CryptoCompare

Exchange Liquidity Report

About CryptoCompare

CryptoCompare is a global leader in digital asset data providing institutional and retail investors with high-quality real-time and historical data. Leveraging its track record of success in data expertise, CryptoCompare's thought-leadership reports and analytics offer objective insights into the digital asset industry.

About This Report

Liquidity is of utmost importance in the context of best execution risk and trading analytics. This report discusses liquidity and several metrics most often associated with its measurement such as trading volumes, depth and spread. However, when assessing certain metrics (such as spread), they need to be explained in the context of market fee microstructure. We exemplify these concepts and compare data across a series of Top-Tier exchanges as determined by CryptoCompare's Exchange Benchmark Methodology. Access to data for analytical purposes is important for making informed data-driven decisions that capitalise on opportunities. Exchanges allow varying levels of access to market data via APIs. This report also aims to provide a comparison of api-related metrics across several of the top exchanges.

Explore the data on the CryptoCompare API

For those interested in accessing CryptoCompare's data for their own purposes, including cryptocurrency trade data, order book data, blockchain data, social data or historical data across thousands of cryptocurrencies and 200+ exchanges, please take a look at CryptoCompare's API here: https://min-api.cryptocompare.com.

For questions related to our research or any potential requests, feel free to contact our research department at **research@cryptocompare.com**.

Disclaimer

The content found in this report is for informational purposes only, you should not construe any such information or other material as legal, tax, investment, financial, or other advice.

The Exchange of Choice for Institutional Traders

Bitstamp has been a cornerstone of the cryptocurrency industry since 2011, earning a reputation as the most stable, secure and reliable trading venue in crypto.

Powered by Nasdaq trading technology

Diversified pool of liquidity

- Structured to enable best all-in price for both makers and takers
- Execute block trades without destabilizing prices

Professional-grade trading tools

- Fastest APIs and highest uptime in crypto
- Matching engine from Nasdaq ensures efficient execution

Trade with peace of mind

- 24/7 support with a human touch
- Institutional-grade custody and asset insurance

TO LEARN MORE, VISIT BITSTAMP.NET/INSTITUTIONAL-TRADING/

Bitstamp

Contents

Executive Summary

This report compares API features and liquidity metrics (on BTC and ETH markets) for a selection of top-tier exchanges including Coinbase, Bitstamp, Bitfinex, Kraken, Gemini, LMAX Digital, OKCoin, Bittrex, CEX.io and Binance US. This report has sourced the majority of its data from CryptoCompare's proprietary API, which aggregates order book and trade data across hundreds of exchange APIs. For comparability purposes, the data assessed in this report is from June 2021.

API Comparison:

Exchange APIs provide a gateway for market participants to analyze and take advantage of market data in order to make better decisions. A superior API can provide participants with a better tool kit to analyze this data. In this regard, there was no clear exchange that stood out. Bitstamp has the highest rate limit, but provides no historical trade data. Coinbase provides Level III order book data, but has a low API rate limit. Several exchanges such as Bitstamp, Coinbase and Bitfinex provide FIX connectivity, while Kraken and Binance US do not.

Measuring Liquidity via Trade Data:

Trading Volume provides a high-level overview of whether an exchange services a liquid or an illiquid market by representing total transaction value executed over some period of time. However, certain less regulated exchanges may artificially inflate volumes via crypto-specific incentive schemes which give the erroneous illusion of high liquidity.

On BTC/USD and ETH/USD markets, in June 2021 Coinbase traded the highest average daily volumes of $699mn and $595mn respectively, followed by Bitfinex ($405mn and $203mn) and LMAX Digital ($309mn and $109mn). BTC/EUR and ETH/EUR markets were topped by Kraken, with an average daily volume of €122mn and €50mn respectively, followed by Bitstamp (€78mn and €30mn) and Coinbase (€62mn and €39mn).

A Granular Look into Liquidity via Order Book Metrics:

A far more robust and comprehensive measure of liquidity can be provided using granular order book data, which allows us to logically organize all the buyers' and sellers' orders by price and amount on any given market. From this information we can extract metrics such as spread, depth and slippage.

Spread (best ask - best bid) represents the cost to trade. Tighter spreads are typically a proxy for higher liquidity, and are a direct function of exchange fee structure, the level of competition on a given market, and the presence of designated market makers.

USD markets have tighter spreads than EUR markets overall, while BTC markets have tighter spreads than ETH markets. On BTC/USD, exchanges with the tightest median spreads were Coinbase ($0.01), Kraken ($0.10) and Bitfinex ($2.0), while those with the widest spreads were Bitstamp ($18.4), and LMAX Digital ($15.0). Similarly, Kraken and Coinbase also had the tightest spreads on ETH/USD with $0.01 and $0.02 respectively.

Spreads are naturally wider on exchanges where participants always pay a fee because a market maker must achieve a minimum breakeven spread to account for the higher cost to trade. On exchanges where market makers are able to achieve zero-fee trading (e.g. with designated market makers or lower zero-fee volume tiers), traders

are able to breakeven on a roundtrip trade for anything over a 1-tick spread value (where spread gravitates) - this is the case for some participants on Coinbase and Kraken.

Most exchanges implement a maker-taker model (makers charged less than takers), while some implement balanced structures where participants pay the same regardless of whether they are a maker or a taker (e.g. Bitstamp). A more balanced structure tends to naturally widen spreads, as there is no pricing advantage between being a maker and crossing the spread to "take" the current best price.

Depth illustrates the cumulative quantity of all the current bid and ask orders waiting in a given order book from a range of buyers and sellers at various price points some % above or below the current market mid-price. It is therefore the most direct measure of available liquidity as it indicates whether a certain order can be filled and at what price.

Kraken, Bitfinex, Coinbase and Bitstamp have the highest 0.1% and 1% order book depth across both BTC and ETH markets trading into USD and EUR. On exchanges that advantage makers over takers in terms of pricing, participants are incentivized to place more limit orders on the books as they are charged less. However, this incentive to add orders to the book becomes attenuated when a more balanced fee structure is implemented that charges makers and takers equally (e.g. Bitstamp). Therefore, while being a highly useful liquidity metric, the limit orders in the book do not account for the "taker" liquidity waiting in the background.

Slippage represents the percentage difference between the current market price for an asset and the price a trader would pay (or receive) after an order is matched. High slippage can be seen as the consequence of having a shallow order book (low depth), i.e. low liquidity.

Slippage is generally lower for USD pairs compared to EUR pairs across all exchanges. This is likely due to these markets being notably larger by volume and depth. On the other hand, slippage was similar for Bitcoin pairs compared to Ethereum pairs.

For a simulated $10k order (buy or sell), LMAX Digital, Bitstamp and Bitfinex produce the lowest mean slippage values for both BTC/USD and ETH/USD markets. Meanwhile, across BTC/EUR and ETH/EUR markets, Kraken, Bitstamp and Bitfinex produce the lowest slippage values.

Our analysis suggests that out of the 10 exchanges in question, Coinbase, Kraken, Bitfinex, Bitstamp, and LMAX Digital consistently performed well in most liquidity metrics during the time period examined.

Introduction

Since the launch of Bitcoin in 2009, cryptocurrency markets have followed a paradigm shift from a previously unregulated, obscure marketplace to one with a more defined market structure. In the early years, the lack of infrastructure meant the asset class was the wild wild west of financial markets. One only has to look at the failure of counterparties such as Mt. Gox, a Japanese exchange, to understand the opaque nature of the market in its early innings.

Since then, we have seen the rise of capable counterparties in the space that have together built the infrastructure necessary for the asset class to succeed. This includes the presence of custodians, regulated asset management products, and a developed ecosystem of spot and derivative exchanges. A well-structured exchange is pivotal for efficient and fair markets, and market makers, retail investors and high frequency traders (HFT) will have varying needs in their search for an appropriate exchange venue, particularly in regards to the following:

Data Provision via exchange APIs allows a user to pull specific data (such as trade data or order book metrics) from an exchange. CryptoCompare plays a key role in aggregating such data from hundreds of exchanges and providing a holistic overview of the market. This report includes an assessment of exchange APIs and data availability, as well as two of the main factors that attract and deter market participants to a certain exchange – liquidity and fee structure.

Exchange Liquidity is an area of acute focus in financial markets as it relates to a range of risk factors that market participants must consider. *Brokers* might assess liquidity in a way that allows them to concentrate on best execution. *Institutions* and *long-term holders* may focus on price discovery – an illiquid exchange with a lack of buyers and sellers may see a divergence between quoted prices and fair asset values. *Market makers* and *HFTs* will typically assess how liquidity combined with fee structures may impact their profit margins and trading strategies. While a tight spread is usually a prime indicator of liquidity, a trader may prefer an exchange with a slightly wider spread if it allows them to accommodate a given trading strategy more effectively.

Market Fee Structure is important as this may incentivize specific participants to move to a certain exchange, and also helps to put certain liquidity metrics (such as spread) in context. For example, a zero-fee maker model (with potential designated market makers) might be common amongst the top exchanges. On the other hand, this may not be beneficial to other participants, such as takers or lower-volume investors, who bear higher fees and may be able to attain marginally better prices at exchanges where fees are split more equally regardless of whether a participant is a maker or taker. It is therefore important to highlight that there is an intertwining nature between liquidity metrics and fee structures, and the two should be examined hand in hand when evaluating an exchange.

Overview of Exchanges Included in this Report

For the analyses included in this report, we have limited our selection to a series of exchanges that offer BTC and ETH trading, quoted across USD or EUR. Our exchange selection is also based on reputation, size in terms of trading volume, and top-tier status as determined via the **CryptoCompare Exchange Benchmark**.

Bitstamp (AA)

A global crypto exchange which has been operating since 2011, based in the UK. It provides specified services for an array of counterparties, including Brokers, Neo Banks and Hedge Funds. It also provides 'Crypto-as-a-Service' for financial institutions to enable their customers access to crypto markets.

Kraken (AA)

Kraken is a United States-based cryptocurrency exchange founded in 2011, with entities in Europe. It offers varying degrees of service for beginner to sophisticated investors and institutions, and in September 2020 became the first exchange to also offer banking services after it received a license from Wyoming, USA.

coinbase (AA)

A leading cryptocurrency exchange that launched in 2012, Coinbase became the first crypto exchange to go public in April 2021 at a close to $100bn valuation. It has over 56m verified users and also provides broker, custodial, and crypto commerce services.

GEMINI (AA)

Gemini is a digital asset exchange founded by Cameron and Tyler Winklevoss in 2014 based in New York. It operates in over 50 countries and provides institutional solutions, including being the first exchange to offer custodial services in 2018.

LMAX DIGITAL (A)

LMAX Digital (founded 2018) is part of LMAX Group: an independent operator of global institutional exchanges for FX and cryptocurrency trading. LMAX Digital allows global institutions to acquire, trade and hold the most liquid digital assets - BTC, ETH, LTC, BCH and XRP safely and securely.

BITTREX (A)

Bittrex is a cryptocurrency exchange founded in 2014 by three Amazon and Microsoft alumni. It has over 700 pairs available to trade, and also has an educative 'discover' page that details the characteristics of a range of cryptocurrencies.

OKCOIN (A)

Founded in 2013, OKCoin provides traders and institutions with a fiat-to-token trading platform for digital assets including Bitcoin, Ethereum, Litecoin, and many more assets. The company has offices in San Francisco, Malta, Hong Kong, and Beijing. It represents the fiat-onramp exchange services of global crypto exchange OKEx.

CEX·IO (A)

CEX.IO entered the cryptocurrency exchange market in 2013, and has 4m users worldwide. Apart from spot and derivative market access, it provides a platform for trading contracts-for-difference (CFDs) and has a payment platform for businesses.

BINANCE.US (A)

Launched in 2019, Binance.US is a digital asset marketplace, powered by matching engine and wallet technologies licensed from Binance. Operated by BAM Trading Services based in California, Binance.US is designed to provide a fast, secure and reliable platform to buy and sell cryptocurrencies in the United States.

BITFINEX (A)

A Hong Kong/BVI-based cryptocurrency exchange founded in 2012. Apart from spot, OTC, and derivative market access, it also provides access to peer-to-peer financing. Users can join the Bitfinex Affiliate Program which allows them to earn additional fees via referrals.

Where Crypto Enters Finance

Serving traders and financial institutions since 2011.

Bitstamp — JOIN 4 MILLION CUSTOMERS

Data Provision Across Exchange APIs

Exchange APIs allow users to access live and historical market data which can provide insights into liquidity, risk, and the path of best trade execution from venue to venue. However, not all exchanges provide the same level of information through their APIs.

What is an API?

An API, or application programming interface, is a messenger that allows two applications to communicate in order to perform tasks such as sending or retrieving data to or from a remote database. In the context of cryptocurrency exchanges, an API allows a user to pull specific data (such as trade data or order book metrics) directly from an exchange. These data requests are accomplished via software programs written in Python or C++, for example. The programs can then display this data in the form of a widget, a dashboard, or serve as an input to automated trading software.

Comparison Metrics

APIs can be compared in various ways, such as data allowances permitted per minute, the types of data feeds available and data granularity.

Public API Rate Limits – This is the number of times a user may request data available via public market data REST APIs over some interval of time. If a user exceeds the allocated rate limit they will be unable to access data via the API for a set amount of time. Higher rate limits allow users to request more data over a set period of time. The Bitstamp API has the highest rate limit, allowing users to make 800 requests per minute (rpm), followed by Binance.US and Okcoin with 600rpm. Kraken, CEX.IO, Bitfinex and Gemini all limit users to between 60-120 requests per minute.

Public API Rate Limits (Requests/Minute)				
Bitstamp	BINANCE.US	OKCOIN	coinbase	GEMINI
800	600	600	180	120
BITFINEX	kraken	BITTREX	CEX·IO	
90	60	60	60	

WebSocket Connectivity - WebSockets enable an open channel between the user and the data source such that a user can retrieve a continuous stream of live data. This allows much larger quantities of data transfer and at higher rates than REST APIs that otherwise require continuous polling for live data. All APIs investigated provide WebSocket connectivity.

WebSocket Connectivity				
Bitstamp	**BINANCE.US**	**OKCOIN**	**coinbase**	**GEMINI**
✓	✓	✓	✓	✓
BITFINEX	**kraken**	**BITTREX**	**CEX·IO**	
✓	✓	✓	✓	

FIX Connectivity - FIX, or Financial Information eXchange, is a standardized electronic communications protocol used by brokers, portfolio managers, and exchanges within the traditional finance space worldwide to exchange securities transaction information. FIX eliminates redundancy in data transfer, allowing for faster communication of real time data - data can thus be integrated more easily from exchanges that offer FIX connection. FIX is offered by seven of the ten exchanges, including Coinbase, Bitstamp, and Bitfinex. WebSockets are versatile for maintaining open data channels but FIX was created specifically for finance, being used by large institutional players such as CME, and is compatible with almost every commonly used network technology.

FIX Connectivity				
Bitstamp	**BINANCE.US**	**OKCOIN**	**coinbase**	**GEMINI**
✓	✗	✗	✓	✓
BITFINEX	**kraken**	**BITTREX**	**CEX·IO**	
✓	✗	✗	✓	

Example FIX Message

```
8=FIX.4.2 | 9=178 | 35=D|
34=972 | 49=ABCD | 56=XYZ|
52=20210206-16:25:10.403|
11=14163685067084226997921|
38=100 | 40=2 | 54=1 |
44 = 39095.03 | 55 = BTC/USD|
60=20190206-16:25:08.968|
10=106
```

translates to -->

Begin string and protocol version	FIX.4.2
Message Length (9)	178 characters
Message Type (35)	New Order Single
Message Seq Number (34)	972
Sender Comp ID (49)	ABCD
Receiver Comp ID (56)	XYZ
Send Time (52)	20210206-16:25:10.403
Order ID (11)	14163685067084226997921
Quantity (38)	100
Order Type (40)	Limit Order
Side (54)	Buy
Price (44)	39095.03
Symbol (55)	BTC/USD
Order Creation Time (60)	20190206-16:25:08.968
Checksum (10)	106

Public Historical Trade Data - Are users able to publicly query the **full history** of trade data by timestamp or ID? This data can be used to build models and forecast strategies for those that require tick by tick granularity. APIs that allow users access to historical trade data also increase the transparency and accountability that is often required from customers of crypto exchanges. This data is not offered publicly by AA exchanges such as Bitstamp or Coinbase, but is available from exchanges such as Kraken and Bitfinex.

Full Public Historical Trade Data

Bitstamp	BINANCE.US	OKCOIN	coinbase	GEMINI
✗	✓	✓	✗	✓

BITFINEX	kraken	BITTREX	CEX·IO
✓	✓	✓	✓

Historical Candlestick Data - Are users able to publicly access the full history of open, high, low, close and volume trade data, and to what granularity is this available? This is a more holistic overview of trade data, and provides a user with clearer insight into trade statistics over a customisable time horizon. This data is easier to read and store than raw trade data. Offered publicly by all exchanges besides Bittrex, OHLCV data is very versatile, being used for volatility analysis and pattern recognition - it is a valuable dataset to many users.

Historical Candlestick Data (Minimum Granularity)				
Bitstamp	**BINANCE.US**	**OKCOIN**	**coinbase**	**GEMINI**
✓(1 min)	✓(1 min)	✓(1 min)	✓(1 min)	✓(1 min)
BITFINEX	**kraken**	**BITTREX**	**CEX·IO**	
✓(1 min)	✓(1 min)	✗	✓(1 min)	

Maximum Order Book Level - Does the exchange provide full L3 order book data (un-aggregated, gives insight into individual orders), L2 data (aggregated orders), or only L1 data (best available prices in the order book). The higher level of the order book an API offers, the more data users can access.

- **LEVEL 1**: Highest price of bid, lowest price of ask, and last price of transaction as well as bid, ask and last, sizes.
- **LEVEL 2**: Aggregated orders, with prices, sizes, and last transaction details.
- **LEVEL 3**: Unaggregated orders, with all bid and ask prices, and sizes.

Bitstamp, Coinbase, OKCoin, and Bitfinex are the only exchanges offering public access to level III order book data. This unaggregated data allows a user to see individual orders within each price point to see how many participants are placing orders at each level. All exchanges provide at least level II data.

Maximum Order Book Level				
Bitstamp	**BINANCE.US**	**OKCOIN**	**coinbase**	**GEMINI**
3	2	3	3	2
BITFINEX	**kraken**	**BITTREX**	**CEX·IO**	
3	2	2	2	

Summary of API Comparison Metrics

	Public API Rate Limit (Req/min)	WebSocket Connectivity	FIX Connectivity	Full Public Trade History	Historical Candlestick (Granularity)	Max OB Level
Bitstamp	800	✓	✓	✗	✓ (1')	**3**
BINANCE.US	600	✓	✗	✓	✓ (1')	2
OKCOIN	600	✓	✗	✓	✓ (1')	**3**
GEMINI	120	✓	✓	✓	✓ (1')	2
BITFINEX	90	✓	✓	✓	✓ (1')	**3**
coinbase	60	✓	✓	✗	✓ (1')	**3**
kraken	60	✓	✗	✓	✓ (1')	2
BITTREX	60	✓	✗	✓	✗	2
CEX·IO	60	✓	✓	✓	✓ (1')	2

*LMAX Digital operates a private API due to its institutional-only client base, and thus has been excluded from the API Comparison. We note that they provide their clients with FIX Connectivity, Trade History, and Level 3 OB data.

Through CryptoCompare's API, we have collected historical data that allows us to evaluate the liquidity of various top-tier exchanges, which will be presented in the next section of this report. **For more information on exchange comparisons, consider the CryptoCompare API, which aggregates order book and trade data across 304 exchanges, in real time and historically.**

Liquidity Across Top-Tier Exchanges

Liquidity refers to the **ease at which an asset on a given market can be bought or sold without a significant change to the underlying price of the asset.** We have selected several metrics with which to compare liquidity across the top exchanges. These metrics include: *volume*, *spread*, *depth* and *slippage*.

Metrics Based on Trade Data

Trading Volume

Summary
Trading volume provides insight into the liquidity of a market by representing total transaction value executed over some period of time. However, certain less regulated exchanges may artificially inflate volumes via crypto-specific incentive schemes which give the erroneous illusion of high liquidity.   - On BTC/USD and ETH/USD markets, in June 2021 **Coinbase** traded the highest average daily volumes of $699mn and $595mn respectively, followed by **Bitfinex** ($405mn and $203mn) and **LMAX Digital** ($309mn and $109mn – excluding private room volumes).   - BTC/EUR and ETH/EUR markets were topped by **Kraken**, with an average daily volume of €122mn and €50mn respectively, followed by **Bitstamp** (€78mn and €30mn) and **Coinbase** (€62mn and €39mn).

A typical measure of liquidity in traditional markets is trading volume, which represents the **aggregated number of asset units executed** over some period of time, expressed in fiat terms (USD, EUR etc). It is a useful measure of liquidity because it represents the value of the transactions that have occurred, and therefore indicates the ease at which one can execute a trade; If trading volumes are high, the ease at which one can exchange their asset for cash is high, and therefore liquidity is high.

Across top-tier venues for USD markets, Coinbase leads with the highest volume for both BTC/USD and ETH/USD markets, with $699mn and $595mn respectively. Bitfinex follows with $405mn and $203mn respectively.

Average Daily Volumes in June 2021 (BTC/USD and ETH/USD)

Coinbase and Bitfinex trade the highest volumes across both Bitcoin and Ethereum markets.

Volume ($Mn)

Legend: BTC/USD (green), ETH/USD (dark)

Exchange	BTC/USD	ETH/USD
COIN	699	595
BITF	405	203
LMAX	309	159
KRAK	232	188
BITS	170	100
GEMI	106	70
BINA	84	64
OKCO	24	11
BITT	18	11
CEXI	8	10
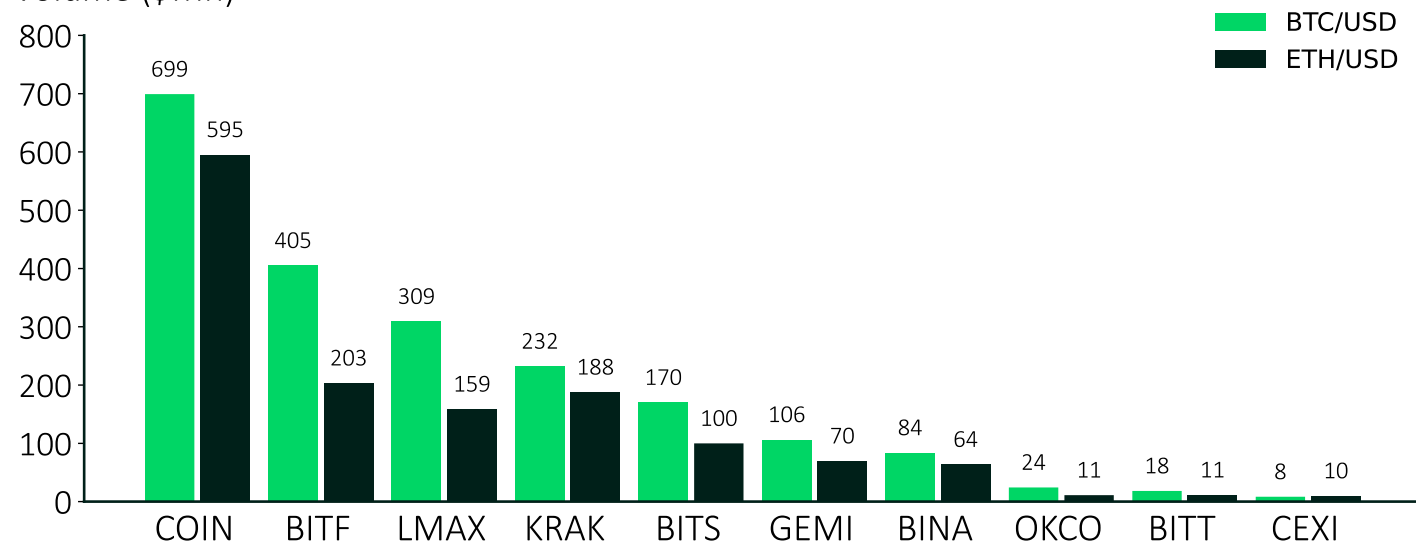
Average Daily Volumes in June 2021 (BTC/EUR and ETH/EUR)

Kraken trades the highest volumes across both Bitcoin and Ethereum Euro markets followed by Bitstamp and Coinbase.

Volume (€Mn)

Legend: BTC/EUR (green), ETH/EUR (dark)

Exchange	BTC/EUR	ETH/EUR
KRAK	122.3	50.0
BITS	77.9	29.7
COIN	61.5	38.9
BITF	19.9	11.7
LMAX	19.6	7.4
CEXI	1.7	1.1
BITT	1.0	0.6
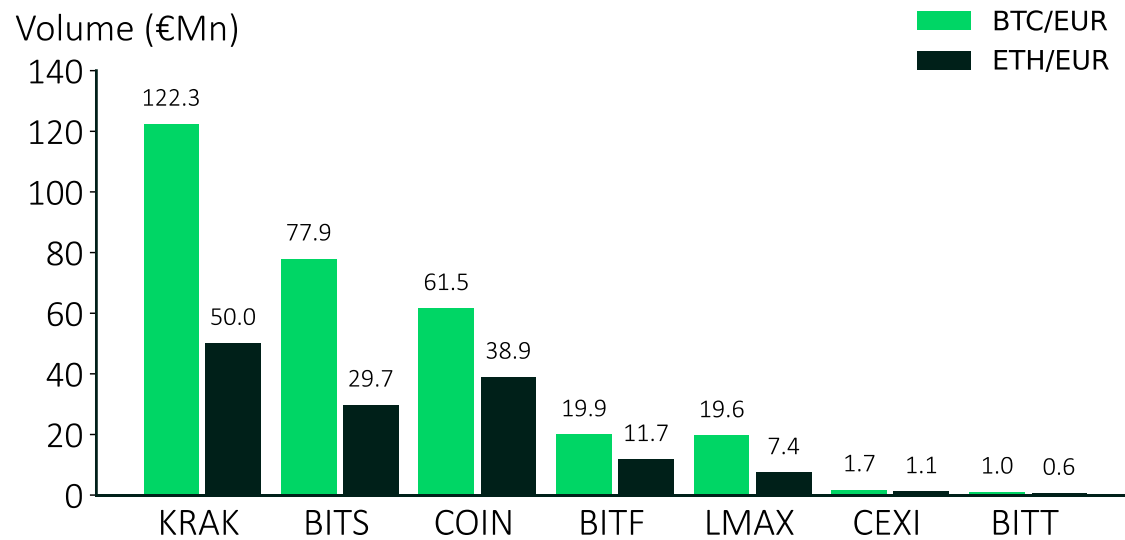
LMAX volumes exclude private room trading.

Meanwhile, across the top venues for EUR markets, Kraken boasts the highest volume for both BTC and ETH markets, recording an average daily volume of €122mn and €50mn respectively.

Why volume might not always be the most reliable liquidity metric for less regulated venues

While this may be a reliable proxy within existing regulated traditional markets, the cryptocurrency industry as a whole and its participants are still relatively unregulated. This has set the stage for a host of crypto-specific incentive schemes and products used to encourage more trading and higher volumes. These include the issuance of specialised exchange tokens, trading competitions, transaction-fee mining and airdrop events, to name a few.

For example, Bithumb's BTC/KRW trading volumes appear to inflate as a direct consequence of their "Super Airdrop Festival" and "Special Gift" promotional events in late 2018:

BTC/KRW Hourly Volume During Bithumb Airdrop Festival Events 2018
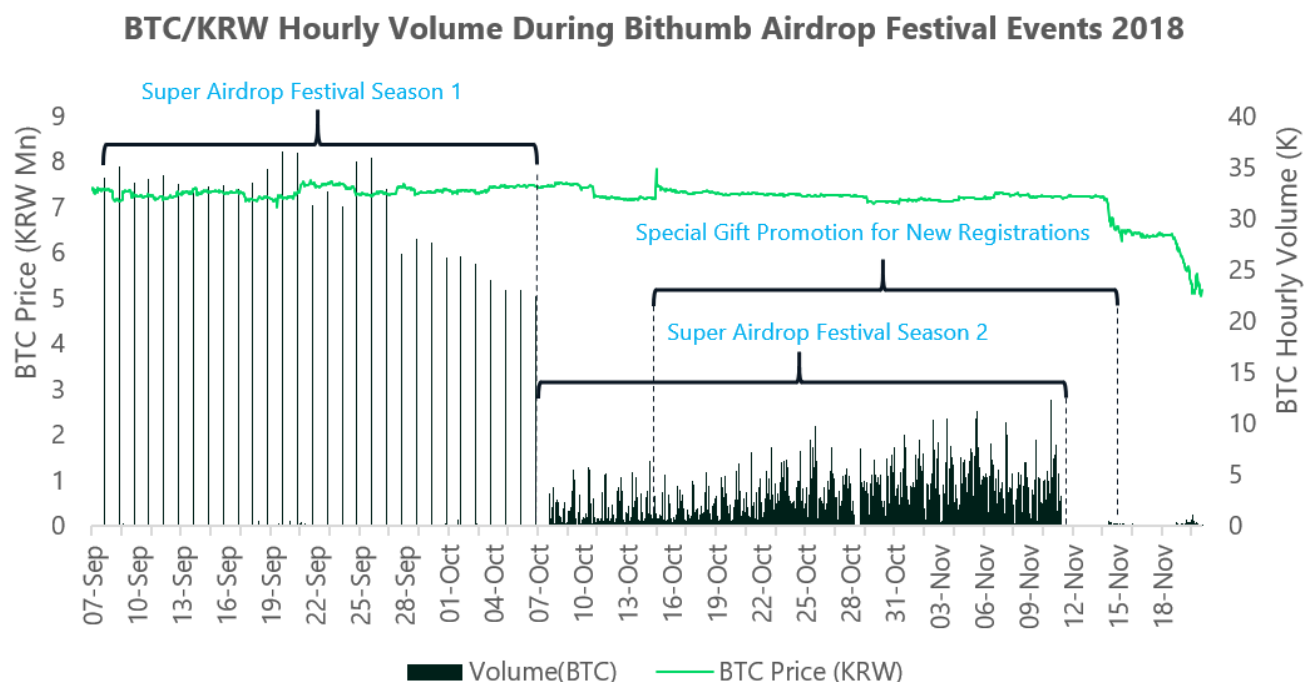
These schemes have often gone hand in hand with producing enormous volumes overnight and have sparked fears of potential wash trading on the largest exchanges over the last few years. **Wash trading** is a term that describes the illegal market manipulation practice of traders' buying and selling with themselves simultaneously to create misleading or artificial signals in the marketplace. It is difficult to prove without private information.

This "inflated" volume gives off a signal that the exchange has high liquidity, and as a result, traders eagerly flock to

> "Inflated" volume gives off a signal that the exchange has high liquidity, and as a result traders eagerly flock to trade only to find that there isn't much real liquidity at all.

trade only to find that there isn't as much real liquidity as they thought. In rare cases, these exchanges might be illicit in nature. In order to exclude those potential actors from our analyses, we have chosen to compare several exchanges, selected based on their long-standing reputations within the industry and their exchange grades (A-AA) - which is derived from a comprehensive Exchange Benchmark methodology implemented by CryptoCompare for its extensive suite of index products.

It must be stated, however, that it is legitimate practice for traditional exchanges to engage the services of liquidity providers or at least offer attractive terms to draw in market makers. Exchanges might offer participants trading fee rebates (paying rather than charging traders to execute a trade) or very low fees to help drive trading volume. Other services such as trading on margin (using leverage) will allow traders to borrow money to place larger orders. Even offering a range of derivatives products such as futures and options will likely attract those wishing to speculate on both rising and falling prices with leverage. All of the above are legitimate methods used to help drive overall exchange volumes.

Metrics Based on Order Book Data

A far more robust and comprehensive measure of liquidity can be provided using order book data. A marketplace is made up of multiple sellers and buyers who each state an amount and price at which they are willing to buy/sell their assets for.

An order book is simply a collection of this marketplace information, which allows us to logically organize all the buyers' and sellers' orders by price and amount. The prices at which buyers are willing to buy an asset (bid) is sorted in ascending order up to the highest (best) bid, while those of the sellers are sorted in descending order down to the lowest price at which they are willing to sell (best ask).

	Bids					**Asks**	
side	**price**	**quantity**			**side**	**price**	**quantity**
bid	**39983.00**	0.08	<-Best Bid	Best Ask->	ask	**39995.75**	0.62
bid	39980.10	0.31			ask	39995.80	0.18
bid	39976.42	0.21			ask	39997.10	0.31
bid	39975.86	0.04			ask	39997.50	0.25
bid	39975.09	0.62			ask	40002.99	0.65
bid	39970.64	0.00			ask	40003.87	0.45
bid	39968.51	0.65			ask	40004.19	0.00
bid	39967.80	0.50			ask	40004.20	0.03
bid	39967.79	0.47			ask	40007.18	0.18
bid	39966.42	0.19			ask	40007.19	0.46
bid	39965.04	0.48			ask	40007.20	0.47

Based on the above information, we can extract several liquidity metrics that we will discuss in more detail: **spread**, **depth** and **slippage**.

Spread

Summary
● Spread (best ask - best bid) represents the **cost to trade**. Tighter spreads are typically a proxy for higher liquidity, and are a direct function of **exchange fee structure**, the level of **competition** on a given market, and the potential presence of **designated market makers**.
● USD markets have tighter spreads than EUR markets overall, while BTC markets have tighter spreads than ETH markets. This suggests that BTC/USD markets are the most liquid. On BTC/USD, exchanges with the tightest median spreads were Coinbase ($0.01), Kraken ($0.10) and Bitfinex ($2.0), while those with widest were Bitstamp ($18.4), and LMAX Digital ($15.0). Similarly, Kraken and Coinbase also had the tightest spreads on ETH/USD with $0.01 and $0.02 respectively.
● Most exchanges implement a maker-taker model (makers charged less than takers) but some implement balanced structures where participants pay the same regardless of whether they are a maker or a taker (e.g. Bitstamp). A more balanced structure tends to naturally widen spreads, as there is no pricing advantage between being a maker and crossing the spread to "take" the current best bid or ask.
● Spreads are naturally wider on exchanges where participants always pay a fee because a market maker must achieve a minimum breakeven spread to account for the higher cost to trade. On exchanges where market makers are able to achieve zero-fee trading (e.g. with designated market makers or lower zero-fee volume tiers), traders are able to breakeven on a roundtrip trade for anything over a 1-tick spread value (where spread gravitates) - this is the case for some participants on Coinbase and Kraken.
● On markets that gravitate towards a 1-tick spread, market makers dominate price discovery and orders compile at the best bid and ask because it is impossible to place a better best bid or ask without becoming a taker (crossing the spread hence paying higher taker fees). Market makers competing in this type of market must be the largest and the quickest to compete.
● Markets with tighter spreads can still be more expensive for takers once fees are accounted for, relative to those with wider spreads and lower taker fees. For example, despite relatively wider spreads, a market order at the $10m trading tier on Bitstamp becomes cheaper than on Coinbase once taker fees are taken into account (0.18% on Coinbase vs 0.12% on Bitstamp).

The difference between the best bid and the best ask is called the **spread**. More directly, the spread actually represents the **cost to trade**. I.e., In order for a bid/ask order (from a buyer/seller) to be matched, one participant needs to cross the spread and "take" the price that exists on the other side of the book. For example, a buyer will need to pay the best bid + spread in order to meet the best ask price (of the seller), and hence establish a transaction.

In traditional markets, it is common for **spreads to be a proxy for liquidity**, whereby a tight spread signals higher liquidity. The logic here is that the closer together the best bid and ask prices are, the more certainty a market has over the fair price of an asset and the more likely market participants will cross the spread to transact.

Spread needs to be understood in the context of exchange fees

Indeed, tighter spreads do typically signal higher liquidity, but they need to be understood in the context of exchange fees which naturally increase the cost to trade and therefore increase spreads. The tightest spreads might be preferable for some trading strategies, and for the participants that are capable of executing such strategies, but others might require wider spreads with a different liquidity structure to maintain profitability and to facilitate their style of trading.

Bitstamp and Bittrex have the widest spreads across USD and EUR markets respectively. On the other hand, Coinbase, Kraken, and Bitfinex are among the exchanges with the tightest spreads. As we will see below, this can be explained by the market fee structure of these exchanges. More specifically, spreads can be narrowed by offering zero-transaction fees to market makers, whereas exchanges with more balanced fee structures will likely see higher spreads.

Median Spread Across Exchanges in June 2021

In June 2021 the lowest spreads on USD markets are found on Coinbase followed by Kraken. On EUR markets lowest spreads are found on Kraken.
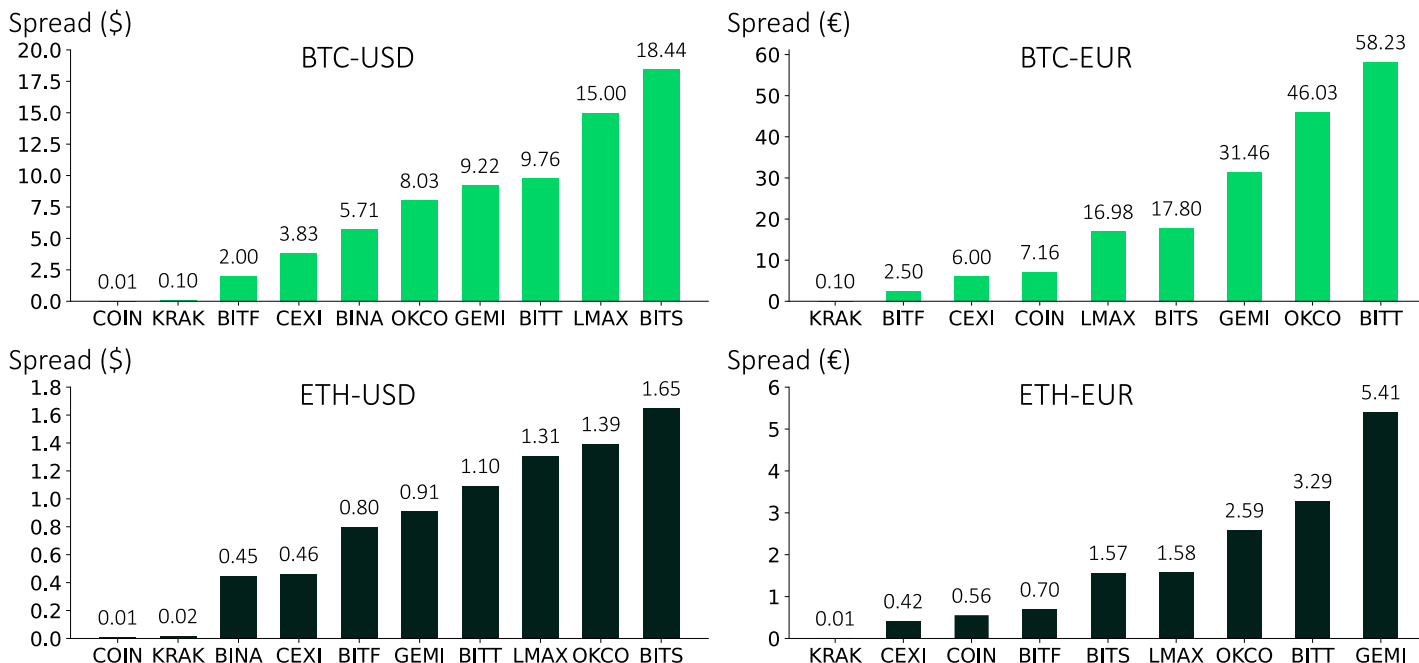
Background on Exchange Trading Fees

In simple terms, an exchange is a business that offers the service of facilitating the transactions between buyers and sellers such that they can exchange their assets at fair value. Much like in traditional markets, crypto exchanges charge for this service by imposing a small % fee for each transaction.

Most of the largest exchanges operate on a maker-taker fee model, providing different fees to each market player depending on whether they provide liquidity (add orders to the book) or take liquidity (take orders from the book), and how much trading they conduct in terms of monthly transaction volume. Since liquidity breeds liquidity, exchanges will often implement a fee model that incentivizes participants to add liquidity rather than take it away by implementing higher fees for takers than makers.

Makers – Provide liquidity for the order book by placing an order that can be matched in the future (i.e. a limit order), this means their fees are often lower than those of takers. These orders are not matched immediately as they remain in the order book until paired with a taker.

Takers – Remove liquidity from the order book by crossing the spread to take the current best market price from a market maker. Fees are often higher for takers as these trades are executed immediately (i.e. they are market orders) whereas those of market makers sit in the book until matched.

Below is a snapshot of the maker and taker fee schedules of various top-tier exchanges. As we can see, there is some variation in the type of model each exchange implements. For example, Coinbase, Kraken, and CEX.io, all offer a typical **maker-taker model** that awards makers with zero-maker fees at the top trading tiers, while eToroX offers a **flat fee** of 0.05% across all trading tiers. itBit **rebates** 0.03% at higher volume tiers and essentially pays participants to provide liquidity. Meanwhile, Bitstamp offers a **balanced fee structure**, where they charge an individual trader equally at various volume tiers regardless of whether they are a taker or a maker. This has implications on how we might interpret liquidity metrics across the above exchanges moving forward.

Maker Fees

Your Vol	Binance US	Bitfinex	bitpanda	BitStamp	BitTrex	CEX.IO	Coinbase	eToroX	Gemini	itBit	Kraken	OKCoin
$1k	0.10%	0.10%	0.10%	0.50%	0.75%	0.16%	0.50%	0.05%	0.25%	0.25%	0.16%	0.10%
$10k	0.10%	0.10%	0.10%	0.25%	0.35%	0.16%	0.35%	0.05%	0.25%	0.25%	0.16%	0.10%
$100k	0.08%	0.10%	0.10%	0.22%	0.12%	0.16%	0.10%	0.05%	0.25%	0.18%	0.14%	0.09%
$1m	0.05%	0.06%	0.10%	0.13%	0.05%	0.15%	0.08%	0.05%	0.15%	0.08%	0.08%	0.04%
$10m	0.00%	0.00%	0.09%	0.11%	0.02%	0.08%	0.08%	0.05%	0.10%	0.00%	0.02%	0.00%
$100m	0.00%	0.00%	0.08%	0.05%	0.00%	0.04%	0.02%	0.05%	0.00%	-0.03%	0.00%	0.00%
$1b	0.00%	0.00%	0.05%	0.03%	0.00%	0.00%	0.00%	0.05%	0.00%	-0.03%	0.00%	0.00%
$10b	0.00%	0.00%	0.05%	0.01%	0.00%	0.00%	0.00%	0.05%	0.00%	-0.03%	0.00%	0.00%

Taker Fees

Your Vol	Binance US	Bitfinex	bitpanda	BitStamp	BitTrex	CEX.IO	Coinbase	eToroX	Gemini	itBit	Kraken	OKCoin
$1k	0.10%	0.20%	0.15%	0.50%	0.75%	0.25%	0.50%	0.05%	0.35%	0.35%	0.26%	0.20%
$10k	0.10%	0.20%	0.15%	0.50%	0.50%	0.25%	0.50%	0.05%	0.35%	0.35%	0.26%	0.20%
$100k	0.09%	0.20%	0.15%	0.25%	0.18%	0.25%	0.25%	0.05%	0.35%	0.35%	0.24%	0.20%
$1m	0.08%	0.20%	0.15%	0.14%	0.18%	0.23%	0.20%	0.05%	0.35%	0.18%	0.18%	0.16%
$10m	0.06%	0.20%	0.13%	0.12%	0.15%	0.15%	0.18%	0.05%	0.13%	0.15%	0.12%	0.10%
$100m	0.05%	0.10%	0.10%	0.10%	0.08%	0.13%	0.10%	0.05%	0.08%	0.06%	0.10%	0.05%
$1b	0.02%	0.09%	0.07%	0.03%	0.05%	0.10%	0.04%	0.05%	0.03%	0.06%	0.10%	0.02%
$10b	0.02%	0.08%	0.07%	0.01%	0.05%	0.10%	0.04%	0.05%	0.03%	0.06%	0.10%	0.02%

For a **retail trader** (assuming trading volume of less than $100k a month) looking to place a market order on a high-volume exchange as a taker, decisions are less driven by liquidity and more by cost and the general quality of the exchange and its user interface. At this volume tier, EtoroX (0.05%) charges the lowest fees followed by Binance US (0.09%) while itBit (0.35%) and Gemini (0.35%) charge the highest fees.

It is important to note that various of the above exchanges offer alternative brokerage services for users to purchase and sell cryptocurrencies into a virtual wallet, generally aimed at retail investors. These platforms typically incur higher transaction costs (typically 1.5% per trade), but have not been considered in the content of this report.

For the **professional trader** looking to implement a variety of trading strategies, fee structure and liquidity metrics become very important. The tightest spreads may not suit all trading strategies.

How can fee structure affect spread and liquidity?

1. Spreads gravitate to the minimum tick size on zero-fee exchanges that advantage market-makers

Exchanges that implement a zero-fee maker-taker structure, such as Coinbase, Kraken and Bitfinex (where market-makers can trade for free at the expense of takers), create a distinct market microstructure whereby **spread tends to revert to a 1-tick value** (the price precision point) because zero-fee paying market-makers are profitable no matter how small the spread. In the case of Coinbase, this amounts to $0.01, while it is $0.1 and $1 on Kraken and Bitfinex respectively.

A HFT market-maker's main business model revolves around being able to capitalize on arbitrage opportunities between the best bid and best ask (i.e. buying at the best bid and selling at the best ask) ...with zero fees, this allows them to trade profitably up to the point at which the best bid and the best ask are separated by only 1-tick in value (e.g. $40,000.00 vs $40,000.01), any further and they would cross the spread and become takers. When a trade occurs that temporarily widens the spread, it quickly reverts back to 1-tick as market makers arbitrage away any margins.

This is demonstrated in the table below. We can see that the median spreads for **Coinbase** ($0.01) and **Kraken** ($0.1) match that of the minimum price precision point (1-tick value). It must be noted that zero-maker fee structures do not guarantee low spreads, but are a significant factor when combined with a high liquidity market environment such as those of Coinbase and Kraken.

	Minimum Tick Size (BTC/ETH)	Fee Structure	Minimum Maker/Taker Fees	Zero Maker Fees	Median BTC/USD Spread	Median ETH/USD Spread
coinbase	$0.01	Maker Taker	0% / 0.04%	✓	$0.01	$0.01
kraken	$0.1/$0.01	Maker Taker	0% / 0.1%	✓	$0.1	$0.02
BITFINEX	$1/$0.1	Maker Taker	0% / 0.06%	✓	$2.0	$0.8
CEX·IO	$0.01	Maker Taker	0% / 0.1%	✓	$3.8	$0.46

BINANCE.US	$0.01	Maker Taker	0% / 0.02%	✓	$5.7	$0.45
OKCOIN	$0.01	Maker Taker	0% / 0.02%	✓	$6.9	$1.4
GEMINI	$0.01	Maker Taker	0% / 0.03%	✓	$9.2	$0.9
LMAX DIGITAL	$0.5/$0.01	Maker Taker	0% / 0.02%	✓	$15.0	$1.3
Bitstamp	$0.01	Balanced	0% / 0%	✓	$18.8	$1.7

Given such a narrow spread on certain exchanges, one might deduce that exchanges with the tightest spreads are more "liquid" marketplaces because crossing the spread is more probable. However, the reality is that exchanges with this characteristic most likely also use designated market makers that pay zero-fees (or are rewarded) to narrow the spread. In practice, a 1-tick spread often makes it impossible for a "natural maker" (i.e. non-market maker who submits a limit order) to set a new best bid or ask as a 1 tick improvement would make them a taker.

2. Spreads on exchanges without zero-fee market-makers are higher due to the economics of a round trip trade

Markets on exchanges that **do not** offer a 0% maker fee won't trade down to a 1-tick value because it simply isn't profitable for market-makers. There exists a **minimum spread** at which a market-maker can cover the cost of trading. For example, assuming a market-maker quickly buys and sells 1 BTC at $40k with 0.01% in fees, they will need at least a spread of $8 (0.01% * 2 * $40,000) in order to breakeven. Hence, fee structure dictates the value towards which spread gravitates. To better illustrate this, we have included an example below with exchange order book data from 15 June 2021.

Take a market-maker who trades $1bn a month and is operating in the following exchanges. Let's assume the maker is simultaneously purchasing and selling 0.005BTC (roughly $200) at each exchange at the best bid and ask price respectively to try and profit from bid and ask arbitrage opportunities. Because this can be filled across all exchanges' best bid/ask orders, there is no slippage.

Example Spread Required to Breakeven for a Round Trip Trade for 0.005BTC at $1bn/Month Trading Fee Tiers

	coinbase	Bitstamp	GEMINI	kraken	BITFINEX	CEX·IO
Maker Fee	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%
Purchase (Bid) Price	$39,980.67	$39,983.00	$39,985.79	$39,977.30	$39,960.00	$39,998.80
Purchase Value	$199.90	$199.92	$199.93	$199.89	$199.80	$199.99
Sale (Ask) Price	$39,980.68	$39,995.75	$39,995.90	$39,977.40	$39,966.00	$40,006.80
Sale Value	$199.90	$199.98	$199.98	$199.89	$199.83	$200.03
Total Cost	$0.00	$0.12	$0.00	$0.00	$0.00	$0.00
Profit After Fees	**$0.00**	**-$0.06**	**$0.05**	**$0.00**	**$0.03**	**$0.04**
Current Spreads	$0.01	$12.75	$10.11	$0.10	$6.00	$8.00
Spread Required to Breakeven	**$0.01**	**$23.99**	**$0.00**	**$0.10**	**$0.00**	**$0.00**

At the $1bn trading volume tier, the market-maker pays no fees at all exchanges including Gemini, OKCoin, and Kraken. Alternatively, the maker may choose to transact at Bitstamp, where they would pay fees for both transactions (cost = 2 * fee* purchase/sale values). The maker's revenue is the spread (ask price - bid price). We can see that in the presence of fees, a wider spread is always required (at least 2 times the fee) for market makers to at least break even.

In the example above, Bitstamp charges 3. Market-makers therefore require spreads of at least $23.99 (~0.05% * 2 * 40k purchase/sale prices) to break-even from a roundtrip trade. As one might imagine, profiting from this strategy is unlikely unless you can trade at a higher trading tier (to lower your trading fees) and you can get to the opportunity first such that your market orders are actually matched - **i.e. only the largest and quickest**

participants can do this. If fees are zero, then makers have no costs and anything above the smallest possible spread (i.e. 1-tick) is enough for makers to make a profit. Hence, exchanges that have 1-tick spreads most likely use designated market makers that trade for free, whereas those with wider spreads most likely consist of more "natural" makers that pay fees.

This provides an explanation of the contributing factor that is fees in deciding spreads. While spreads are indeed indicative of liquidity, it is inappropriate to compare spreads without first considering fee structure, as it is a determining factor in the profitability of market-maker strategies, which are pivotal in providing exchange liquidity.

The chart below includes the spreads across all evaluated exchanges in June 2021. This has been smoothed out via a 12h moving average for ease of interpretation. The differences in spread are most likely due to a combination of fee structure and the nature of liquidity present on the exchange.

Spread 12hr Moving Average in June 2021

Spreads are widest on Bitstamp and LMAX Digital, and tightest on Kraken and Coinbase, where they temporarily widen and then revert to 1-tick values.

Spread ($)
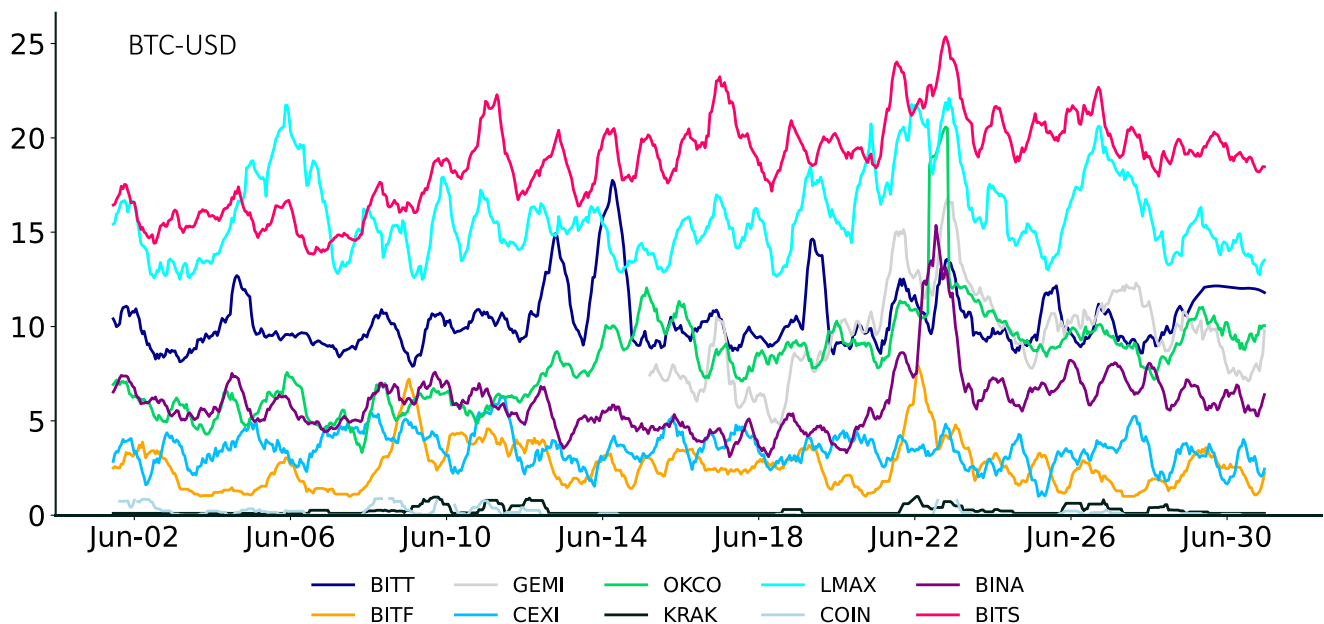
3. Market makers dominate price discovery on zero-fee exchanges - orders compile at the best bid and ask

On exchanges such as Coinbase and Kraken, being a zero-fee market maker means a clear pricing advantage. At a 1-tick spread, it is impossible to place a better best bid or ask in the book without becoming a taker (one additional tick means that you cross the spread 40,000.0/40,000.1 in the case of Kraken to meet the best ask).

If one were to do this, they would be charged significantly higher fees than simply waiting at the best bid as a maker until an order is matched by a large market order. For example, at the $25m monthly trading tier level, makers are charged 0% on Kraken, while takers are charged 0.1%. A taker would pay an additional $40 (40,000 * 0.1%) to cross a spread that is only $0.1 wide.

In the example above, it is better in terms of cost to be a maker, which is why **makers dominate price discovery** on these types of markets. Takers on the other hand pay a significant premium for placing a market order.

Because of this, **orders tend to build up at the best bid and ask**, as the alternative would be to become a taker and pay higher fees. In the context of liquidity, this means that there are more buyers and sellers available at the best bid and ask on the tightest exchanges with zero-fee market-maker models. This may be ideal for those looking to implement simple buy/sell strategies for longer periods of time, and plan on placing relatively large market orders immediately with no slippage.

Mean Best Bid/Ask Amount in June 2021

Mean best bid and ask amounts are highest on Kraken and Bitfinex, across all markets. Amounts are highest on exchanges with zero-fee participants and/or those with relatively larger minimum tick values.
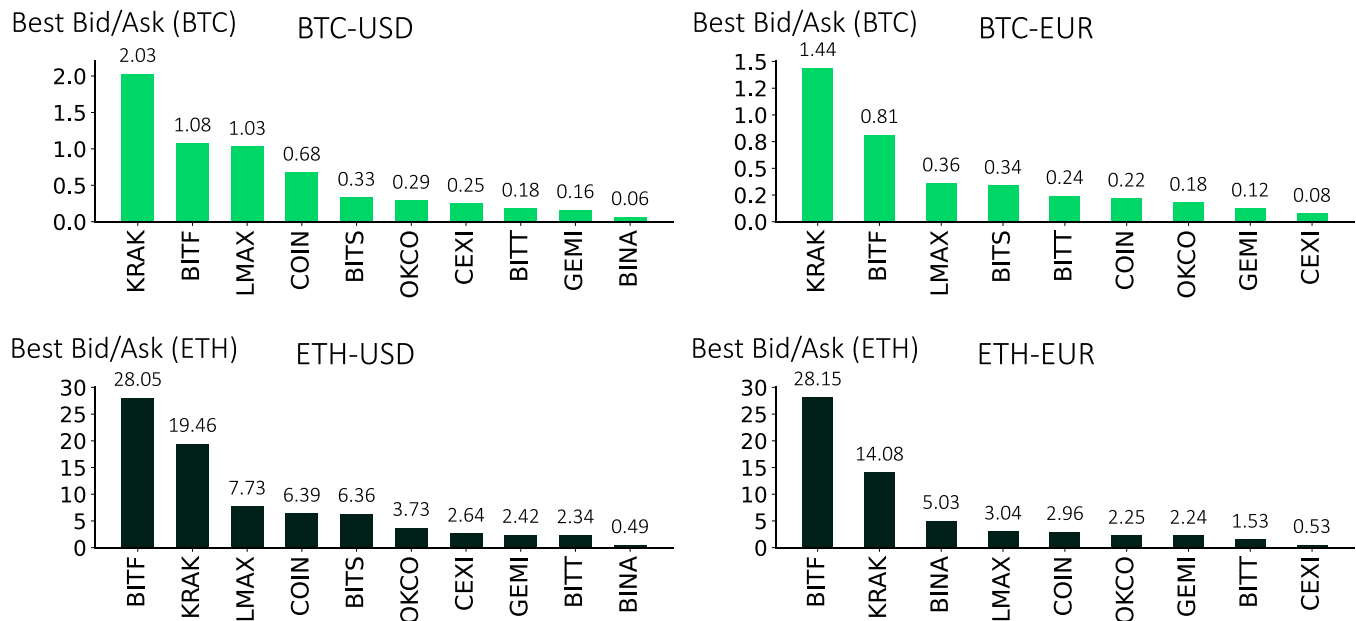
The charts above illustrate the mean quantities at the best bid and ask across the top exchanges in June, and supports this theory - exchanges with zero-fee participants combined with higher minimum tick values like Kraken ($0.1) and Bitfinex ($1) will generally see larger order sizes around the best bid and ask prices.

In the context of makers, a larger order queue means that any new limit orders from slightly slower market-making participants either sit at the back of the order queue or are less competitive than those at the best bid and ask values and therefore don't get matched as easily (longer wait times). In order for those looking to

capitalize on a temporary pricing opportunity, they will have to wait until all other traders' orders (who got there first) in the queue are matched. Hence, to compete effectively on a zero-fee maker exchange a HFT needs not only to be the largest (in order to attain a 0% maker fee), but also the fastest.

This again **has liquidity implications** because it is unlikely for most traders to place a competitive limit order that gets matched on 1-tick spread exchanges. On the other hand on exchanges that have wider spreads via higher maker fees (or less competition), it is still possible for traders to place a new best bid or ask without becoming a taker. Exchanges with wider spreads might therefore present opportunities for market makers to submit a new best bid/ask which may likely be better priced than on competing exchanges. If this new order is in fact the best price available, it will be filled quickly.

4. Markets with tighter spreads can still be more expensive

Following the above, we have outlined an example below to illustrate maker vs. taker price differences per exchange, using the same order book data for consistency. We have assumed the position of a maker and taker looking to purchase $200 worth of Bitcoin (approximately 0.005BTC), with monthly trading volumes of $10m and the respective fees.

Example Trade Cost for a Maker vs Taker at the $10m Trading Volume Tier

	coinbase	Bitstamp	GEMINI	kraken	BITFINEX	CEX·IO
Initial Funds	$200	$200	$200	$200	$200	$200
Taker						
Taker Fee	0.18%	**0.12%**	0.13%	**0.12%**	0.20%	0.15%
Ask Price	$39,980.68	$39,995.75	$39,995.90	$39,977.40	$39,966.00	$40,006.80
Total Cost	$0.36	$0.24	$0.26	$0.24	$0.40	$0.30
Leftover $ After Initial Cost	$199.64	**$199.76**	$199.74	**$199.76**	$199.60	$199.70
Final BTC Price	$40,052.77	**$40,043.80**	$40,047.96	**$40,025.43**	$40,046.09	$40,066.90
Maker						

Maker Fee	0.08%	0.12%	0.00%	**0.02%**	**0.00%**	0.05%
Bid Price	$39,980.67	$39,983.00	$39,985.79	$39,977.30	$39,960.00	$39,998.80
Total Cost	$0.16	$0.24	$0.00	$0.04	$0.00	$0.10
Leftover $ After Initial Cost	$199.84	$199.76	$200.00	**$199.96**	**$200.00**	$199.90
Final BTC Price	$40,012.68	$40,031.04	$39,985.79	**$39,985.30**	**$39,960.00**	$40,018.81

Exchanges that implement a typical maker-taker model where makers are charged very low fees, must offset this by charging takers more. Hence, exchanges such as Gemini charge 0% for makers and 0.13% for takers at high trading tiers.

On the other hand, exchanges with a balanced fee structure like Bitstamp (relatively higher spreads and less competitive taker prices) impose lower taker fees (because makers are now charged relatively higher fees), which might lead to an overall lower final price compared to other exchanges. In the table above, takers in Bitstamp will pay a final BTC price of $40,044, compared to $40,053 at Coinbase. Of course, all of this depends on fees which are dictated by a given trader's monthly volume tier level.

Conversely, a maker will strongly benefit from the lower fees of maker-taker models, and generally end up paying a lower price per BTC. Thus, while choosing an exchange, market participants must consider fees and market structure, but their strategy (for example, to submit a limit order and be a maker, or a market order and be a taker) is equally important.

Order Book Depth

Summary
● Depth illustrates the cumulative quantity of all current bid and ask orders waiting in the order book from a range of buyers and sellers at various price points some % above or below the current market mid-price. It is therefore the most direct measure of available liquidity.
● Higher depth (deeper books) indicates that more orders are available on the book and hence a prospective trader is more likely to find a buyer or seller that is willing to take the other side of a given position. This also means there is less market price impact (slippage) once a trade occurs.
● Kraken, Bitfinex, Coinbase and Bitstamp have the highest 0.1% and 1% order book depth across both BTC and ETH markets.
● Depth only accounts for limit orders waiting in the book. On exchanges that advantage makers over takers, participants are incentivized to place limit orders on the books as they are charged less. However, this incentive becomes attenuated when a more balanced fee structure is implemented that charges makers and takers equally; Here, order book depth fails to account for the "taker" liquidity waiting in the background.

Another commonly used metric to assess market liquidity is **Order Book Depth**. Order book depth illustrates the cumulative quantity of all current bid and ask orders waiting in the order book from a range of buyers and sellers at various price points at some % above or below the current market mid-price.
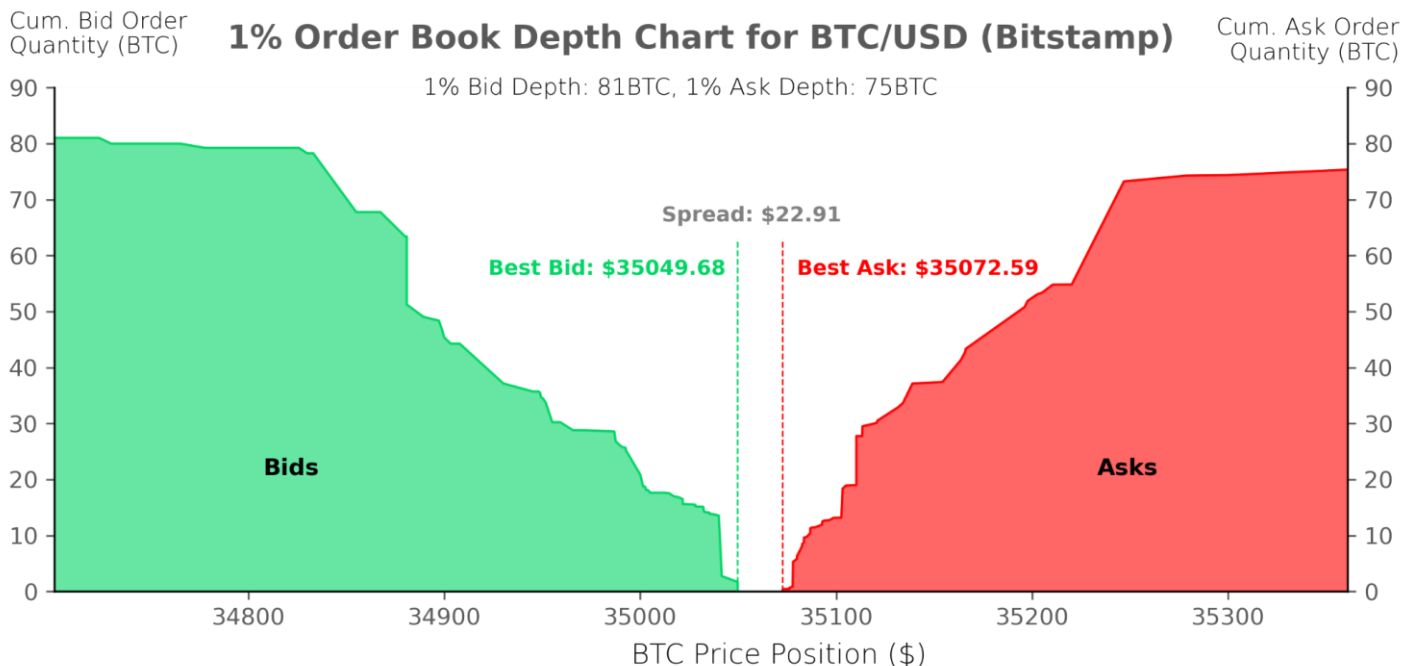
It is therefore a useful indication of supply and demand. This information can be used to simulate how a given market would react to a market order (e.g price stability), and whether a given order quantity can actually be filled, and at what price a trader is likely to receive.

In this way, it represents the most direct measure of liquidity, because it assesses the tangible willingness to buy or sell of various participants with orders in the book, and therefore how much a prospective trader can purchase and at what price. Depth can be segmented into bid depth (cumulative sum of bids - green in above chart) and ask depth (cumulative sum of asks - red in above chart). The higher the depth, the higher the quantity of assets available on a given market and the higher the liquidity.

It can be considered a reliable measure of liquidity for two main reasons:

- Higher depth (deeper books) means that more orders are available on the book and hence a prospective trader is more likely to find a buyer or seller that is willing to take the other side of a given position

- Higher depth also means that there is less market price impact (slippage) once a trade occurs.

For the purpose of our analysis, we assume that order book depth closer to the market mid-price is more representative of "true liquidity" because these orders are more likely to actually be filled by market participants. We implement depth metrics for 0.1% and 1% above and below the mid-price (both the cumulative sum of asks and bids). More formally, we can thus define depth as the cumulative sum of all the buy and sell orders **0.1% and 1%** from the market mid-price at any given time.

Order Book Depth (0.1%) in June 2021

Kraken, Bitfinex, Coinbase and Bitstamp have the highest 0.1% order book depth across both ETH and BTC markets.

Depth BTC — BTC-USD

KRAK	BITF	COIN	BITS	LMAX	GEMI	OKCO	BITT	BINA	CEXI
51.1	47.9	46.0	25.0	18.6	8.2	7.2	4.5	4.2	2.8

Depth BTC — BTC-EUR

BITF	KRAK	BITS	COIN	LMAX	OKCO	CEXI	GEMI	BITT
59.3	35.1	26.6	13.4	6.3	2.5	1.3	0.8	0.5

Depth ETH — ETH-USD

BITF	COIN	KRAK	BITS	LMAX	GEMI	OKCO	BITT	BINA	CEXI
649.6	529.4	443.0	240.7	163.7	85.3	58.0	50.7	39.1	38.3

Depth ETH — ETH-EUR

BITF	KRAK	BITS	COIN	LMAX	CEXI	OKCO	GEMI	BITT
560.2	312.6	173.8	153.8	23.9	15.5	14.3	5.3	4.7
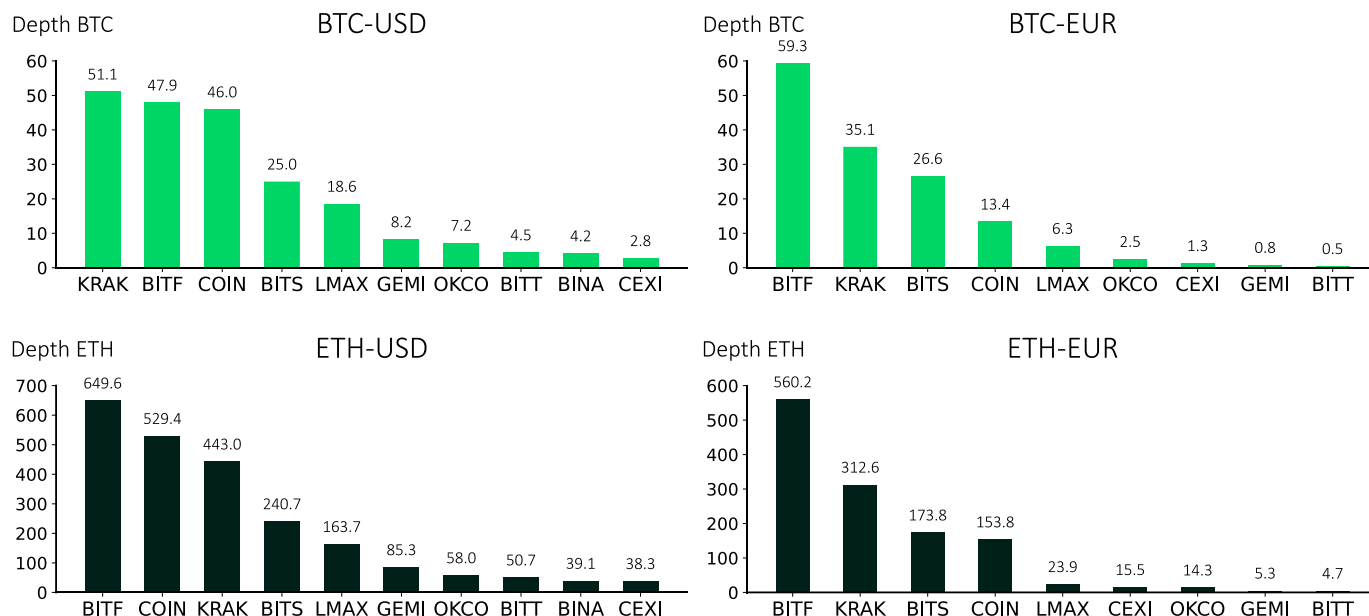
Order Book Depth (1%) in June 2021

Kraken and Bitfinex have the highest 1% order book depth across both ETH and BTC markets.

Depth BTC — BTC-USD

KRAK	BITF	COIN	LMAX	GEMI	BITS	OKCO	BINA	CEXI	BITT
492.5	322.0	247.2	160.7	144.5	131.1	90.0	62.2	42.6	31.1

Depth BTC — BTC-EUR

BITF	KRAK	BITS	LMAX	COIN	OKCO	CEXI	BITT	GEMI
374.4	373.7	113.0	75.1	69.8	11.2	9.9	8.1	6.5

Depth ETH — ETH-USD

BITF	KRAK	COIN	LMAX	GEMI	BITS	CEXI	OKCO	BINA	BITT
5974.6	3522.1	3146.1	2050.5	1735.9	1195.3	826.6	732.3	597.4	485.0

Depth ETH — ETH-EUR

BITF	KRAK	LMAX	COIN	BITS	CEXI	BITT	GEMI	OKCO
6749.8	2928.3	2039.0	816.6	795.4	175.8	135.1	60.5	38.3

As illustrated above, Kraken has the highest order book depth in the BTC/USD market, having an average of over 51 BTC of market orders around the mid-price during the month of June. This is followed by Bitfinex, with 48 BTC

of order book depth. Bitfinex also has the highest market depth across all exchanges for the ETH/USD, BTC/EUR, and ETH/EUR markets, followed by Coinbase, for ETH/USD and Kraken for both EUR markets.

As the BTC/USD market is the largest cryptocurrency market across all exchanges, the chart below provides more detail on this market by looking at time series order book depth data, for both 0.1% book depth and 1.0% book depth.

BTC-USD 12 Hour Moving Average of Order Book Depth in June 2021

Kraken, Coinbase and Bitfinex are consistently among the exchanges with the deepest books for BTC-USD.
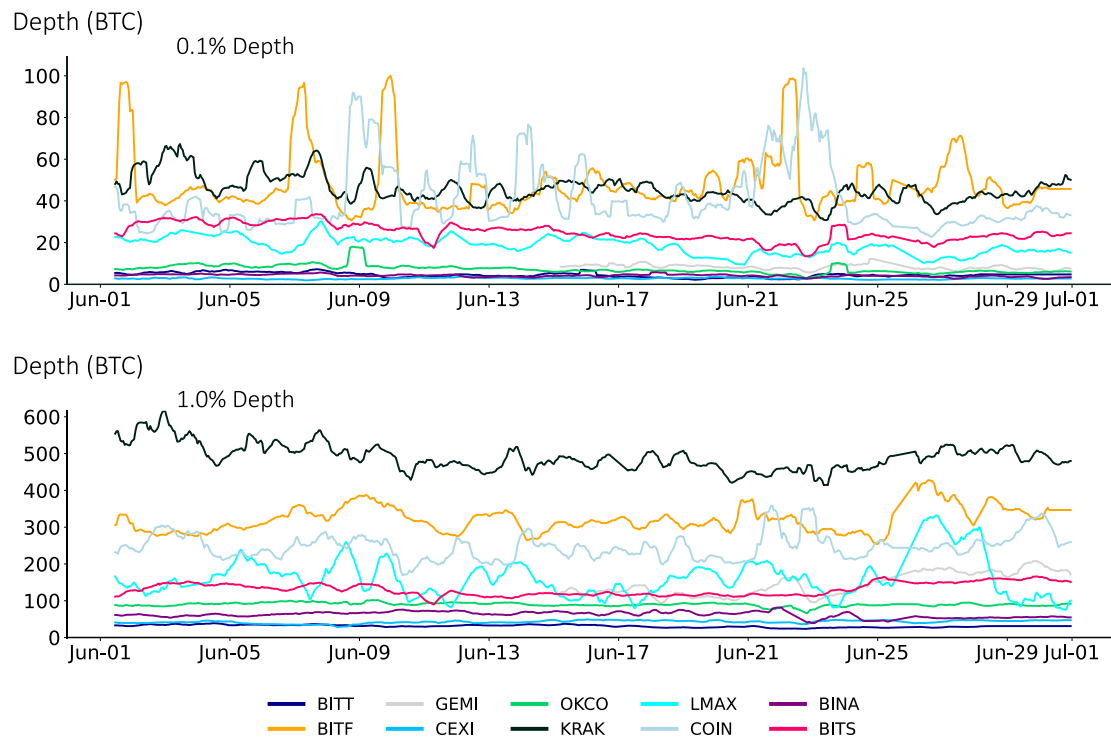
This suggests that Bitfinex, Kraken and Coinbase are among the most liquid exchanges based on order book depth. **However, depth still has its limitations as it only accounts for limit orders waiting in the book...**

As mentioned previously, exchanges that advantage makers over takers with significantly lower fees will encourage participants to act as makers. As a result, it is natural to see more orders waiting in the books on these types of exchanges. However, on exchanges that offer more balanced fee structures (charge makers and takers equally) such as Bitstamp or EtoroX, this incentive to add orders to the book becomes attenuated because placing a market order is charged similarly to waiting in the book. I.e. **The limit orders in the book do not account for the "taker" liquidity waiting in the background.**

Slippage

Summary
● Slippage represents the percentage difference between the current market price for an asset and the price a trader would pay (or receive) after an order is matched. High slippage can thus be seen as the consequence of having a shallow order book, i.e. low liquidity.
● Slippage is generally lower for USD pairs compared to EUR pairs across all exchanges. This is likely due to these markets being notably larger by volume and depth. On the other hand, slippage was similar for Bitcoin pairs compared to Ethereum pairs.
● For a simulated $10k order (buy or sell), **LMAX Digital, Bitstamp and Bitfinex** produce the lowest mean slippage values for both BTC/USD and ETH/USD markets. Meanwhile, across BTC/EUR and ETH/EUR markets, **Kraken, Bitstamp and Bitfinex** produce the lowest slippage values.

Slippage represents the percentage difference between the current market price for an asset and the price a trader would pay (or receive) after an order is matched. It is a direct cost of low liquidity, as an order may be executed at a worse price point than the current market price.

For instance, take a trader that is looking to purchase 1BTC at Gemini or Bitstamp. The table below illustrates this example by taking a snapshot of orderbook data for a number of exchanges. A trader would initially be indifferent between these exchanges given the almost identical purchase (best ask) price. However, the best ask quantity at Bitstamp is notably higher than at Gemini. This means to complete the 1BTC purchase, the remainder of the order has to be matched with the next best asks until the 1BTC order is filled, which will involve purchasing at worsening prices. The result is a final purchase price of $39,996.45 at Bitstamp compared to $40,052.51 at Gemini.

It is important to note that it is not just best ask quantities that are relevant here - the prices and quantities (i.e. Depth) of the following best ask orders will influence the slippage and thus total costs. This is clear by looking at Coinbase as an example - while it has the highest best ask quantity, the succeeding best ask orders are very small in size, and thus slippage can be larger than at competing exchanges with lower best ask quantities, such as Bitstamp.

Example Taker Cost for 1BTC Incorporating Price Slippage at the $10m Trading Volume Tier

	coinbase	Bitstamp	GEMINI	OKCOIN	kraken
Taker Fee	0.18%	0.12%	0.13%	0.10%	0.12%
Best Ask Price	$39,980.68	$39,995.75	$39,995.90	$39,992.12	$39,977.40
Best Ask Quantity (BTC)	0.58	0.35	0.20	0.32	2.21*
Purchase Price	$39,984.50	$39,996.45	$40,000.51	$39,998.88	$39,977.40
Transaction Cost	$71.97	$48.00	$52.00	$40.00	$47.97
Total Purchase Price	$40,056.47	$40,044.45	$40,052.51	$40,038.87	$40,025.37
Slippage	$3.82	$0.70	$4.61	$6.76	$0.00
Slippage (BPS)	0.95	0.18	1.15	1.69	0.00
Total Cost	$75.79	$48.70	$56.61	$46.75	$47.97
Total Cost %	**0.19%**	**0.12%**	**0.14%**	**0.12%**	**0.12%**

*Note that the aggregate order quantity at Kraken's best ask is comparatively larger due to their $0.1 minimum tick size. Other exchanges are able to distribute orders across 10 times the number of price points given that their minimum tick sizes are all $0.01.

Slippage is a good indicator of liquidity because the more orders (liquidity) available closer to the current market price, the lower the amount of slippage that results from large market orders. Following on from the above, it is important to understand the relationship between slippage and order book depth. A shallow order book will

result in large trades requiring multiple orders, and thus worsening prices, to fill out. This incurs a slippage cost on the trader. Thus, slippage can be seen as the consequence of having a shallow order book, i.e. low liquidity.

Average Slippage on a $10k order (June 21)

Bitstamp and Coinbase consistently experience lower slippage than competing exchanges

Slippage (BPS)
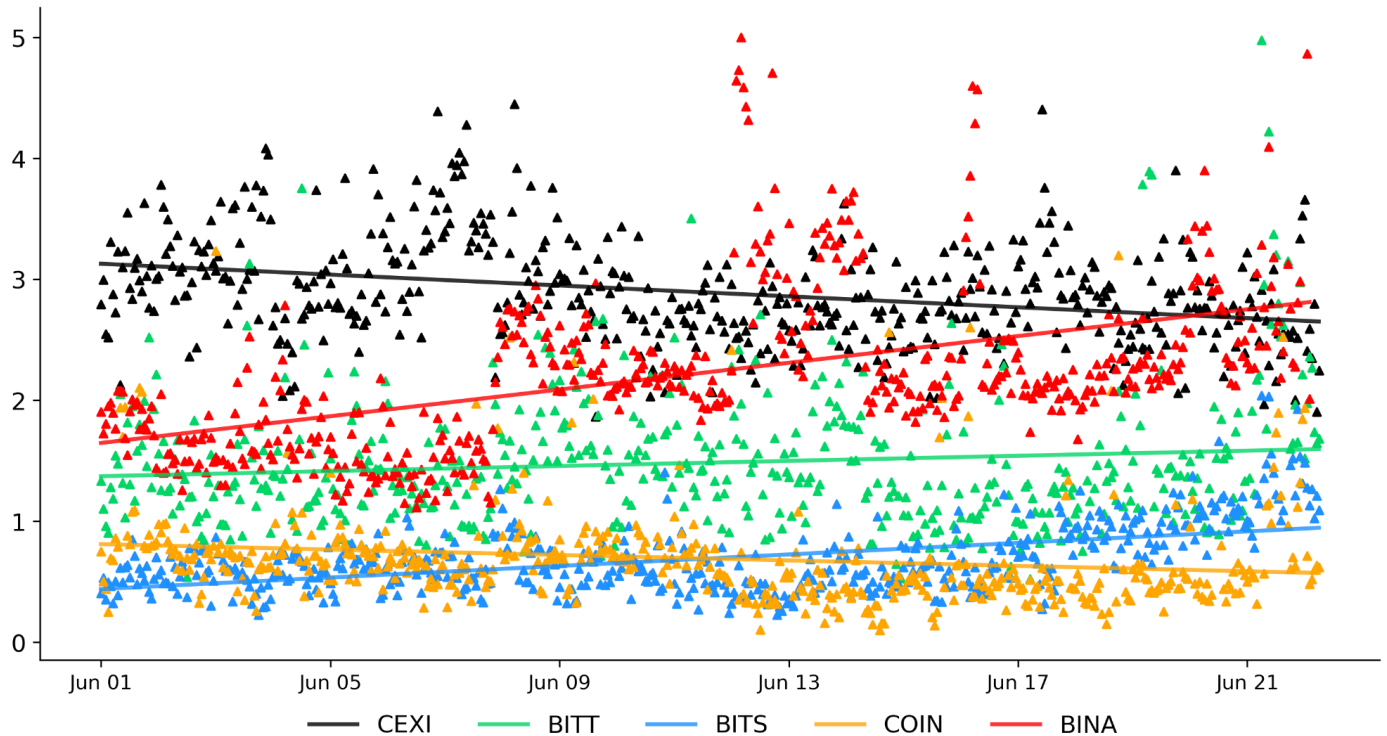
The graph above highlights the average percentage slippage cost on a $10,000 BTC buy/sell order in June. While slippage is shown to be quite consistent across exchanges, outliers must be taken into consideration, as these may intensify during turbulent market periods.

To summarize the comparison between exchanges, included below are charts describing mean slippage for $10,000 buy and sell orders across exchanges for different market pairs.

Mean Slippage for a 10000 (USD/EUR) Order in June 2021

On USD markets, a 10k order on LMAX Digital results in the lowest slippage. On EUR markets, the lowest slippage values for both BTC and ETH were found on Bitfinex and Bitstamp respectively.

Slippage (BPS) — **BTC-USD**

LMAX	BITS	BITF	KRAK	COIN	OKCO	BITT	GEMI	BINA	CEXI
0.6	0.8	0.9	0.9	1.0	1.2	1.5	1.6	2.5	2.9

Slippage (BPS) — **BTC-EUR**

BITF	KRAK	BITS	LMAX	COIN	BITT	GEMI	CEXI	OKCO
1.0	1.0	1.0	1.1	1.8	4.4	8.3	12.3	38.9

Slippage (BPS) — **ETH-USD**

LMAX	BITS	BITF	KRAK	COIN	GEMI	BITT	OKCO	BINA	CEXI
0.5	0.7	0.8	0.9	1.0	1.3	1.8	1.9	3.1	4.3

Slippage (BPS) — **ETH-EUR**

BITS	BITF	KRAK	COIN	GEMI	LMAX	BITT	CEXI	OKCO
0.8	0.9	1.1	1.8	2.3	4.9	7.9	19.0	41.5
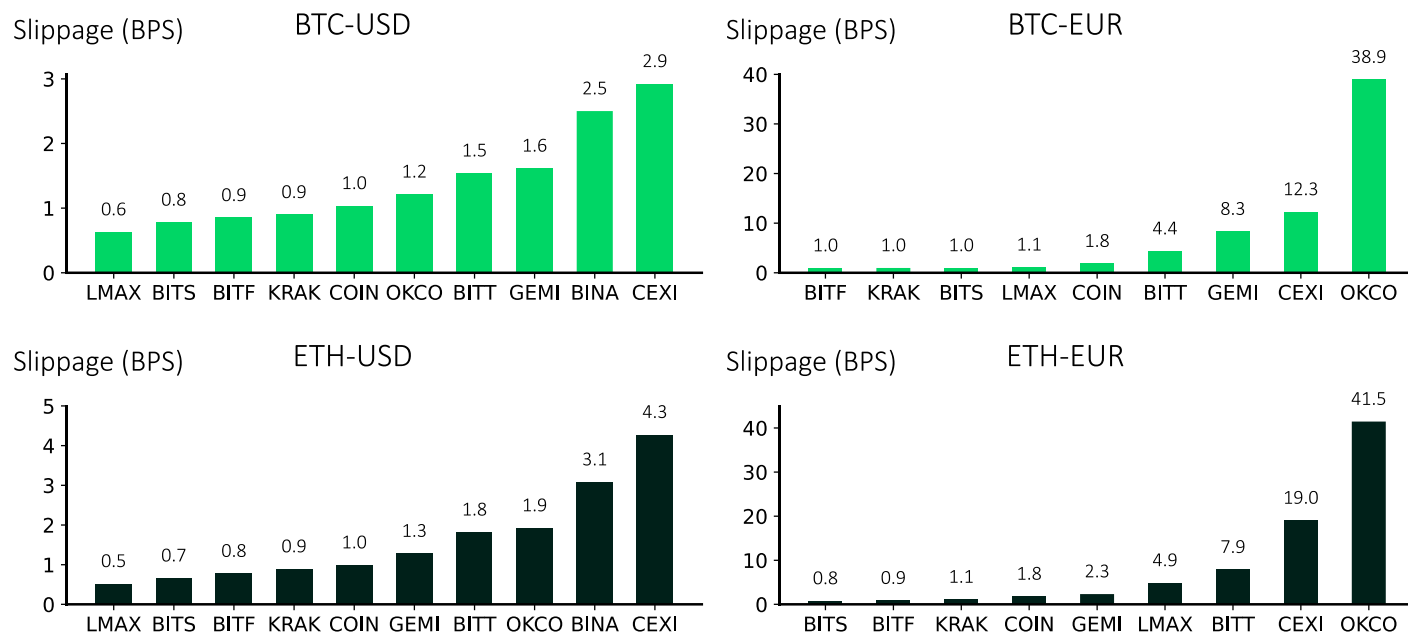
In the BTC/USD, CEX.io has one of the largest absolute slippage values over the selected time period, with an average of 2.9BPS. On the other hand, LMAX Digital looks to be amongst the exchanges with the lowest absolute slippage values, recording 0.6BPS. Bitstamp and Bitfinex have similarly low slippage values on BTC/USD. On BTC/EUR, Bitfinex, Kraken, Bitstamp and LMAX Digital all maintain the lower slippage values at approximately 1BPS.

Slippage is generally lower for USD pairs compared to EUR pairs across all exchanges. This is likely due to these markets being notably larger by volume. On the other hand, slippage was similar for Bitcoin pairs compared to Ethereum pairs.

Summary of all liquidity metrics: USD Markets

BTC/USD	Depth 0.1% (BTC)	Depth 1% (BTC)	Av. Absolute Slippage $10k Order (BPS)	Spread ($)	Daily Volume ($Mn)
Kraken	51.11	492.50	0.90	0.10	232.29
Bitfinex	47.93	322.03	0.85	2.00	405.09
Coinbase	45.96	247.15	1.04	0.01	699.17
Bitstamp	25.01	131.11	0.78	18.44	170.14
LMAX Digital	18.56	160.65	0.63	15.00	309.11
Gemini	8.25	144.46	1.62	9.22	106.35
OKCoin	7.24	89.97	1.21	8.03	24.39
Bittrex	4.46	31.10	1.54	9.76	18.40
Binance US	4.17	62.24	2.50	5.71	83.90
CEX.IO	2.78	42.60	2.92	3.83	8.38

ETH/USD	Depth 0.1% (ETH)	Depth 1% (ETH)	Av. Absolute Slippage $10k Order (BPS)	Spread ($)	Daily Volume ($Mn)
Bitfinex	649.56	5974.65	0.78	0.80	203.42
Coinbase	529.41	3146.10	0.99	0.01	595.37
Kraken	442.99	3522.06	0.89	0.02	187.89
Bitstamp	240.71	1195.33	0.66	1.65	99.86
LMAX Digital	163.71	2050.06	0.52	1.31	158.70
Gemini	85.34	1735.87	1.28	0.91	69.76
OKCoin	58.03	732.27	1.92	1.40	11.17
Bittrex	50.65	485.03	1.82	1.10	11.35
Binance US	39.14	597.37	3.08	0.45	63.81
CEX.IO	38.29	826.57	4.28	0.47	9.90

- The above summaries illustrate the relationship between depth and slippage, as the exchanges with high order book depth typically experience lower slippage. While spreads are similarly related, the relationship is not as clear due to the influence of fee structures. Daily volumes also tend upwards for exchanges with higher depth.

- **Kraken, Bitfinex, Coinbase, Bitstamp** and **LMAX** perform the best across the above liquidity metrics, although Bitstamp and LMAX have notably high spreads. In the case of Bitstamp, this is heavily related to its flat fee structure. Coinbase has significantly higher volumes than its competitors in the USD markets, followed by Bitfinex and Kraken.

Summary of all liquidity metrics: EUR Markets

BTC/EUR	Depth 0.1% (BTC)	Depth 1% (BTC)	Av. Absolute Slippage €10k Order (BPS)	Spread (€)	Daily Volume (€Mn)
Bitfinex	59.34	374.40	0.95	2.50	19.87
Kraken	35.08	373.70	0.97	0.10	122.33
Bitstamp	26.63	113.01	0.98	17.80	77.87
Coinbase	13.39	69.84	1.85	7.16	61.50
LMAX Digital	6.34	75.08	1.12	16.98	19.57
OKCoin	2.54	11.19	38.95	46.03	0.14
CEX.IO	1.33	9.91	12.27	6.00	1.71
Gemini	0.82	6.48	8.31	31.46	0.81
Bittrex	0.48	8.14	4.37	58.23	0.99

ETH/EUR	Depth 0.1% (ETH)	Depth 1% (ETH)	Av. Absolute Slippage €10k Order (BPS)	Spread (€)	Daily Volume (€Mn)
Bitfinex	560.15	6749.84	0.86	0.70	11.70
Kraken	312.60	2928.29	1.10	0.01	50.03
Bitstamp	173.80	795.42	0.78	1.58	29.67
Coinbase	153.80	816.65	1.80	0.56	38.87
LMAX Digital	23.89	2039.03	4.87	1.58	7.37
CEX.IO	15.49	175.78	19.03	0.42	1.10
OKCoin	14.27	38.29	41.45	2.59	0.04
Gemini	5.28	60.51	2.33	5.41	0.24
Bittrex	4.74	135.07	7.87	3.29	0.57

- The relationship between depth and slippage is also visible in the EUR markets. **Kraken, Bitfinex, Coinbase, Bitstamp** and **LMAX** continue to be the top exchanges in EUR markets, although liquidity looks to be slightly poorer. This is no surprise considering the significantly lower volumes and market size relative to USD markets.

- As a result of this relatively lower liquidity, EUR markets experience higher average slippage and spreads across all exchanges.

- Coinbase is not the volume leader in EUR markets, beaten by Kraken for both Bitcoin and Ethereum trading as well as Bitstamp in the ETH/EUR market.

Liquidity Report Takeaways

The aim of this report has been to provide the reader with a thorough assessment of the key topic areas that are relevant when examining cryptocurrency exchanges. After a brief overview of the development of cryptocurrency markets, we first broke down exchange APIs into a set of individual elements. Each of these signal at the capabilities of APIs, and it was clear that each exchange looks to prioritize different API features. Because of this, we came to the conclusion that no particular exchange has a superior API.

We then explained the concept of liquidity in the context of cryptocurrency exchanges, and suggested a range of metrics by which liquidity can be assessed. The closing thought here is that these metrics cannot be looked at individually as it may lead to a biased analysis of liquidity; each measurement has its own set of advantages and drawbacks, and order book data specifically is heavily intertwined with market structure. Thus, an understanding of exchange fees, microstructure, and available incentives is a critical component in liquidity discussions. We hope readers have been able to extract this knowledge from our analysis.

We have outlined below some key takeaways to elaborate on the above:

1. **Volumes** provide a broad level view of liquidity, however certain exchanges may artificially inflate volumes via crypto-specific incentive schemes which give the erroneous illusion of high liquidity.

2. **Spreads** measure the cost to trade in a given exchange, but are highly dependent on fee structures and the use of delegated market makers by certain exchanges. Thus, it is best to compare spreads across exchanges with similar fee structures.

3. **Depth** is the most direct measure of liquidity as it describes the supply and demand *readily* available at each exchange, but does not account for liquidity provided by market takers, which may be significant at certain exchanges.

4. **Slippage** is an appropriate metric to quantify the cost of low liquidity and order book depth, although one must be wary of the presence of outliers in slippage data, which may become more prevalent during turbulent market moves.

Having said all of this, our analysis suggests that out of the 10 exchanges in question, Coinbase, Kraken, Bitfinex, Bitstamp, and LMAX Digital consistently performed well in most liquidity metrics during the time period examined.

Where Crypto Enters the World of Finance

Bitstamp is the world's longest-running crypto exchange, serving institutional traders for as long as they've been in crypto.

As innovative products like lending platforms, Bitcoin-backed leverage and derivatives trading continue to drive the evolution of the crypto industry, having access to secure, reliable and regulated spot exchanges has become more important than ever. This is where Bitstamp comes in to strengthen the bridge between crypto and finance.

# of clients: **4 M**	2020 total volume: **$72 B**	Client assets: **$7-8 B**

A reliable gateway into the cryptocurrency market

While diverse projects drive innovation for Bitcoin and other cryptocurrencies, the market as a whole remains a sort of walled garden. The efficiency of the entire system depends on the ability to get in and out of the market. Spot exchanges like Bitstamp are the gates welcoming you into this exciting new sector of finance.

Bitstamp is leading the charge when it comes to bringing exchange infrastructure in crypto on par with traditional finance. Bitstamp's APIs have the fastest response times in crypto[1] and the underlying infrastructure, built around a matching engine from Nasdaq, has proven its reliability during every demand spike the crypto industry has ever seen, including in 2021. Combine that with robust banking rails, including the option for select clients to settle payments 24/7/365, and the result is a fast, reliable and stable trading venue.

1 CryptoCompare: Exchange Benchmark

"Our deep and diversified pool of liquidity, combined with the quality of our tech, is what makes institutional traders choose Bitstamp. But what makes them stay for the long term is our dedication to supporting them every step of the way and whenever they need us. We've built our brand around integrity and reliability and that's how we approach every partner."

David Osojnik
CHIEF TECHNOLOGY OFFICER

Institutional access to crypto markets

Get in touch:
partners@bitstamp.net