# Liquidity Monitoring Insights

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# Which market provides the best execution?

## Definition of Liquidity?

- “Degree to which the quick sale or purchase of an asset affects the asset’s price”

## Important for all market participants

- Day traders face implementation shortfall when executing strategies
- Long-term investors have to sell assets when experiencing shocks

## Market segmentation raises *choice of trading venue*

# We typically look at CoinMarketCap for price information

Charts | **Markets** | Social | Tools | Historical Data

## Bitcoin Markets

Pair: USD | Category: Spot | Fee Type: All | USD

| # | Source | Pair | Volume (24h) | Price | Volume (%) | Category | Fee Type | Updated |
|---|---|---|---|---|---|---|---|---|
| 15 | Simex | BTC/USD | $92,68 M | $3.395,78 | 1,22% | Spot | Percentage | Recently |
| 16 | RightBTC | BTC/USD | $92,10 M | $3.407,39 | 1,21% | Spot | Percentage | Recently |
| 23 | Cryptonex | BTC/USD | $77,19 M | $3.474,21 | 1,02% | Spot | Percentage | Recently |
| 28 | Coinsuper | BTC/USD | $62,61 M | $3.393,89 | 0,82% | Spot | Percentage | Recently |
| 36 | Bitfinex | BTC/USD | $40,89 M | $3.471,10 | 0,54% | Spot | Percentage | Recently |
| 42 | Coinbase Pro | BTC/USD | $36,31 M | $3.394,13 | 0,48% | Spot | Percentage | Recently |
| 59 | Exrates | BTC/USD | $26,27 M | $3.464,34 | 0,35% | Spot | Percentage | Recently |
| 62 | Bitstamp | BTC/USD | $24,71 M | $3.395,39 | 0,33% | Spot | Percentage | Recently |
| 74 | Kraken | BTC/USD | $21,62 M | $3.394,10 | 0,28% | Spot | Percentage | Recently |

# CoinMarketCap only provides very limited information

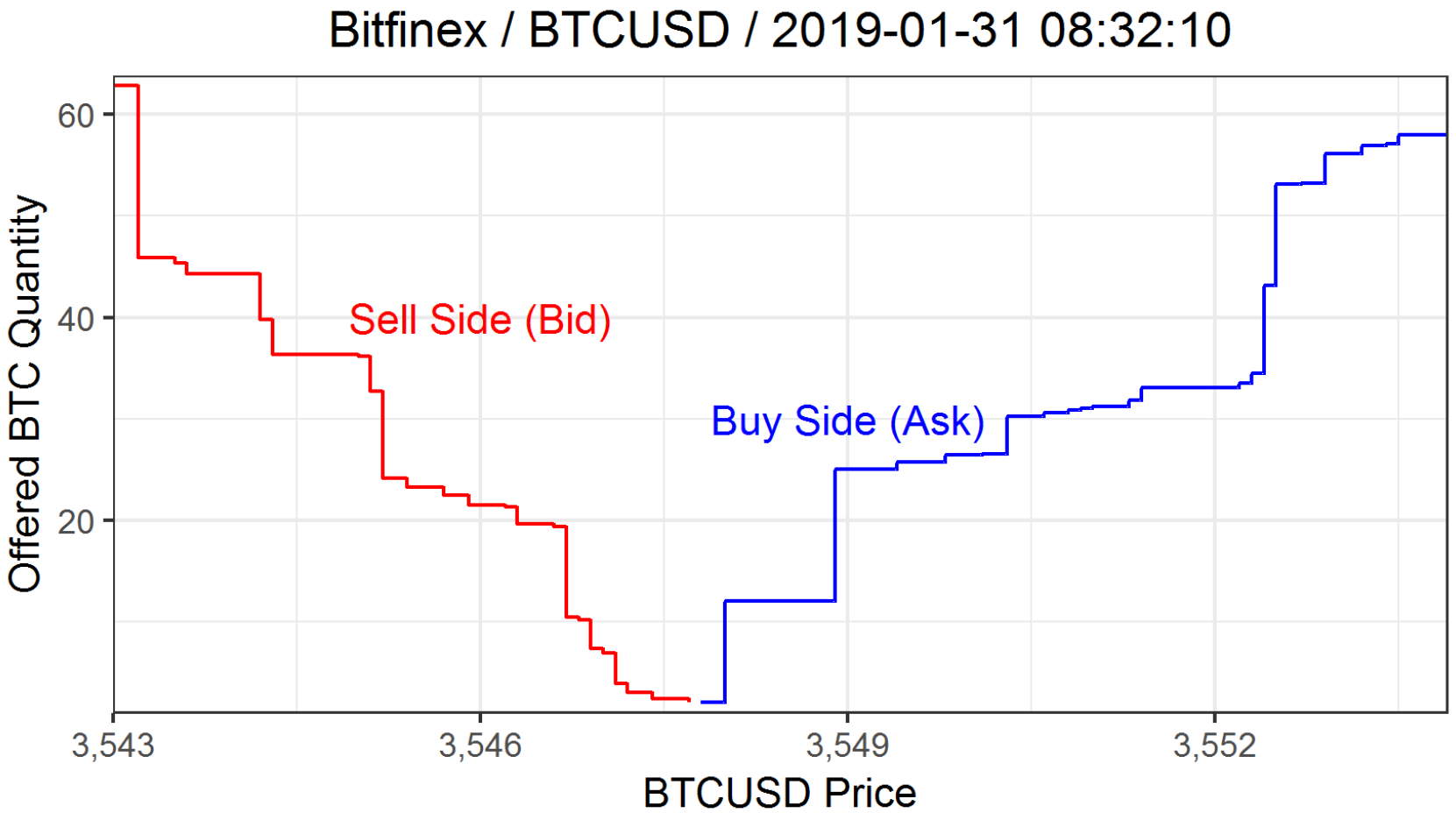
## How much does my trade move the price?

- Traders & market makers offer price-quantity schedules (*orderbook*)
- I assume orderbooks show *true liquidity*

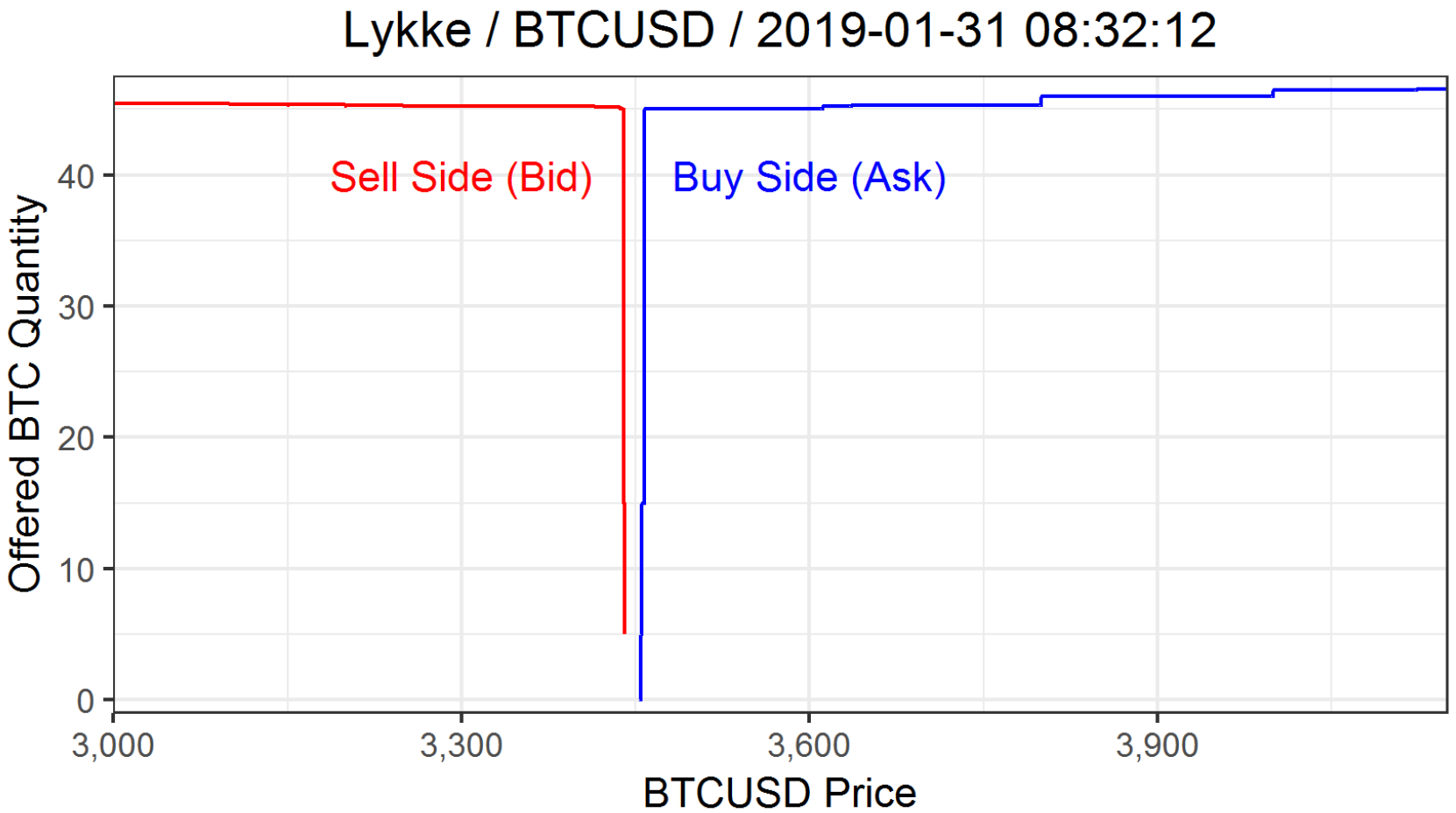
## How much fees do I have to pay?

- Exchanges provide fee menu depending on trading quantity
- I do *not* consider fees in my presentation

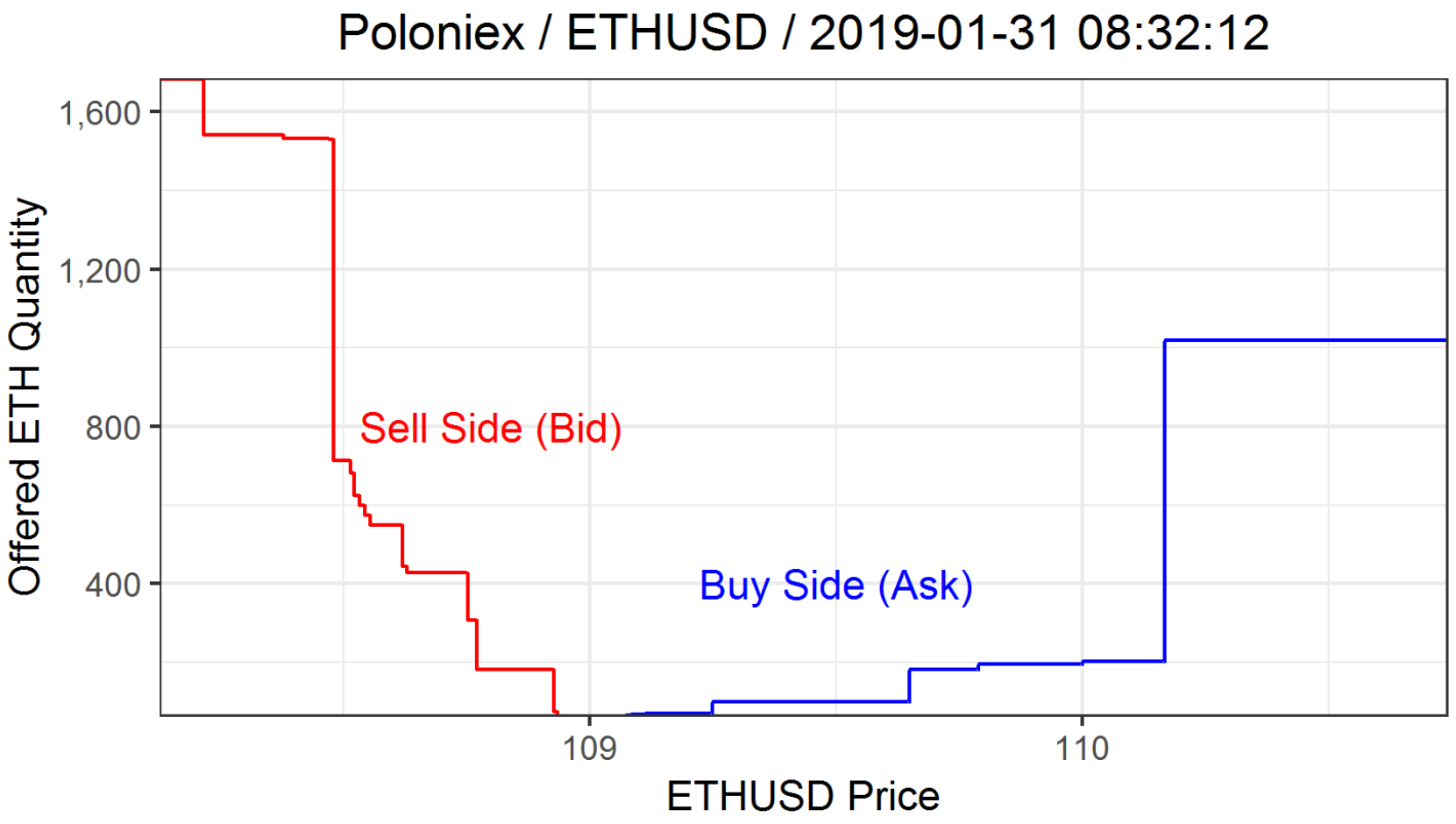
# Example of a typical orderbook



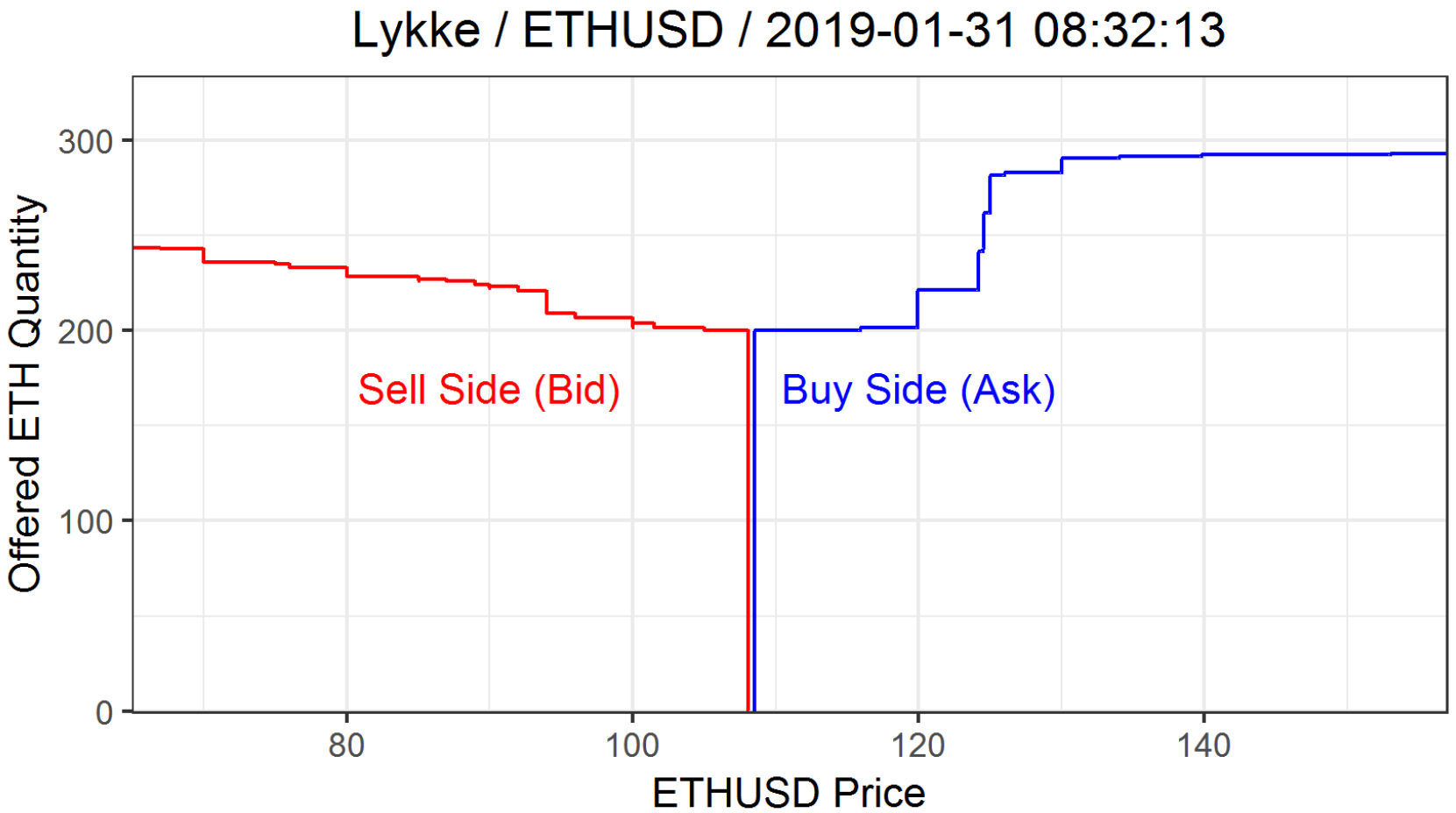
# Lykke orderbook at the same time



# Another example of an orderbook



# Again Lykke at the same time



# Overview of my talk

1. Data collection
2. Descriptive statistics
3. Liquidity measurement
4. Outlook & potential questions

# How do we collect data?

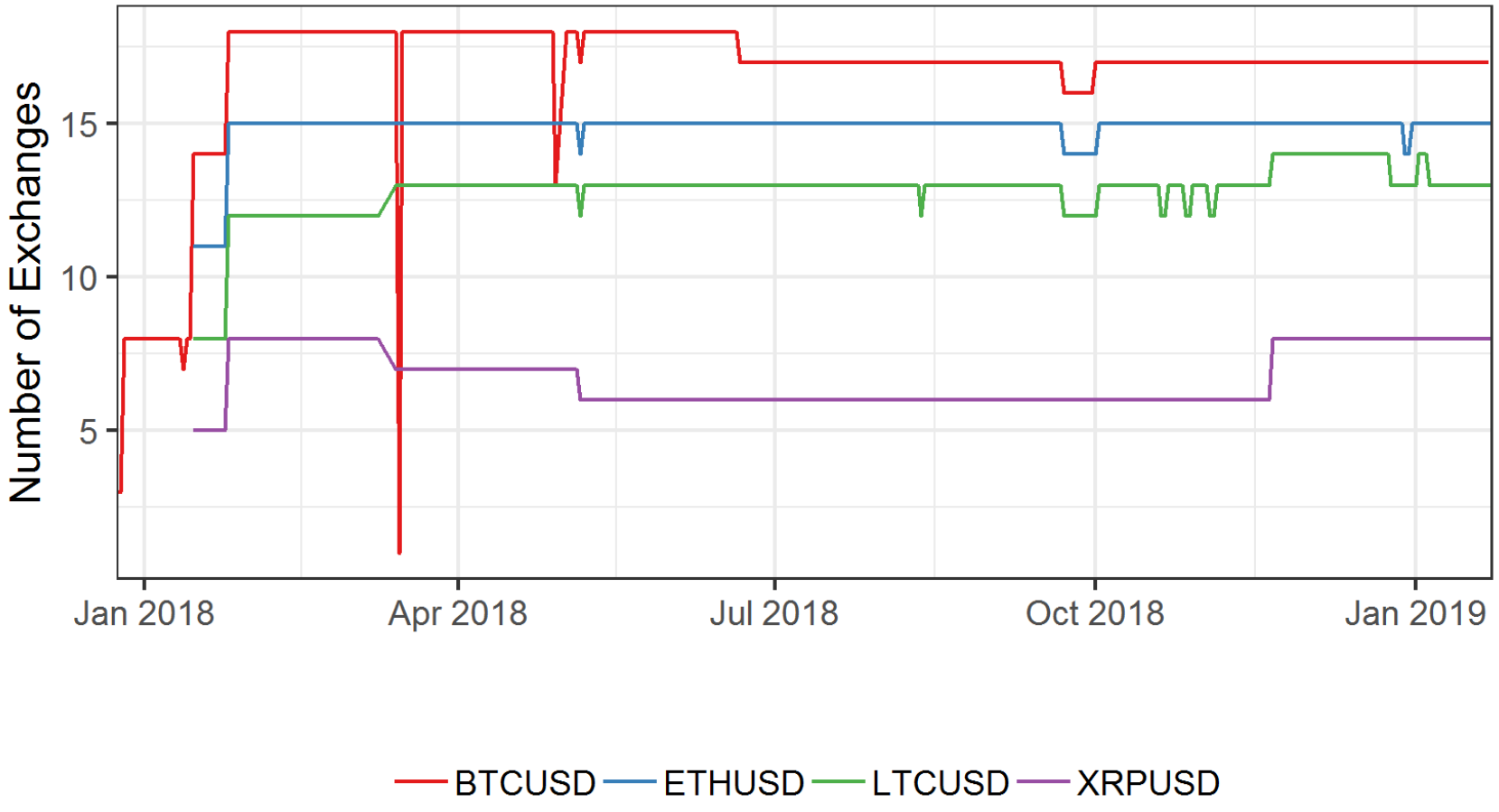
We run several servers & use our own code

- DigitalOcean (free credit: `https://education.github.com/pack`)
- CryptoX *R* Package (`https://github.com/ckscheuch/CryptoX`)

Every minute we simultaneously ping 17 exchanges

Every day we create a backup on Google drive

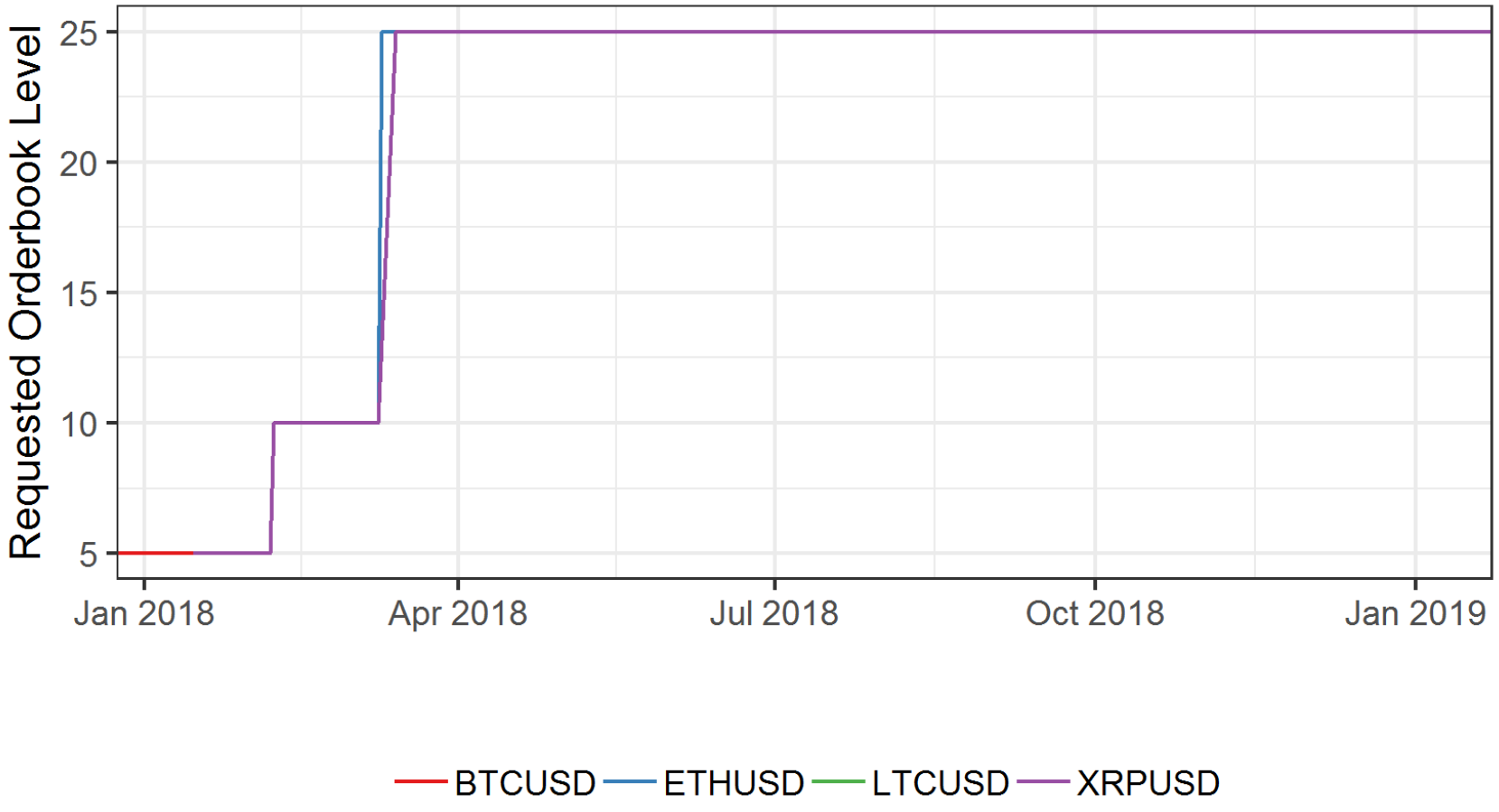
# Number of exchanges in our sample



# We currently track these exchanges

| | BTC | ETH | XRP | LTC | Tether | Company Location |
|---|---|---|---|---|---|---|
| Binance | ✓ | ✓ | ✓ | ✓ | ✓ | Tokyo, Japan |
| Bitfinex | ✓ | ✓ | ✓ | ✗ | ✗ | Central, Hong Kong |
| bitFlyer | ✓ | ✗ | ✗ | ✗ | ✗ | Tokyo, Japan |
| Bitstamp | ✓ | ✓ | ✓ | ✓ | ✗ | London, UK |
| Bittrex | ✓ | ✓ | ✓ | ✓ | ✓ | Las Vegas NV, USA |
| BTCC | ✓ | ✗ | ✗ | ✗ | ✗ | Shanghai, China |
| CEX.IO | ✓ | ✓ | ✓ | ✓ | ✗ | London, UK |
| Gate | ✓ | ✓ | ✓ | ✓ | ✗ | Sparta NJ, USA |
| Gatecoin | ✓ | ✓ | ✗ | ✓ | ✓ | Wanchai, Hong Kong |
| Coinbase Pro | ✓ | ✓ | ✗ | ✓ | ✗ | San Francisco CA, USA |
| Gemini | ✓ | ✓ | ✗ | ✓ | ✗ | New York NY, USA |
| HitBTC | ✓ | ✓ | ✗ | ✓ | ✓ | Hong Kong |
| Kraken | ✓ | ✓ | ✓ | ✓ | ✗ | San Francisco CA, USA |
| Liqui | ✓ | ✓ | ✗ | ✓ | ✓ | Kiev, Ukraine |
| Lykke | ✓ | ✓ | ✓ | ✓ | ✗ | Zug, Switzerland |
| Poloniex | ✓ | ✓ | ✓ | ✓ | ✓ | Wilmington DE, USA |
| xBTCe | ✓ | ✓ | ✗ | ✓ | ✗ | Charlestown, Nevis |

# Requested orderbook levels



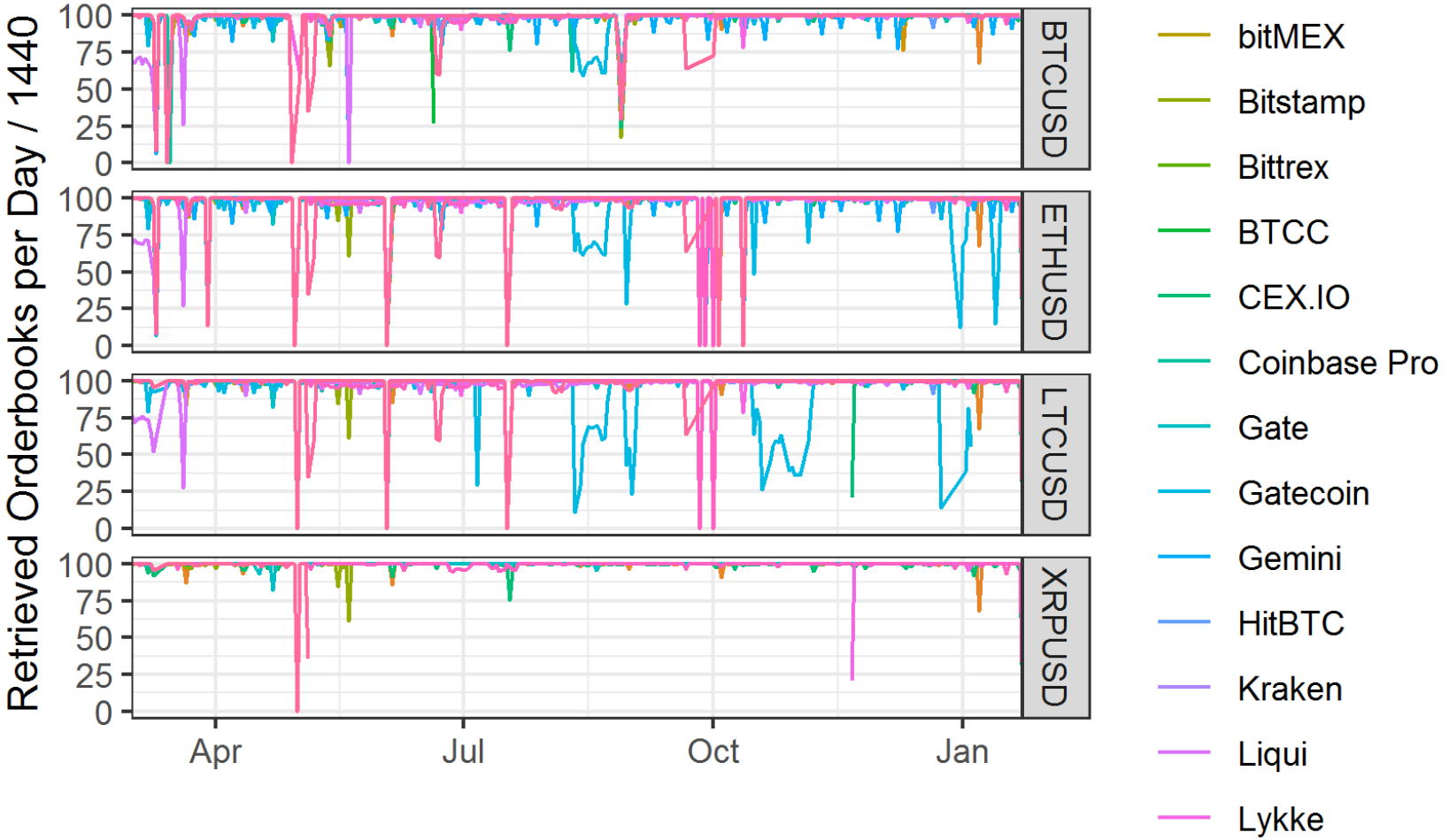
# How does our data look like?

| | asset_pair | exchange | ts | ts_received | ts_exchange | requested_level | side | level | price | size |
|---|---|---|---|---|---|---|---|---|---|---|
| | <chr> | <chr> | <dbl> | <dbl> | <dbl> | <int> | <chr> | <int> | <dbl> | <dbl> |
| 1 | XRPUSD | cex | 1521504063. | 1521504064. | 1521504063 | 25 | ask | 1 | 0.728 | 100 |
| 2 | XRPUSD | cex | 1521504063. | 1521504064. | 1521504063 | 25 | bid | 1 | 0.723 | 2000 |
| 3 | XRPUSD | bitfinex | 1521504063. | 1521504064. | 1521504061 | 25 | ask | 1 | 0.713 | 12000 |
| 4 | XRPUSD | bitfinex | 1521504063. | 1521504064. | 1521504061 | 25 | bid | 1 | 0.711 | 26987. |
| 5 | XRPUSD | bitstamp | 1521504063. | 1521504064. | 1521504059 | 25 | ask | 1 | 0.714 | 3594. |
| 6 | XRPUSD | bitstamp | 1521504063. | 1521504064. | 1521504059 | 25 | bid | 1 | 0.712 | 992. |
| 7 | XRPUSD | bitstamp | 1521504123. | 1521504137. | 1521504117 | 25 | ask | 1 | 0.714 | 13959. |

# How often do we successfully retrieve data (% of all minutes)?

| | BTCUSD | ETHUSD | LTCUSD | XRPUSD |
|---|---|---|---|---|
| Binance | 97.39 | 95.58 | 96.62 | 97.20 |
| Bitfinex | 97.05 | 95.16 | 96.10 | 97.35 |
| bitFlyer | 97.26 | | | |
| bitMEX | 97.68 | | | |
| Bitstamp | 96.94 | 95.26 | 96.24 | 97.42 |
| Bittrex | 97.32 | 95.49 | 96.52 | 97.69 |
| BTCC | 81.98 | | | |
| CEX.IO | 97.05 | 95.03 | 96.52 | 97.18 |
| Gate | 97.62 | 95.63 | 96.70 | 97.86 |
| Gatecoin | 95.98 | 92.48 | 90.76 | |
| Coinbase Pro | 97.27 | 95.48 | 96.45 | |
| Gemini | 96.46 | 94.60 | | |
| HitBTC | 97.47 | 95.42 | 96.40 | |
| Kraken | 97.13 | 95.49 | 96.50 | 88.32 |
| Liqui | 93.71 | 91.50 | 93.04 | |
| Lykke | 97.32 | 95.29 | 97.92 | 97.09 |
| Poloniex | 96.93 | 94.72 | 95.93 | 97.78 |
| xBTCe | 96.35 | 95.29 | 96.32 | 92.67 |

# Coverage ratio by exchange and asset pair



# Percentage spread as a simple measure of liquidity

$A$ = best ask (price if you want to *buy*)

$B$ = best bid (price if you want to *sell*)

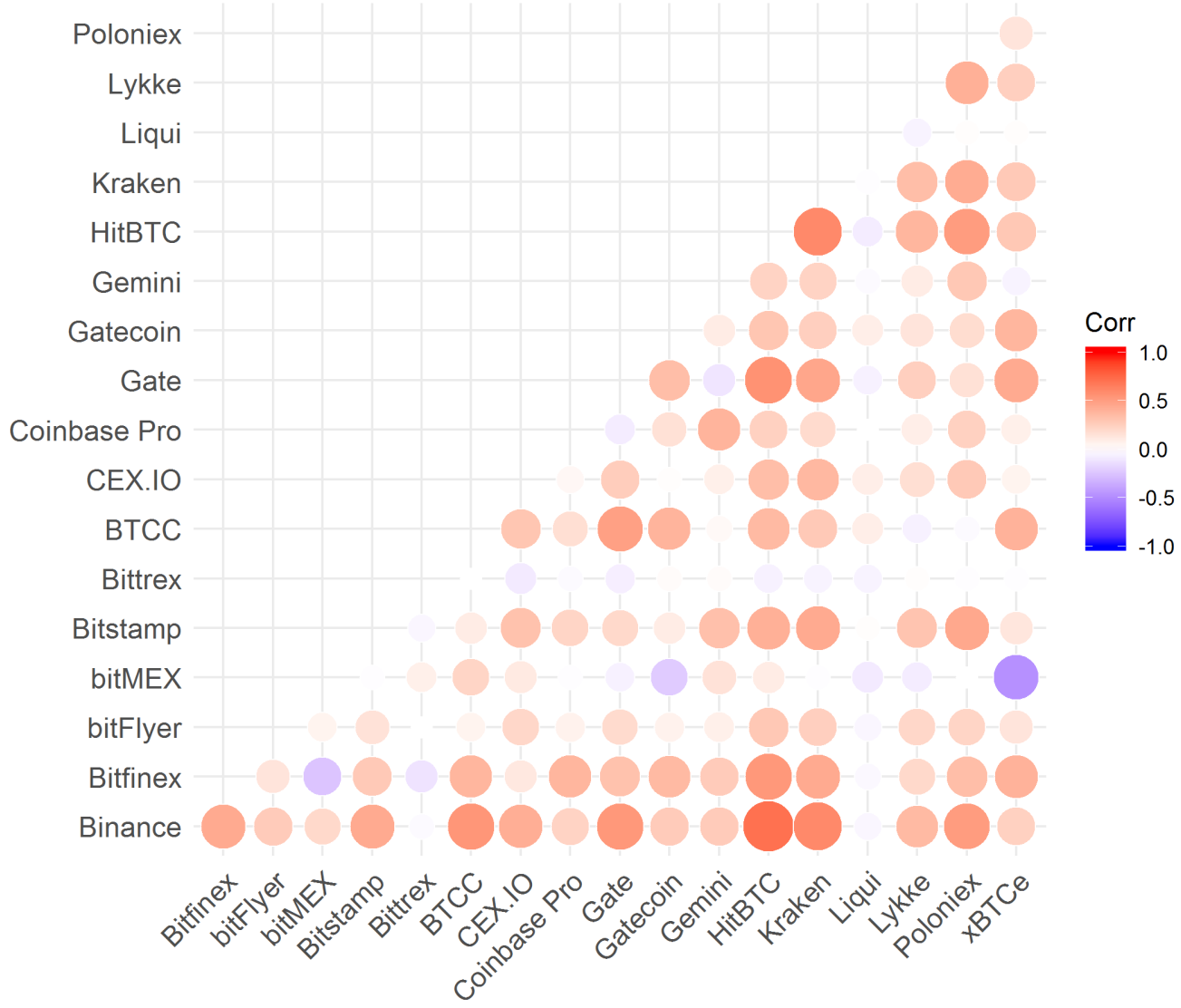
Definition of *percentage spread*

$$\text{Spread} = \frac{A - B}{A} \cdot 100$$

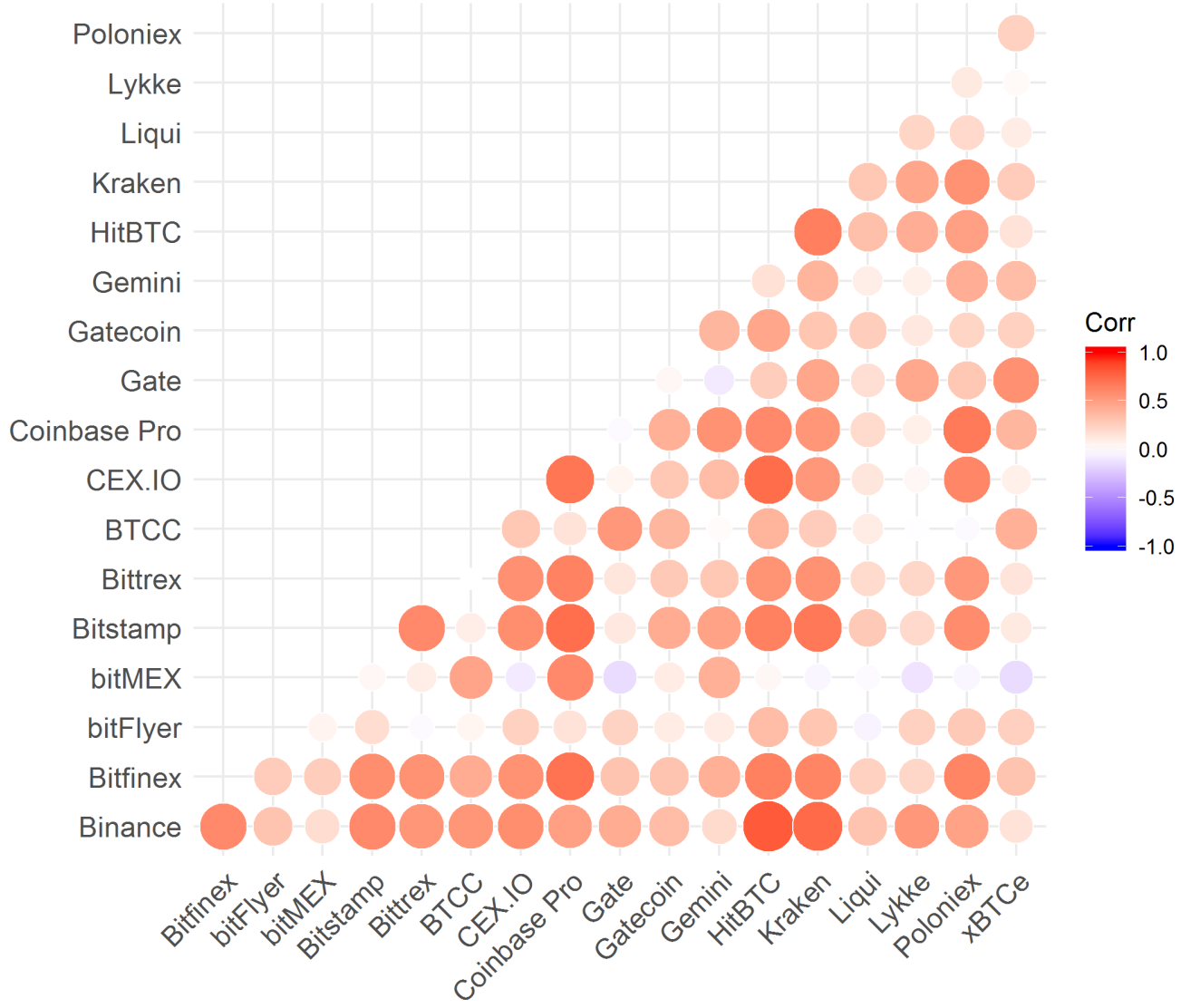
# Median percentage spreads by asset pair & exchange

| | BTCUSD | ETHUSD | LTCUSD | XRPUSD |
|---|---|---|---|---|
| Binance | 0.03 | 0.05 | 0.12 | 0.08 |
| Bitfinex | 0.00 | 0.01 | 0.04 | 0.05 |
| bitFlyer | 0.17 | | | |
| bitMEX | 0.19 | | | |
| Bitstamp | 0.06 | 0.15 | 0.21 | 0.17 |
| Bittrex | 0.16 | 0.28 | 0.51 | 0.42 |
| BTCC | 1.37 | | | |
| CEX.IO | 0.15 | 0.29 | 1.16 | 0.39 |
| Gate | 0.33 | 0.33 | 1.21 | 1.16 |
| Gatecoin | 0.73 | 9.20 | 24.34 | |
| Coinbase Pro | 0.00 | 0.01 | 0.02 | |
| Gemini | 0.02 | 0.06 | | |
| HitBTC | 0.03 | 0.05 | 0.22 | |
| Kraken | 0.03 | 0.07 | 0.13 | 0.20 |
| Liqui | 0.46 | 0.50 | 0.64 | |
| Lykke | 0.31 | 0.49 | 0.60 | 0.46 |
| Poloniex | 0.09 | 0.18 | 0.30 | 0.25 |
| xBTCe | 0.05 | 0.46 | 0.93 | 17.97 |

# Correlation matrix of spreads for BTCUSD



# Correlation matrix of spreads for all asset pairs



# Change in marginal prices for given trading quantities

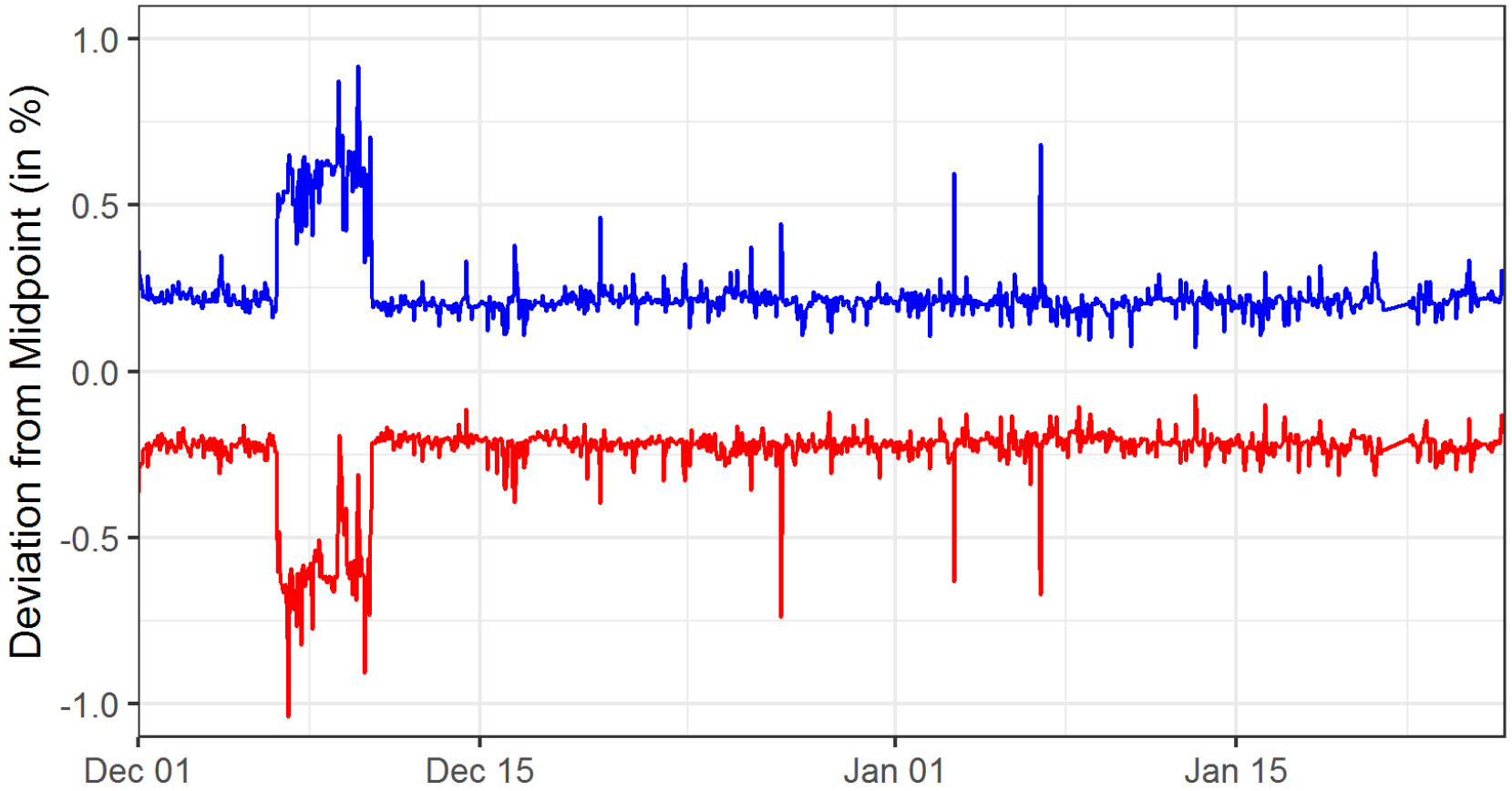
$$\text{Ask Impact}(q) := \left(\frac{A(q)}{A} - 1\right) \cdot 100,$$
$$\text{Bid Impact}(q) := \left(1 - \frac{B(q)}{B}\right) \cdot 100$$

where $A(q)$ ($B(q)$) is price of buying (selling) $q$ USD of the asset

*Alternative* definition: $q$ in terms of units of the asset

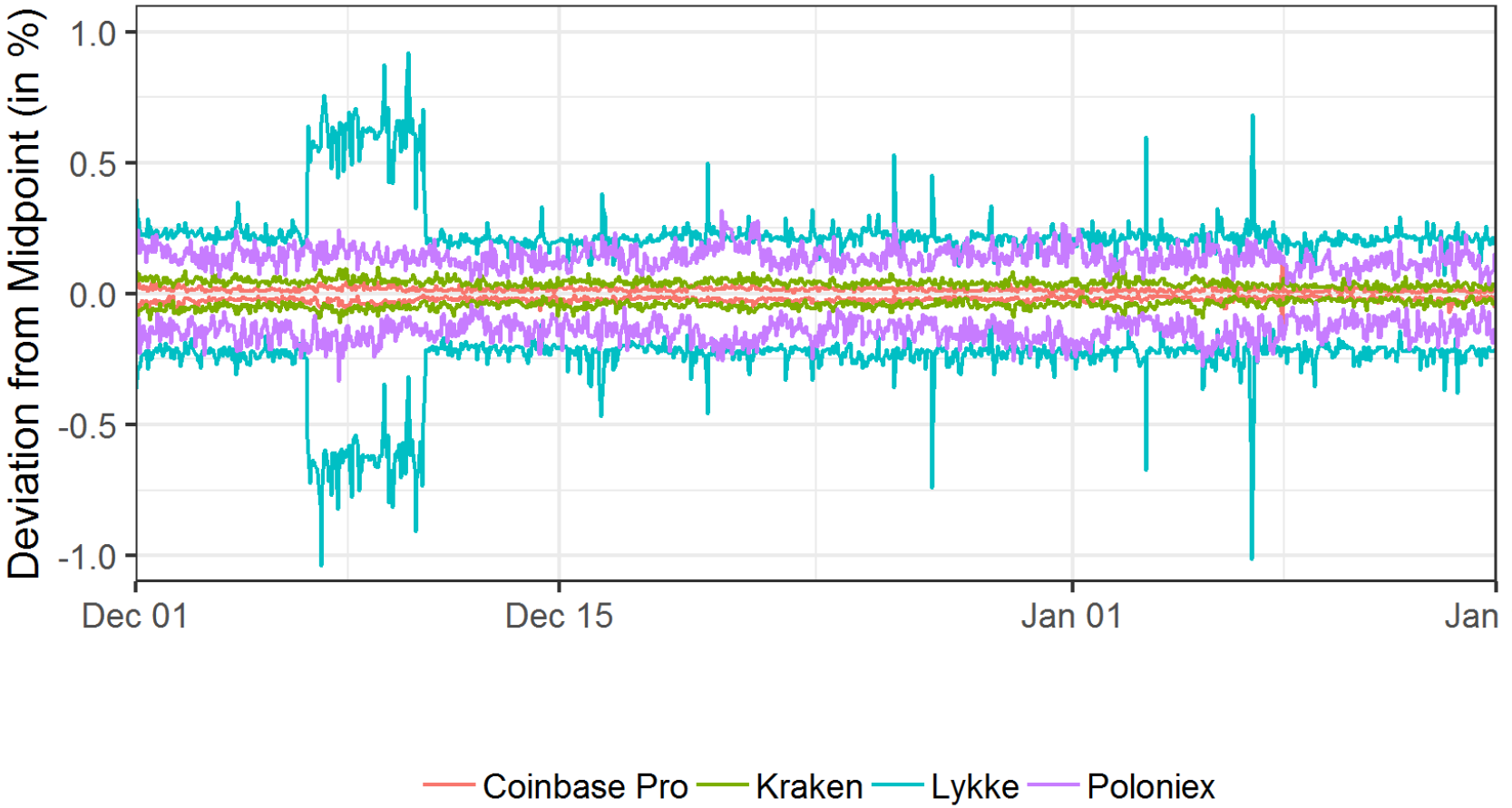
- Caveat: hard to compare across assets!

# Market impact measure of trading 1k USD on Lykke

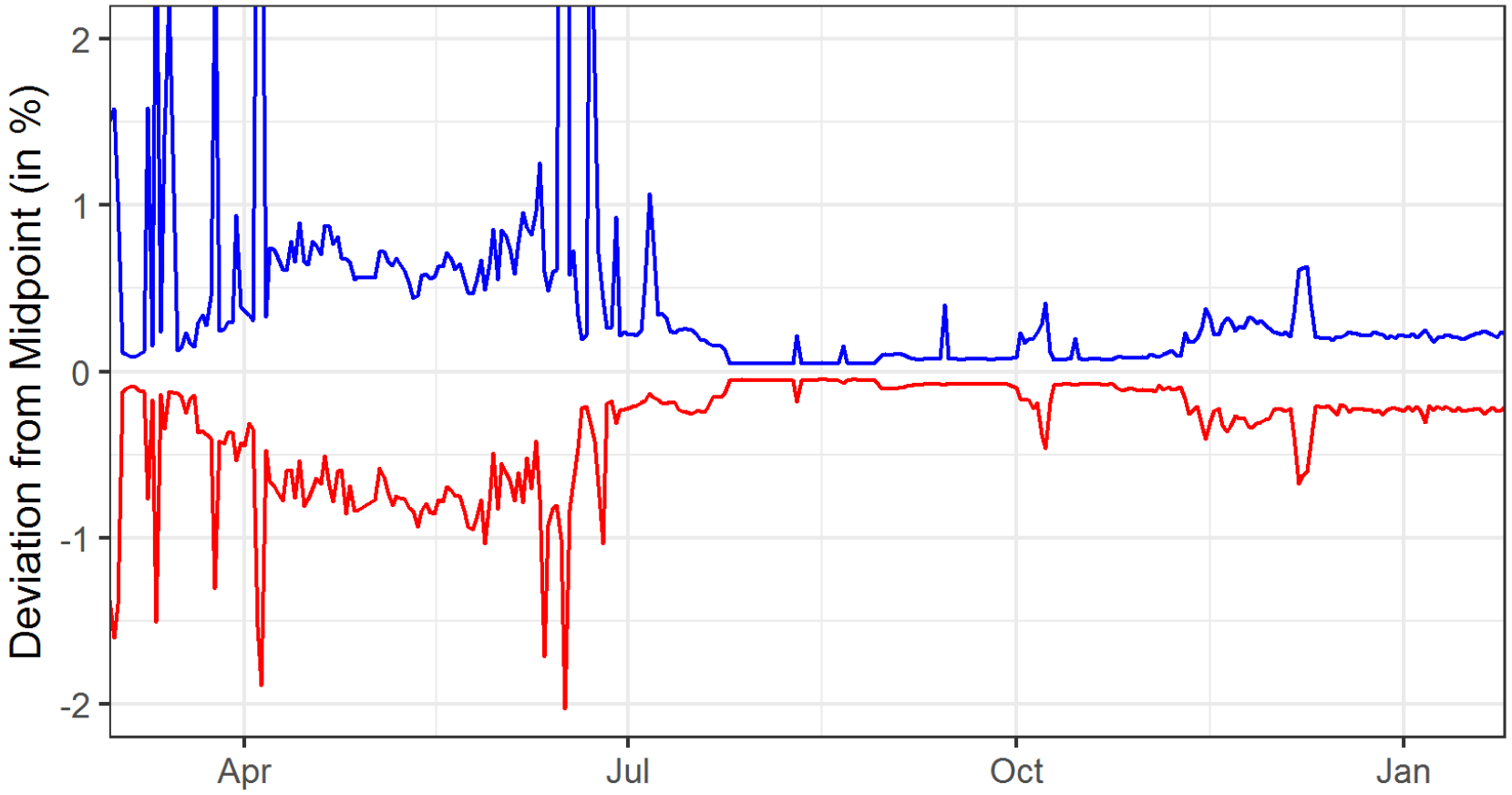


# Trading different quantities on Lykke

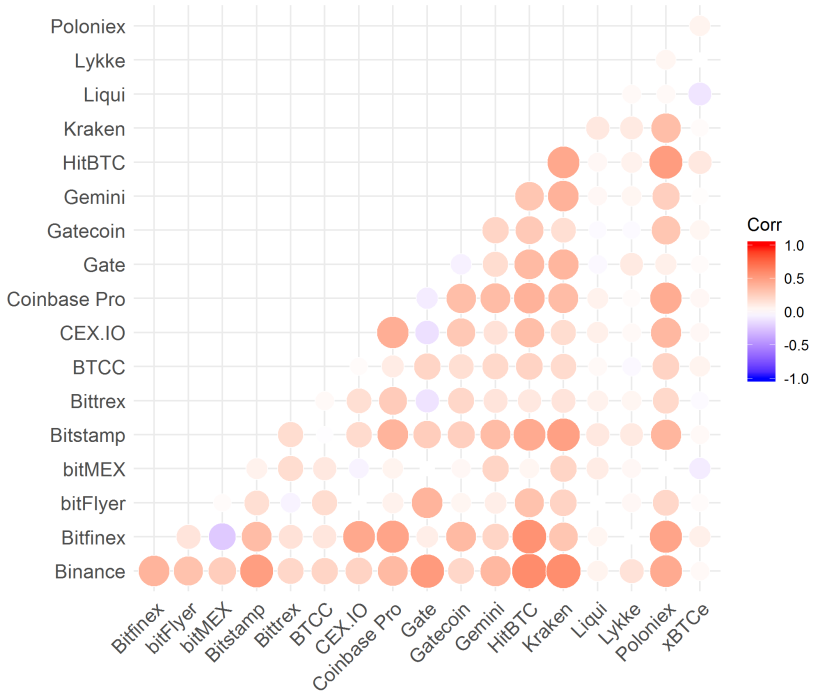
# Illustration of trading 10k USD on different exchanges

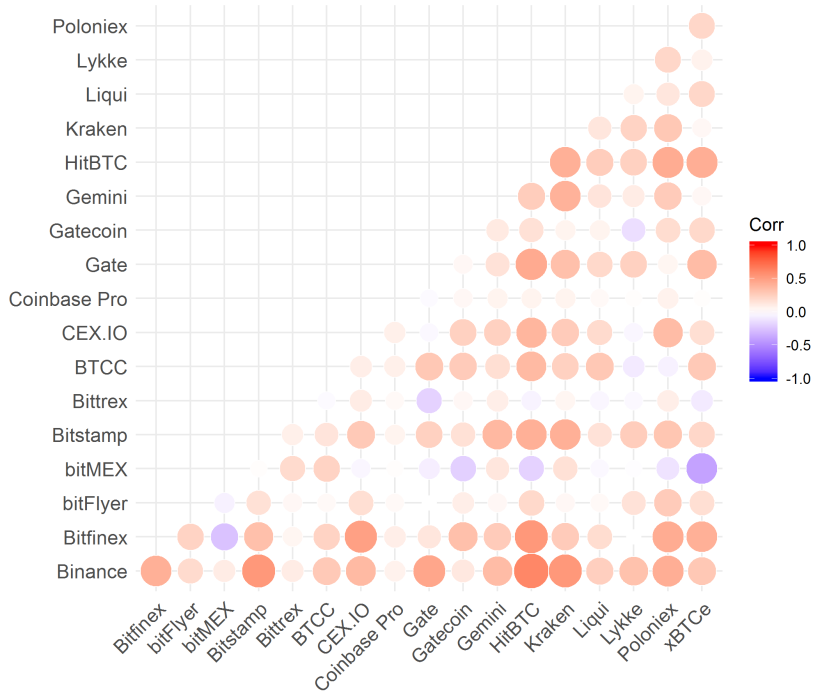


# Average daily price impacts for 10k USD on Lykke

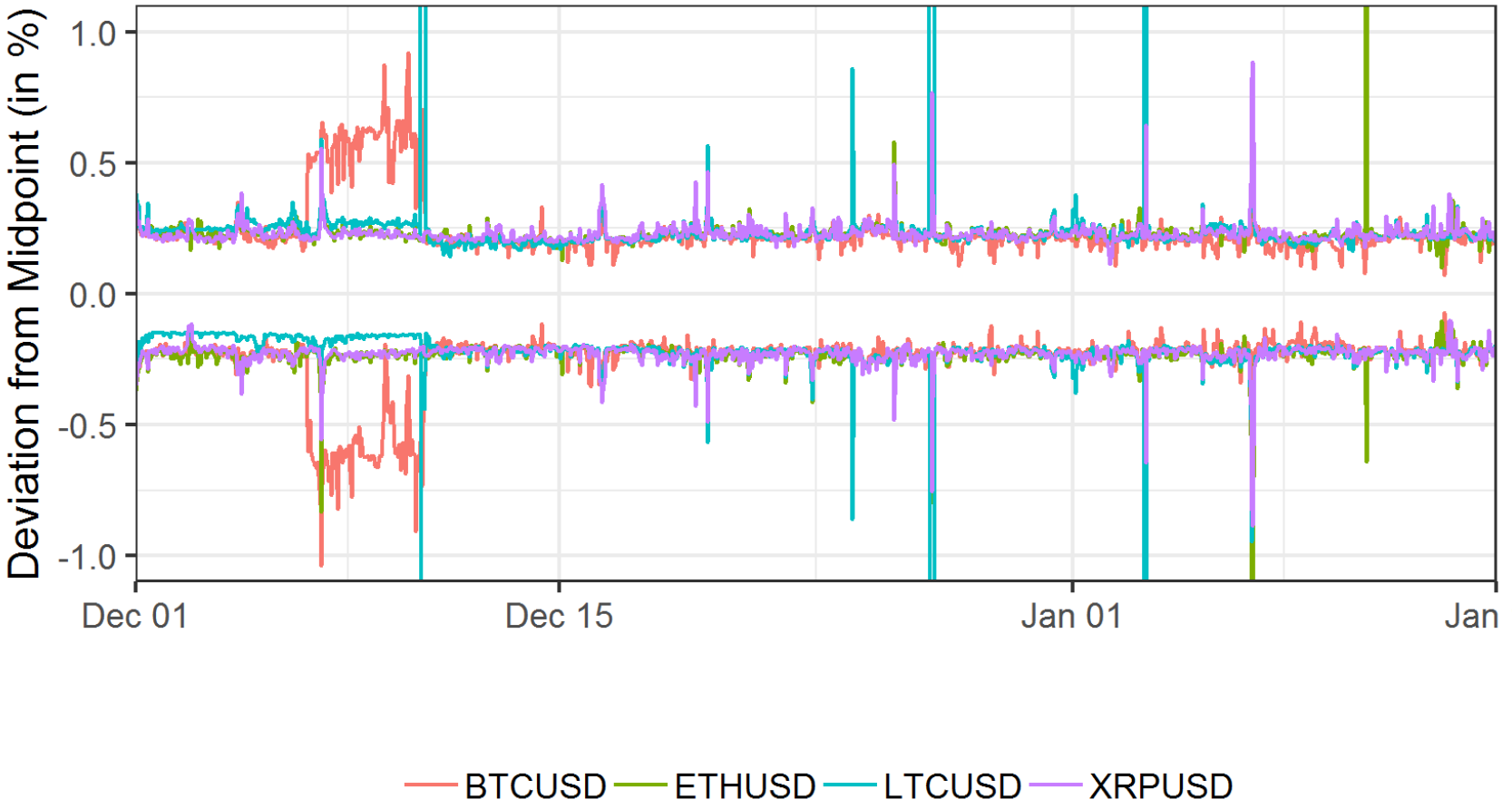


# Correlation of trading 10k USD on different exchanges



# Trading 10k USD in different assets on Lykke



# Tool for live monitoring of price differences?

Can we exploit price differences across exchanges?

`https://ckscheuch.shinyapps.io/arbitrage`

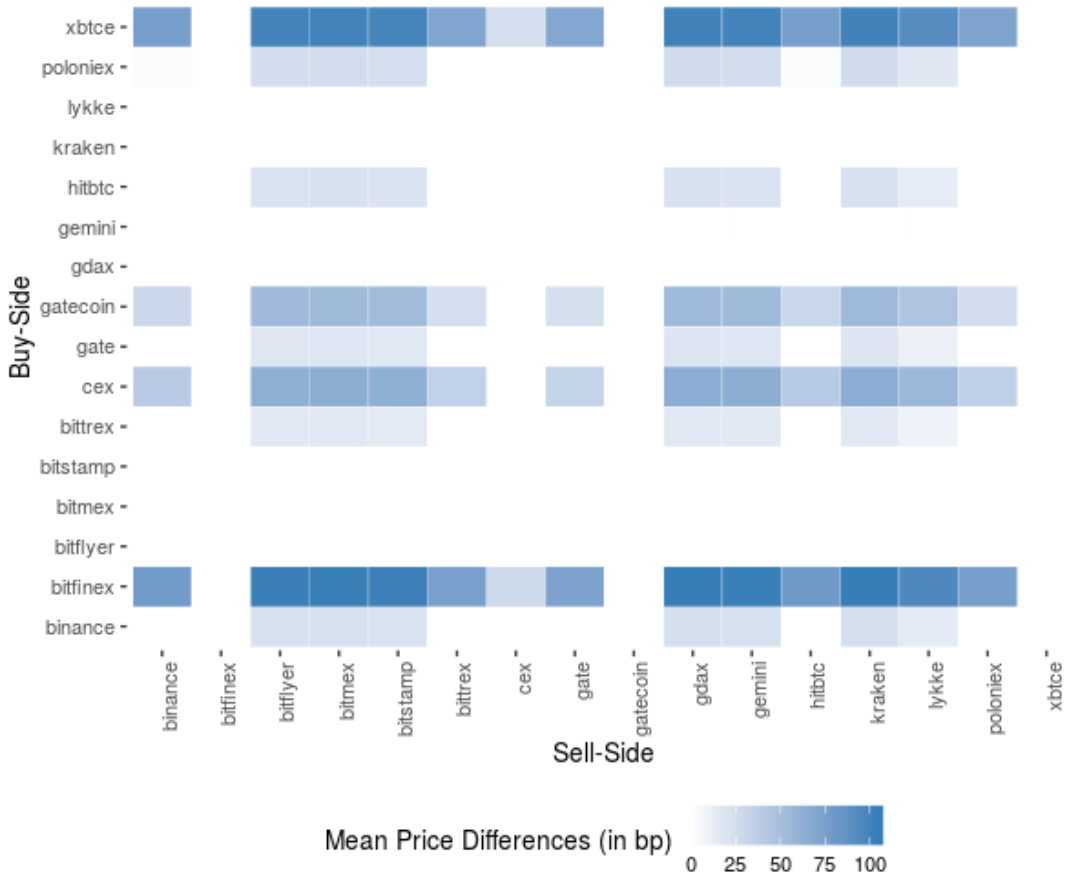
App downloads orderbooks from all exchanges & computes potential arbitrage opportunities

# Example of very simple app to look for arbitrage

## Arbitrage Possibilities

**Trading Size**

- 0
- 1
- 5
- 10



# Some suggestions for further exploration

## Technological perspective

- What is the most efficient way to retrieve & store orderbook data?
- How often / fast can we ping exchanges?
- Which exchanges provide the stablest connection?

## Applied finance perspective

- How much do fees shift prices?
- How much can we trust orderbooks (*fake liquidity*)?
- How stable are liquidity relations over time?

## Academic finance perspective

- How are cryptos / blockchains different from current financial system & what can we learn from them?

Thank you!

ckscheuch.github.io

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