC-USD	100	2
...	...	...	...
Exchange R	BTC-USD	500	8
Exchange S	BTC-USD	534	9
Exchange T	BTC-USD	611	9
Exchange U	BTC-USD	900	10
Exchange V	BTC-USD	1456	10

Exchange	Markets	Aggregated Metric Score
Exchange B	BTC-USD ETH-USD ETH-BTC	8.4
Exchange C	ETH-USD ETH-KRW ETH-JPY	8.0
Exchange A	BTC-USD BTC-KRW ETH-BTC	6.5
Exchange D	BTC-JPY ETH-BTC	6.2
Exchange E	BTC-USDT ETH-USDT ETH-BTC	5.9

3.a Stability - Minute Volatility

When trading the same asset across exchanges, it is preferable to have lower volatility. Measures of market risk such as the Sharpe ratio use the volatility of an asset.

As we would prefer lower risk when holding an asset on an exchange, we would also prefer lower volatility.

$$volatility = \sigma \left(\frac{price_t - price_{t-1}}{price_t} \right)$$

To calculate the metric, price is bucketed into minutes and the volatility is calculated using the close price of each minute bucket over a rolling 6H period. The volatility is then averaged over the full time period (1st-30th May).

3.b Scoring Minute Volatility

Define metric | Score across each market | Aggregate

Higher volatility = Lower score
Lower volatility = Higher score

Comparative

We rank each exchange and market combination relative to its peers on a market by pair basis.

Following an ordered sort (direction is specific to each metric), a score of 0-10 is distributed across the group.

$$score(i) = \left\lfloor \frac{10i}{n} \right\rfloor \quad where\ i\ = position\ in\ the\ list$$

Exchange	Market	Metric	Metric Score
Exchange A	BTC-USD	0.3	0
Exchange B	BTC-USD	0.18	0
Exchange C	BTC-USD	0.12	1
Exchange D	BTC-USD	0.11	1
Exchange E	BTC-USD	0.10	2
...	...	...	...
Exchange R	BTC-USD	0.04	8
Exchange S	BTC-USD	0.03	9
Exchange T	BTC-USD	0.01	9
Exchange U	BTC-USD	0.009	10
Exchange V	BTC-USD	0.003	10

Exchange	Markets	Aggregated Metric Score
Exchange B	BTC-USD ETH-USD ETH-BTC	8.4
Exchange C	ETH-USD ETH-KRW ETH-JPY	8.0
Exchange A	BTC-USD BTC-KRW ETH-BTC	6.5
Exchange D	BTC-JPY ETH-BTC	6.2
Exchange E	BTC-USDT ETH-USDT ETH-BTC	5.9

4/5 Metrics to Identify Unusual Behaviour

Recent industry focus has centred around highlighting suspicious trading behaviour on exchanges. There has, however, been a shortage of clear and transparent methodologies published for ascertaining whether trading is suspicious for a given market.

We provide a summary of metrics deemed to give a good assessment of whether the trading on an exchange conforms to behaviour that one might generally expect to see. Each of these metrics are designed to single out specific types of trading behaviour.

Behaviour towards market movement - volatility & volume correlation

We analyse the correlation between volume and volatility and use this to provide insights into the types of market participants trading on exchanges, and consider how this differs from the aggregate average.

Natural trading behavior - standard deviation of trading volume

We analyse the standard deviation of trading volumes over different time periods and show that this metric can be used to separate two very different trading behaviours on an exchange.

4.a Behaviour Towards Market Movement

Volatility & volume correlation

The relationship between market volatility and volume can be used to glean an insight into the sorts of trading activity which are being carried out on an exchange.

To explain the modes of trading behaviour seen on exchanges, we define two types of market participants:

- Market makers operate on exchanges, and aim to make a profit while maintaining a market neutral position. They provide liquidity and narrow spreads on a market . Generally, they make money from payments from the exchange, through arbitrage, or on the bid-ask spread.

- Investors are defined here as traders who take a position in the market. They make money based on the price movements of the asset.

4.b An ‘Investor Market’

Investors who take a position in the market are likely to trade more actively in times of volatility.

Price movements may cause limit orders to be filled and new investors will likely join the market to react to price movements.

The end result of this is that volume is positively correlated with price volatility.

4.c A ‘Maker Market‘

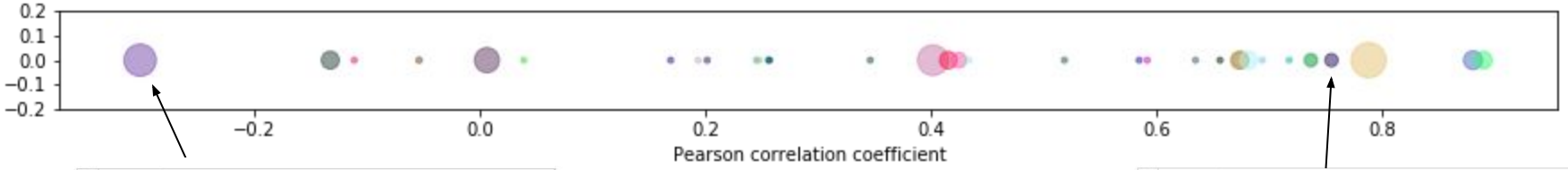
In times of high volatility it becomes less certain that market makers are able to hedge any trade they make effectively.

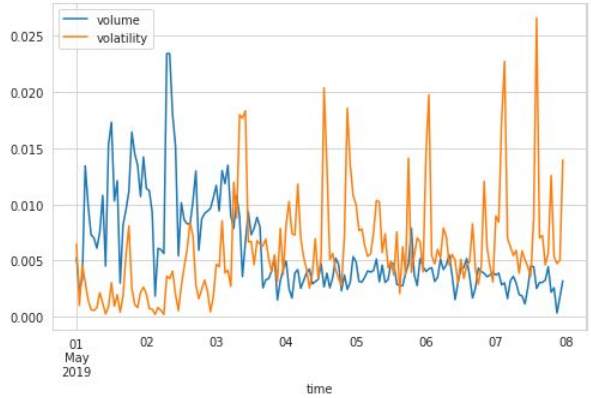
They therefore reduce volumes at each position or increase the spread they are willing to provide for the market. This makes the asset less liquid and means that smaller trades will cause larger price movements.

To avoid large slippage, traders therefore need to trade smaller amounts and the volume becomes negatively correlated to the volatility.

4.d Differentiating Between Types of Market

Taking the Pearson correlation coefficient between hourly trading volume and standard deviation of trade-on-trade return we can separate exchanges which operate with trading in each of these regimes. Size of the marker represents reported trading volume.



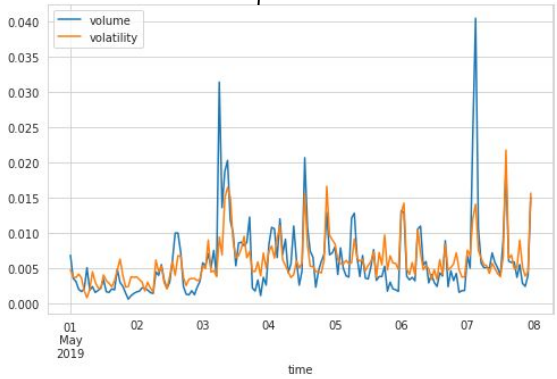


FCoin

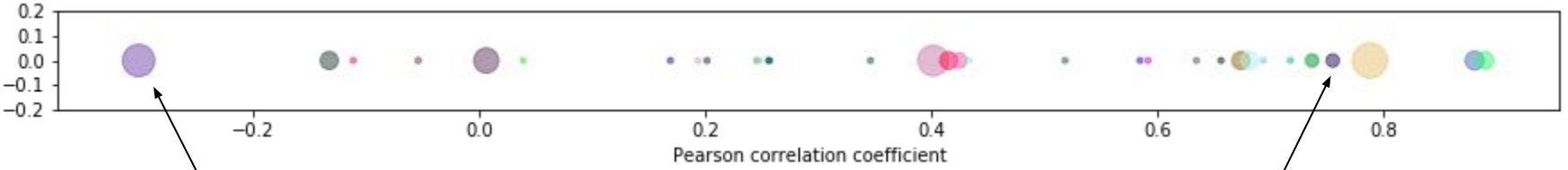
'Maker market'

HuobiPro

'Investor market'



4.e Differentiating Between Types of Market



'Maker market'

'Investor market'

4.f The Market as a Whole

Both types of behaviour occur in traditional financial markets, but to define what we expect for a cryptocurrency market we turn to a market aggregate.

Here we use the CryptoCompare Index (CCCAGG) as an example of a wide market index. The volume can be seen to correlate with price movements. This is therefore considered to be the preferred behaviour for an exchange.

4.g Scoring Behaviour Towards Market Movement

Volatility & Volume Correlation

Define metric | Score across each market | Aggregate

Low or negative correlation = Lower score
High positive correlation = Higher score

Threshold

A correlation threshold can be applied to fairly rank it across any market.

Pearson's correlation is one such measure which we can assign a fixed score to any given value.

The table on the right sets out the thresholds for each score.

Correlation	Metric Score
<= 0	0
< 0.12	1
< 0.19	2
< 0.27	3
< 0.35	4
< 0.42	5
< 0.5	6
< 0.58	7
< 0.65	8
< 0.73	9
>= 0.73	10

Exchange	Markets	Aggregated Metric Score
Exchange B	BTC-USD ETH-USD ETH-BTC	8.4
Exchange C	ETH-USD ETH-KRW ETH-JPY	8.0
Exchange A	BTC-USD BTC-KRW ETH-BTC	6.5
Exchange D	BTC-JPY ETH-BTC	6.2
Exchange E	BTC-USDT ETH-USDT ETH-BTC	5.9

5.a Natural Trading Behavior

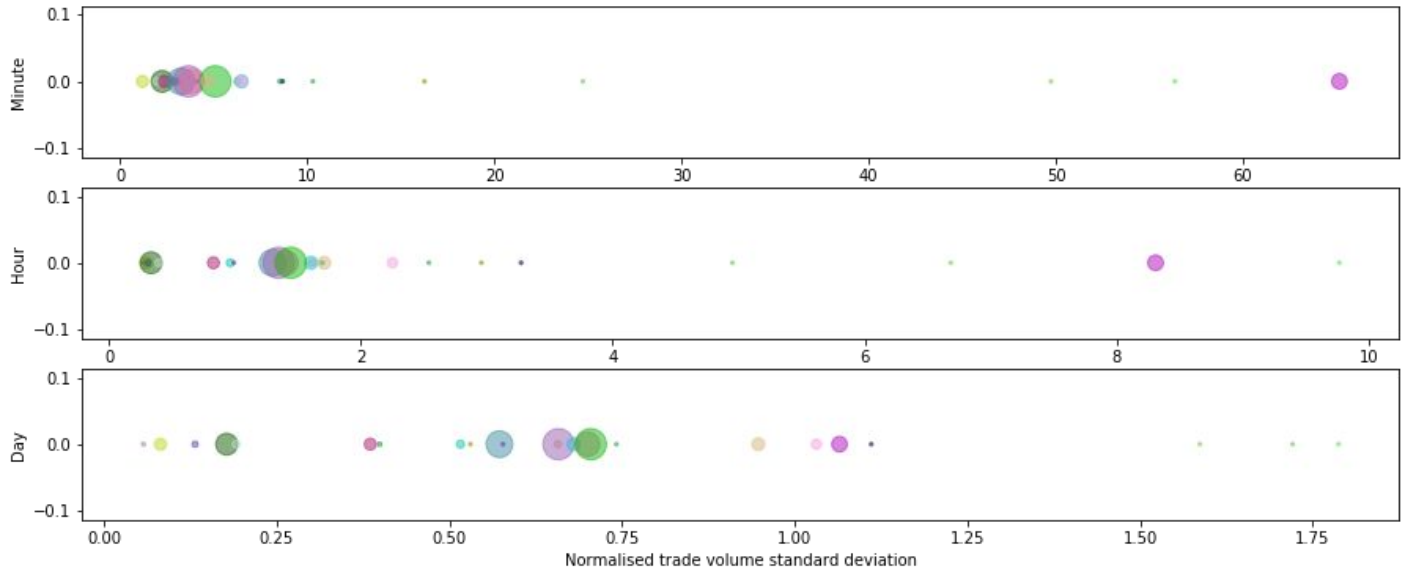
Standard deviation of trading volume

While, as previously discussed, we might expect price volatility to affect trading volume, it is unlikely that in a time of constant price volatility the trading volume would remain constant.

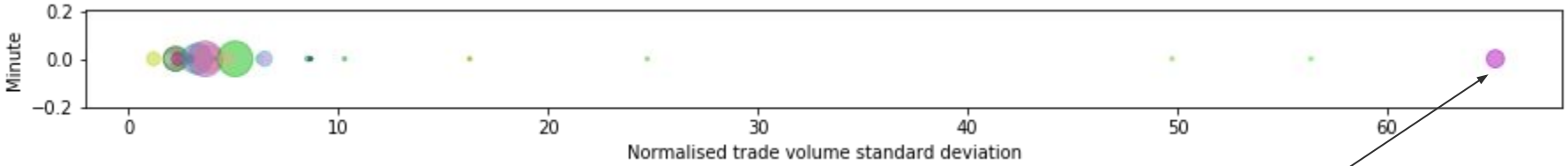
This behaviour is explored by considering how much the minutely, hourly and daily volume vary on average using the standard deviation.

5.b Varying the Time Period

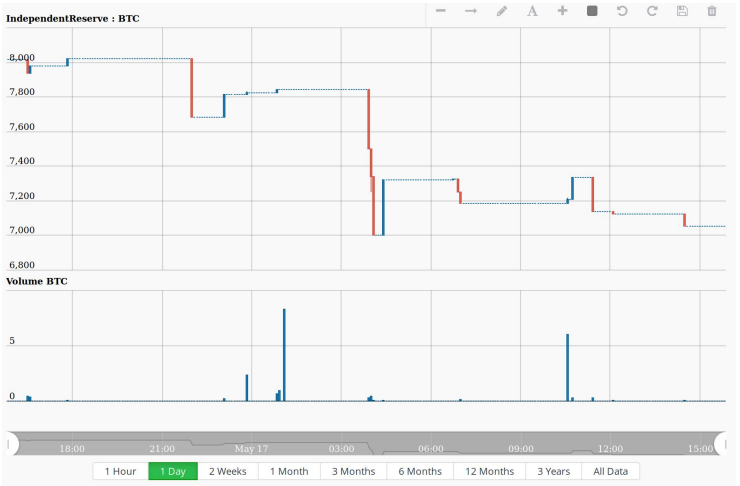
We take the standard deviation of the trading volume over different time periods, and normalise by the mean trading volume for the period.



5.c Small Time Periods

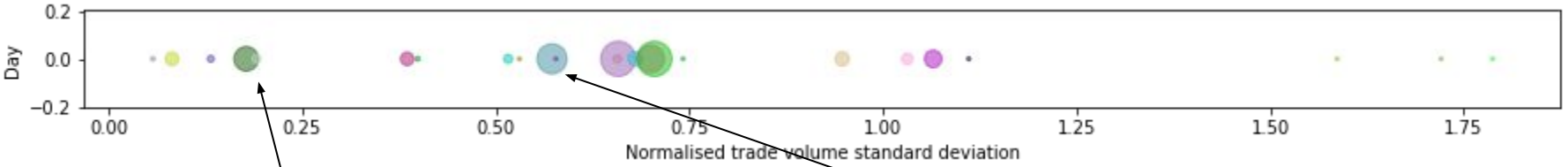


Outliers at small time periods are caused by exchanges which trade very infrequently.



5.d Long Time Periods

Groups at longer time periods (1 day volume) display clear demarcation of the target behaviour.



5.e Scoring Natural Trading Behavior

Standard deviation of trading volume

Define metric | Score across each market | Aggregate

Low standard deviation = Lower score
High standard deviation = Higher score

Comparative + Threshold

Following a ascending sort, a median standard deviation is determined.

Every constituent with a higher standard deviation than the median is given a score of 10.

With the remaining constituents, a score of 0-10 is distributed across the group.

Exchange	Market	Metric	Metric Score
Exchange A	BTC-USD	0.03	0
Exchange B	BTC-USD	0.09	1
Exchange C	BTC-USD	0.10	2
Exchange D	BTC-USD	0.13	3
...	...	...	...
Exchange K	BTC-USD	0.43	10
...	...	...	...
Exchange S	BTC-USD	0.71	10
Exchange T	BTC-USD	0.81	10
Exchange U	BTC-USD	0.85	10
Exchange V	BTC-USD	0.91	10

Exchange	Markets	Aggregated Metric Score
Exchange B	BTC-USD ETH-USD ETH-BTC	8.4
Exchange C	ETH-USD ETH-KRW ETH-JPY	8.0
Exchange A	BTC-USD BTC-KRW ETH-BTC	6.5
Exchange D	BTC-JPY ETH-BTC	6.2
Exchange E	BTC-USDT ETH-USDT ETH-BTC	5.9

Appendix C - Points and Grading Summary

Points Categories

A. Geography
B. Legal/Regulatory Assessment
C. Investment
D. Team/Company Quality
E. Data Provision Quality
F. Trade Surveillance
G. Market Quality
H. Inflation Score (*not used in ranking)

Points Categories A-C

A. Geography	Scoring	B. Legal	Scoring	C. Investments	Scoring
Country Quality	0-5	Legal Company Name	Found: 5 Not Found:0	Funding by Large VC or Non-Crypto Established Company	YES: 10 NO: 0
Exchange Regulation Score	0-5	Registered as an MSB	YES:10 NO: 0	Funding by Smaller VC Companies	YES: 5 NO: 0
Total Geography Points	0-10	Subsidiary Exchange Registered as MSB	YES: 2.5 NO: 0	Total Investment Points	0-15
		Licensed	YES: 10 NO: 0		
		Subsidiary Exchange Licensed	YES: 2.5 NO: 0		
		KYC/AML	YES: 5 NO: 0		
		Part of Regulatory/Industry Group	YES: 5 NO: 0		
		Insurance Against Losses	YES: 10 NO: 0		
		Total Legal Points	0-40		
Re-Scaled Geography Points Available	**10**	**Re-Scaled Legal Points Available**	**10**	**Re-Scaled Investments Points Available**	**10**

Points Categories D-F

A. Team/Company	Scoring	B. Data Provision	Scoring	C. Trade Surveillance	Scoring
Transparency	Public: 10 Private: 0	API Average Response Time (ms)	0 < Time < 150: 5 150 < Time < 400: 4 400 < Time < 700: 3 700 < Time < 1000: 2 1000 < Time < 2000: 1 2000 <Time: 0	Market Surveillance System	YES: 2.5 NO: 0
CEO	Found:5 Not Found: 0	Ability to Query Historical Trades	YES:5 NO: 0	External/Internal (if YES to above)	External:2.5 Internal: 0
CTO	Found:5 Not Found: 0	Offers Websocket Connection	YES: 5 NO: 0	Total Trade Surveillance Points Available	5
CFO/COO	Found:5 Not Found: 0	Provides Order Book API Endpoint	YES: 5 NO: 0		
CEO/CTO/CFO Masters or Post-Graduate Certification *Repeat for each executive	YES:5 NO:0 *(15 Total)*	API Rate Limits	0 < Rate Limit < 100: 1 100 < Rate Limit< 400: 2 400 < Rate Limit< 700: 3 700 < Rate Limit< 1000: 4 Rate Limit>1000: 5		
CEO/CTO/CFO Experience *Repeat for each executive For CEO: director to c-level For CTO: software roles For CFO/COO: all roles	Years = 0: 0 0 < Years< 2: 1 2 < Years< 5: 3 5 < Years< 10: 7 Years>10: 10 *(30 Total)*	Total Data Provision Points Available	25		
Exchange Age Since Launch	Years < 1: 1 1<Years < 3: 3 3 < Years< 5: 5 5 < Years< 7: 7 Years>7: 10		YES: 5 NO: 0		
Total Team/Company Points Available	0-80		YES: 5 NO: 0		
Re-Scaled Team/Company Points Available	**10**	**Re-Scaled Data Provision Points Available**	**10**	**Trade Surveillance Points Available**	**5**

Points Categories G-H

A. Market Quality	Scoring	B. Inflation Score	Scoring
Market cost to trade (average spread)	0-10	Competitions	YES:5 NO: 0
Liquidity (average depth of 1% price impact)	0-10	Airdrops	YES: 2.5 NO: 0
Stability (minute volatility)	0-10	Transaction Fee Mining	YES: 15 NO: 0
Behaviour towards sentiment (volatility and volume correlation)	0-10	Margin Trading	YES: 5 NO: 0
Natural trading behaviour (volume standard deviation)	0-10	No Fees	YES: 5 NO: 0
Total Market Quality Points	0-50	Total Inflation Points	0- 32.5
Re-Scaled Market Quality Points Available	**20**	**Re-Scaled Inflation Score Available**	**10**

Points Aggregation and Grading

Scores from each category were aggregated to form a total cumulative score. The **maximum score is 75.**

These scores are then re-scaled to 0 - 100 based on the score of the exchange that scored the highest (Exchange Max). Therefore, this is a relative grading system.

Exchange Re-Scaled Score =
Exchange Score/Exchange Max * 100

This process was repeated for each exchange. Grades are then assigned based on various thresholds.

Category	Maximum Points
Geography	10
Legal	10
Investments	10
Management/Company	10
Data Provision	10
Trade Surveillance	5
Market Quality	20
Total Cumulative Points Available	**75**

Threshold (Re-Scaled Scores)	Grade
90-100	AA
80-89	A
70-79	B
55-69	C
45-54	D
30-44	E
30<	F

Appendix D - Full Metrics List

Metrics Categories and Available Fields

1. Incentive Schemes and Exchange Tokens (8)
2. Fees (6)
3. Geography/Nationality (7)
4. Legal/Regulatory (17)
5. Investment/Business (12)
6. Company/Management Team (19)
7. Data Provision (10)
8. Market/Trading Characteristics (5)
9. Exchange Type/Services (2)
10. Web Traffic (4)

Total Fields Available: 90
Total Active Exchanges: 112

1. Incentive Schemes and Exchange Tokens

Metric	Description	Data Format
1.a Competitions	Has the exchange conducted a trading competition in the last year?	Bool (Yes/No)
1.b Margin Trading	Does the exchange offer margin trading?	Bool (Yes/No)
1.c Trans-fee Mining	Does the exchange implement a trans-fee mining model?	Bool (Yes/No)
1.d No Fees	Does the exchange offer free trading?	Bool (Yes/No)
1.e Airdrops	Does the exchange enable the distribution of airdrop tokens for promotion purposes or in competitions?	Bool (Yes/No)
1.f Exchange token	Does the exchange enable the trading and or use of its own proprietary exchange token?	Bool (Yes/No)
1.g Exchange token name	Name and ticker of the exchange's token.	Qualitative Details
1.h Exchange Token Features	What features does the proprietary token possess?	Qualitative Details

2. Fees

Metric	Description	Data Format
2.a Average Taker	Represents the average between the minimum taker and maximum taker trading fee.	Numerical (units in %)
2.b Taker Min	Represents the minimum taker fee on the exchange.	Numerical (units in %)
2.c Taker Max	Represents the maximum taker fee on the exchange.	Numerical (units in %)
2.d Average Maker	Represents the average between the minimum maker and maximum maker trading fee.	Numerical (units in %)
2.e Maker Min	Represents the minimum maker fee on the exchange.	Numerical (units in %)
2.f Maker Max	Represents the maximum maker fee on the exchange.	Numerical (units in %)

3. Geography/Nationality

Metric	Description	Data Type
3.a Arbitration Jurisdiction	According to the terms and conditions or other, which country laws must be used in the case of any legal dispute with a customer.	String
3.b Legal/Registered Jurisdiction	Represents the country in which the exchange is registered	String
3.c Exchange Nationality	According to Linkedin profiles or other sources, which nationality do those running the exchange most likely represent?	String
3.d Countries of Operation	Which country or countries does the exchange operate in, and/or have offices?	String
3.e Headquarters	In which country is the main operational headquarters located?	String
3.f Country Governance Quality	According to the exchange's legal/registered jurisdiction, what level of institutional quality does this jurisdiction represent. Ratings are derived from the World Bank's WGI ratings. Max score: 5.	Numerical
3.g Country Crypto Regulation Score	What is the level of stringency with respect to cryptocurrency exchange regulation in the jurisdiction in which it is registered? Max score: 5	Numerical

4. Legal/Regulatory

Metric	Description	Data Type
4.a Operating Company/Legal Entities	What is the exchange's legal name? Who operates the exchange?	String
4.b MSB	Is the exchange registered as MSB or similar/equivalent?	Bool (Yes/No)
4.c MSB Registration Details	In which country and with which regulatory authority or other is the exchange registered?	String
4.d MSB_Sub	Are any of the exchanges subsidiaries/partner/parent companies registered as an MSB or similar/equivalent?	Bool (Yes/No)
4.e MSB_Sub Registration Details	In which country and with which regulatory authority or other is the subsidiaries/partners/parent companies registered?	String
4.f Licensed	Has the exchange be granted authorisation or a license to operate in its current jurisdiction (if applicable)	Bool (Yes/No)
4.g License Details	Which authority has granted this authorisation? Which license has been granted?	String
4.h License Location(s)/Region	In which country or region is this authority located?	String
4.i Licensed_Sub	Have any of the exchange's subsidiaries/partner/parent companies be granted authorisation or a license to operate in their current jurisdictions (if applicable). Which license has been granted?	Bool (Yes/No)
4.j License_Sub_Details	Which authority has granted this authorisation to the exchange's subsidiaries/partner/parent companies? E.g Japan FSA	String
4.k License_Sub Location(s)/Region	In which countries or regions are these authorities located?	String
4.l Reg/Blockchain Group	Is the exchange and/or subsidiaries/partner/parent companies a member of a self-regulatory group or industry blockchain group?	Bool (Yes/No)
4.m Reg/Blockchain Group (s) Details	Names of the regulatory or blockchain or similar group that the exchange/subsidiary/partner is a member	String
4.n Reg/Blockchain Group Entity	If main exchange not part of reg/blockchain group, which subsidiary/parent/partner company is?	String
4.o KYC/AML	Is identity verification required on the exchanges? Assume larger trade tier or withdrawal of fiat/token.	Bool (Yes/No)
4.p Insurance	Does the exchange offer/provide insurance against losses? This excludes lender insurance or for contracts/margin trading.	Bool (Yes/No)
4.q Insurance Provider	If available, who is the insurance provided by?	String
4.r Amount Insured	Up to what amount is insured?	String

5. Investment/Business

Metric	Description	Data Type
5.a Banking Partners	Which bank(s) is the exchange partnered with?	String
5.b Strategic Partners	Which companies is the exchange associated with for strategic purposes?	String
5.c Fund Raising Mechanism(s)	How has the exchange raised funds in the past? E.g. VC (Series A-C)/Angel/Seed	String
5.d Investor_Large	Is the exchange funded by very a large traditional high quality investor/VC/tech/Other finance firm?	Bool (Yes/No)
5.e Investor_Small	Funded by group of smaller well-known traditional VC firms/investors, or tech holding company?	Bool (Yes/No)
5.f Major Investors/Owners/Founders	Which VC/Tech/Other firms have invested in the exchange and/or partners/parent/subsidiary exchanges? Who are the owners/founders?	String
5.g Monthly Revenue Estimate	What is the monthly revenue estimate from trading fees? Monthly revenue is derived from average monthly volume (Feb, March, April) x (Av. Taker Fee + Av. Maker Fee)	Numerical (USD)
5.h Average Monthly Volume	Average monthly volume is derived from the average of the months of February, March and April in USD.	Numerical (USD)

6. Company/Team

Metric	Description	Data Type
6.a Transparency	To what extent has the exchange been transparent about who runs the company? Have the executive team been easy to find? Possible tags include: private/public.	String
6.b Staff Count	What are the estimated number of staff that work at this exchange? Figures are derived from Linkedin/Crunchbase profiles where available.	Numerical
6.c Management Team Notes	Additional notes (if available) that explain the nature of the employees running the company.	String
6.d CEO	What is the name of the CEO or equivalent	String
6.e CEO Masters Degree	Does the CEO have a masters degree or a professional qualification (e.g. CFA)	Bool (Yes/No)
6.f CEO Masters Degree Details	Where did the CEO obtain his or her masters degree, and in which field?	String
6.g CEO Years Exp at Director to C-level	How many years of professional experience has the CEO attained in director/manager to c-level roles?	Numerical
6.h CTO	What is the name of the CTO/equivalent	String
6.i CTO Masters Degree	Does the CTO have a masters degree or a postgraduate professional qualification?	Bool (Yes/No)
6.j CTO Masters Degree Details	Where did the CTO obtain his or her masters degree, and in which field?	String
6.k CTO Years Exp (in software/tech roles)	How many years of professional experience has the CTO attained in software-related roles?	Numerical
6.l CFO/COO	What is the name of the CFO/COO/equivalent	String
6.m CFO/COO Masters Degree	Does the CFO/COO have a masters degree or a professional qualification (e.g. CFA)	Bool (Yes/No)
6.n CFO/COO Masters Degree Details	Where did the CFO/COO obtain his or her masters degree, and in which field?	String
6.o CFO/COO Years Exp	How many years of professional experience has the CFO/COO attained?	Numerical
6.p Exchange Start	When did the exchange launch?	Date (Month, Year)
6.q Exchange Current Age	How many years have passed since the exchange originally launched?	Numerical (years)

7. Data Provision

Metric	Description	Data Type
7.a IP Country	IP address of the public REST API as returned by https://ipinfo.io/	String
7.b IP Region	Geographic region of the public REST API as returned by https://ipinfo.io/	String
7.c ISP	ISP used by the public REST API as returned by https://ipinfo.io/	String
7.d API Av. Connection Latency - London	API Average Connection Latency from London (ms)	Numerical (ms)
7.e API Av. Response Time	How long does it take on average, from the time an exchange has received an API data request, for the first byte of data to be sent back to the the user? Average response time is measured in milliseconds (ms)	Numerical (ms)
7.f Public API Rate Limit	What is the exchange's public API rate limit (requests/minute). I.e. how many requests/calls can a user make to public endpoints until they are prevented access to data?	Numerical (calls/min)
7.g Websocket Connection	Does the exchange provide a websocket (WS) connection?	Bool (Yes/No)
7.h Historical Trade Data	Does the exchange offer historical trade data via REST or WS using a trade ID/timestamp/page to query?	Bool (Yes/No)
7.i API Order Book	Does the exchange provide an API order book endpoint?	Bool (Yes/No)

8. Market/Trading Characteristics & 9. Exchange Type/Services

Metric	Description	Data Format
8.a Live Pairs	How many pairs are currently available to trade on this exchange?	Numerical
8.b Fiat Capability	Does the exchange enable trading of crypto to fiat pairs?	Bool (Yes/No)
8.c Formal Market Surveillance Tool	Does the exchange have a formal market surveillance tool in place, or use an external surveillance provider to monitor suspicious or illicit trading activity?	Bool (Yes/No)
8.d Surveillance Tool Details	If applicable, who does the exchange use as a market surveillance provider? What is the name of the internal system the exchange uses? E.g. Irisium Market Surveillance	String
8.e Internal/External Provider	Is trading surveillance provided internally or via an external surveillance provider?	String

Metric	Description	Data Format
9.a Exchange Type	Is this exchange centralised or decentralised?	String
9.b Exchange Services	What services including and in addition to spot trading does this exchange offer? E.g. OTC trading or derivatives trading.	String

10. Web Traffic

Metric	Description	Data Format
10.a Average Alexa Ranking	Represents the average Alexa ranking per exchange over over Feb, March, April	Numerical
10.b Average Daily Page Views	Represents the average daily page views over Feb, March, April	Numerical (per day)
10.c Average Page Views per Visitor	Represents the average daily page views per user over Feb, March, April	Numerical (per day)
10.d Implied Number of Daily Visitors	Represents the implied number of visitors per day. Average daily page views divided by average daily page views per visitor = implied number of daily visitors.	Numerical (per day)

Contact

CryptoCompare Research

research@cryptocompare.com

Team

Constantine Tsavliris

Ben Hunter-Craig

James Huckle

Quynh Tran-Thanh

Special thanks to the content and support teams for their data collection assistance.