Fragmentation in the Bitcoin market: Evidence from multiple coexisting order books*

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Abstract

We explore the consolidated order book of five major exchanges to investigate how fragmentation affects the Bitcoin market. Using intraday snapshots of the order book data, we find that the Bitcoin market is quite fragmented, wherein the exchange liquidity measure is significantly negative, even for small transactions. Our results suggest that consolidation tools, such as smart order routers, can be effective in reducing the cost of trading, and that further development of the Bitcoin market's trading and regulation is needed.

JEL Classification: C58, G14, G15

Keywords: Bitcoin; fragmented market; market microstructure; smart order router

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1 Introduction

Since the seminal work of Nakamoto (2008), Bitcoin has gradually gained popularity as a decentralized peer-to-peer digital currency. In addition to its technological importance, Bitcoin has also become an alternative investment asset. Since early 2017, when it reached its peak and during its rally late in the same year, it has become a potential choice among retail investors.[1] Although the price and trading volume have cooled down, Bitcoin continues to be actively traded in multiple exchanges around the world.

Despite its popularity among investors, cryptocurrency exchanges are highly unregulated. Although the legal status of Bitcoin and other cryptocurrencies has been finalized, its precision varies across countries based on whether it is treated as a currency, physical asset, or commodity. Consequently, although the number of stock exchanges remains significantly greater than the number of cryptocurrency exchanges, there is no unified framework regulating trades across different cryptocurrency exchanges. Compared to stock exchanges, these exhibit more frequent arbitrage opportunities across different exchanges, greater bid-ask spread, and increased volatility.[2] In other words, cryptocurrency exchanges carry an elevated level of fragmentation in terms of market efficiency. This unique feature has led to many studies examining the market microstructure of the cryptocurrency market, with a focus on liquidity and efficiency.[3]

Notably, most of the existing studies focus on the aforementioned factors in a single exchange and often neglect the possibility of investors trading in multiple exchanges, simultaneously.[4] Market fragmentation has been widely studied in the stock exchange markets, documenting price discovery, convergence, and latency, but fragmentation has not been effectively investigated in the consolidated cryptocurrency markets.[5] Although the use of

[1] See Dyhrberg (2016) for hedging capabilities of Bitcoin.

[2] An arbitrage opportunity across different cryptocurrency exchanges is observed quite often. Makarov and Schoar (2020) document and analyze potential sources of arbitrage opportunity in Bitcoin markets.

[3] See Dimpfl (2017), Dyhrberg et al. (2018a), Dyhrberg et al. (2018b), Koutmos (2018), Vidal-Tomás and Ibañez (2018), and Wei (2018) for examples.

[4] Silantyev (2019) studies order flow of Bitcoin in BitMex alone.

[5] See Lee (2019), Menkveld and Yueshen (2019), and Westerholm et al. (2016).

consolidation tools in stock markets, such as smart order routers, is almost by default, no such tool is easily accessible to investors in the cryptocurrency market. For example, according to the National Best Bid and Offer (NBBO) regulation set by the Securities and Exchange Commission (SEC), the purchase and sale of stocks must be executed at the best available bid and ask prices across all exchanges in the U.S. However, no easy access to such NBBO-type of trading execution currently exists in the cryptocurrency market.

Due to the lack of a consolidation tool, cryptocurrency market fragmentation is therefore more extreme than merely having multiple exchanges around the world. This results in a substantial advantage for investors who have access to the consolidated order book versus retail investors who only trade in a single exchange.

This study provides a comprehensive analysis of such advantages by employing intraday snapshots of the order book data.[6] We consolidate and examine an exhaustive dataset of five major cryptocurrency exchanges. By employing the Exchange Liquidity Measure (ExLM) of Gomber and Schweickert (2002) and Gomber, Schweickert, and Theissen (2015), we focus on how much liquidity gain an investor can obtain by using the consolidated order book instead of placing orders on individual exchanges.[7]

By comparing local liquidity with the liquidity from the consolidated order book across different order sizes of 100K, 500K, 1M, and 2M USD, we show the resulting greater depth that exists in the consolidated order book and document the market fragmentation in the Bitcoin market. Using data from five major exchanges around the world during the sample period from January 2017 to May 2019, we test for ExLM across individual exchanges and the consolidated data and find that an investor who uses the consolidated order book can significantly benefit from additional liquidity gain. In addition, the observed fragmentation in the Bitcoin market has not improved over time, which further supports the lack of

[6]There are a limited number of studies examining complete intraday order book data of the Bitcoin market. For example, see Schnaubelt, Rende, and Krauss (2019).

[7]Herein, the "consolidated order book" refers to the merged order book of five individual exchanges, rather than a true consolidated order book as in the equity market. In fact, if the true consolidated order book exists, we will not observe any arbitrage opportunity available through the crossed order book.

consolidation tools, such as smart order routers.

Our goal is to understand liquidity supply in the Bitcoin market for the consolidated order book, compared with individual exchanges. Because there are no regulation requirement and easy access to consolidation tools, the Bitcoin market may not have sufficient liquidity supply provided by cross-arbitrageurs. Consequently, the Bitcoin market is more vulnerable to "Flash Crash" type of events. As argued in Menkveld and Yueshen (2019), lack of such cross-arbitrageurs or tools could lead to a vulnerable system due to the inability to manage increased liquidity locally and immediately. Our study is the first attempt to quantify the level of such fragmentation that exists in the Bitcoin market. To do so, we focus on the comparison between local liquidity and that from the consolidated order book.

Moreover, the potential advantage is not limited to the earlier period of higher investor attention, but rather stays almost constant throughout the sample period. Overall, our findings suggest the importance of consolidation tools in the Bitcoin market and a potential new channel for understanding the Bitcoin market microstructure through the consolidated order book.

The remainder of the paper is structured as follows. Section 2 discusses the data and methodology used to construct our estimation of Bitcoin market fragmentation. Section 3 then discusses empirical findings. Finally, concluding remarks are presented in Section 4.

2 Data and Methodology

To create our unique comprehensive dataset, we obtain Bitcoin to USD order book data from CryptoTick, who collect historical intraday changes to the order book through open API interfaces provided by individual exchanges. Our sample period is from January 2017 to May 2019, except for Kraken whose sample starts from November 2017. To ensure fair comparison, our main analysis is conducted for the sample period from November 2017 to May 2019. We also provide brief results for the period between January 2017 to October

2017 without Kraken data. To ensure sufficient trading activities for multiple exchanges, the start date is set at January 2017 as the trading of Bitcoin was scarce prior to 2017. We focus on the following five exchanges: Bitfinex, Bitstamp, Coinbase, Poloniex, and Kraken.[8]

Bitstamp is based in Luxembourg, Bitfinex in Hong Kong, and the other three exchanges are in the U.S. This ensures global coverage of the exchanges representing Europe, Asia, and the U.S. so that the advantage of having access to the globally consolidated order book is maximized.[9] Bitfinex and Poloniex only provide trading pairs between BTC (Bitcoin) and USDT (Tether) instead of BTC to USD. Since we do not have complete intraday data on USDT to USD trading pairs, we use the daily closing price of USDT to USD downloaded from CoinMarketCap (`www.coinmarketcap.com`) to convert the data to USD within each day.

Due to the exhaustive size of the dataset, we limit our analysis to the end of each hour. Our basic research question is how much gain in ExLM can an investor make using the consolidated order book? Using a snapshot of the hourly limit order book, we compute ExLM corresponding to trade sizes of 100K, 500K, 1M, and 2M USD, for each of the aforementioned exchanges, as well as the consolidated order book of the five exchanges.

The raw dataset obtained from CryptoTick contains order book snapshots taken at different times of the day, usually twice at the beginning and the end of each day, and all orders that were added and removed from the order book. To construct a snapshot at the end of each hour, we filter the data by taking the latest snapshot available up to each hour, and then, adjust the snapshot for all orders added and subtracted, between the time of the last snapshot and end of each hour. We then consolidate order book snapshots of the five exchanges at the end of each hour to define the consolidated order book.

Table 1 provides descriptive statistics of the hourly order book snapshots for the five

[8]Trimborn et al. (2020) find evidence for a leading effect of three exchanges in the Bitcoin price formation, namely Bitfinex, Kraken, and Cex.io. Our data cover two of the three, since both Bitfinex and Cex.io are large exchanges.

[9]Brauneis et al. (2019) study trading of BTC against USD on Bitfinex, Bitstamp and Coinbase Pro, and they find that BTC/USD market is highly liquid, in terms of bid-ask spreads and order book depth, with persistent differences between the three exchanges.

exchanges. Panel A presents descriptive statistics for the January 2017–October 2017 period for four exchanges excluding Kraken and Panel B shows those of the remaining period for all five exchanges. Note that the raw data we obtain often does not provide a full order book for Bitfinex and Poloniex, but only the order book corresponding to the first 100 bid and ask prices. Therefore, the depth of the order book measured by the total dollar amount of the entire order book may not represent the actual size; rather, it should be understood as a size of the data set used for this study. It does not affect our analysis because we only focus on order sizes of up to $2 million, which is fully covered in most periods, particularly in the main sample period shown in Panel B. Overall, Bitfinex and Coinbase exhibit lower spread in both dollar and percentage, while the remaining three exchanges show significant bid-ask spread.

Next, we calculate the ExLM by directly using Gomber and Schweickert (2002)'s and Gomber et al. (2015)'s definition as follows. For an order size of V, we first compute the weighted average prices to buy and sell V dollars' worth of Bitcoin. Denoting these weighted average prices to buy and sell by $P_{B,t}(V)$ and $P_{S,t}(V)$, respectively, we compute the ExLM in basis points by

$$\text{ExLM}_{B,t}(V) = 10,000\frac{P_{B,t}(V) - \text{MQ}_t}{\text{MQ}_t} \tag{1}$$

$$\text{ExLM}_{S,t}(V) = 10,000\frac{\text{MQ}_t - P_{S,t}(V)}{\text{MQ}_t}, \tag{2}$$

where MQ_t denotes the average price of the highest quoted bid price and the lowest quoted ask price at time t. Note that when we compute ExLM of the consolidated order book, we often encounter the situation in which the order book is crossed so that the highest quoted bid price is greater than the lowest quoted ask price. For these occasions, ExLM can take negative values, particularly when the order size V is small. We interpret negative ExLM as a crossed order book, or an abstract arbitrage opportunity due to lack of transaction cost.

Finally, the ExLM of each order book at time t corresponding to order size V is defined

as the sum of two ExLMs

$$\text{ExLM}_t(V) = \text{ExLM}_{B,t}(V) + \text{ExLM}_{S,t}(V). \tag{3}$$

Here, time t corresponds to the end of each hour. Thus, our sample consists of 24 observations per day, over the January 2017–May 2019 sample period, which gives us a total of 21,144 data points in total across five exchanges.

ExLM of the consolidated order book may take negative values when the order book is crossed. To show this, we provide an example in Figure 1 which plots the consolidated order book of five exchanges constructed from a snapshot taken at 12:00 AM on February 6, 2019. The horizontal axis corresponds to the quoted price level for the bids and asks book and the vertical axis denotes the amount of Bitcoin that can be absorbed up to the corresponding price level. We use different colors to denote the portion of the consolidated order book from each exchange. First, we find that the consolidated order book is significantly crossed, and the highest bid price is larger than the lowest ask price. This does not necessarily imply an arbitrage opportunity as the transaction costs of the cryptocurrency exchanges are large enough to offset potential arbitrage strategy.[10] Nevertheless, it signals a potential advantage for using the consolidated order book.

In the consolidated order book, the highest bid price is \$3,512.9 for one unit of Bitcoin from the Bitfinex order book while the lowest ask price is \$3,428.41 for one unit coming from the Coinbase order book. Thus, the quoted midprice of the consolidated order book is \$3,477.655. If we compute the ExLM for order size of \$100,000, then Bitfinex alone can absorb \$100,000 liquidity at the average price of \$3,512.9 for bid side and Coinbase alone can absorb \$100,000 liquidity at the average price of \$3,429.03 for ask side. Using these average prices, we compute ExLM for buy order as -139.82 and ExLM for sell order as -121.72; thus, ExLM of the consolidated order book is -261.54. In the next section, we use ExLM

[10] Lee (2019) demonstrates the negative impact of cross-venue latency on market quality in fragmented markets.

as the main tool to understand fragmentation in the Bitcoin market.

3 Results

Our main findings are reported in Table 2. We first report the arithmetic average of hourly ExLM for the consolidated order book and individual exchanges. The first panel reports the average ExLM during the early sample period, which consists of four exchanges only. Most notably, the ExLM of the the consolidated order book is negative on an average, for order sizes of 100K, 500K, and 1M USD. ExLM of individual exchanges are somewhat similar, where Bitfinex and Poloniex exhibit the best and worst liquidities, respectively, for 100K. ExLM of Poloniex for order sizes of $1M and $2M are omitted, as the size of the order book is too small, during this period.

When we examine at the main sample period from November 2017–May 2019, the average ExLM of the consolidated order book is still negative.[11] We also perform the test of difference in the average ExML measure for each individual exchange, compared with the consolidated order book. The results are significant across all exchanges, supporting that the average ExLM of the consolidated order book is lower than that of individual exchanges. In economic terms, the consolidated order book provides an average advantage of 77.47 basis points for an investor using the consolidated order book over Bitfinex alone when buying or selling 100K worth of Bitcoin using the market order.[12]

Interestingly, ExLM for order size of 100K is larger than the early sample period, but is now even smaller for order sizes of 500K, 1M, and 2M than the earlier sample period. This reflects the increased trading activity, or greater depth in the order book in the Bitcoin

[11] As defined in Equation (3), the ExLM measure is simply the sum of two components corresponding to buy and sell ExLMs. The ExLM for buying and selling are qualitatively similar and we therefore only focus on the total ExLM.

[12] ExLM(V) corresponds to a measure of the cost of a roundtrip trade of order size V. Therefore, ExLM of -147.89 corresponding to the consolidated order book during main sample period can be interpreted as a gain of 147.89 basis points when making a roundtrip trade of 100K. In comparison, ExLM of Bitfinex during the same period is 7.05, again which can be interpreted as a cost of 7.05 basis points when making a roundtrip trade of 100K. Assuming that buy and sell ExLM are roughly equal to each other, we take the difference between the two ExLM and divide it by 2 to obtain economic gain of 77.47 basis points on average.

market without much improvement in market fragmentation. In other words, although the market size has steadily grown in the past couple of years, the magnitude of market fragmentation, measured by ExLM of the consolidated order book, has not improved, and may have worsened. A possible reason behind this observation could be the lack of a consolidation tool, such as a smart order router. Although it is possible to use such a router in the Bitcoin market, the results indicate that usage of such a tool seems to be quite limited.

In addition, we investigate time-series behavior of market fragmentation, also measured by ExLM of the consolidated order book for order size of 100K. Figure 2 plots the time-series of average monthly ExLM of order size 100K for the consolidated order book and five individual exchanges. As can be seen from the drop in January 2018 and the decline in November–December 2018, the ExLM of the consolidated order book drops significantly during market downturns. Once the market stabilizes, ExLM also seems to increase accordingly. In terms of individual exchanges, ExLM improves over time for most of the exchanges with a decreasing trend, with an exception of Poloniex, which exhibits greater ExLM in later periods.

Finally, we examine whether there is an intraday pattern observed in ExLM measure. Figure 3 plots the average ExLM of order size 100K at the end of each hour, during the main sample period, for the consolidated order book and individual exchanges. Average ExLM is mostly stable throughout the day while it exhibits a sharp decline toward the end of the day, at around 22:00–23:00 UTC.

Overall, our results point to the potential role of consolidation tools, such as smart order routers, to significantly improve the liquidity of the Bitcoin market. Either having easy access to a consolidation tool, or establishing regulation requirements similar to those of NBBO would greatly benefit Bitcoin investors.

4 Conclusion

Using the history of entire intraday order book data, we study how the elevated level of fragmented exchanges affect the Bitcoin market. By employing an exhaustive dataset of five major Bitcoin exchanges, we create the consolidated order book and investigate the statistical properties and economic significance of its potential gains.

Using the ExLM, we document how much liquidity gain an investor can obtain through the consolidated order book when compared to placing orders at individual exchanges, and find significant gain advantage for the consolidated order book, which is tested across different order sizes. Moreover, our results reveal that the magnitude of market fragmentation has not improved over time, despite the growing size of the Bitcoin market.

Based on our reported results, we conclude by suggesting the lack (or limitation) of a consolidation tool, such as smart order routers, as an important reason behind this fragmentation. In summary, our findings suggest that potential development is needed in both trading and regulation of the Bitcoin market.

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Table 1: **Descriptive Statistics of Order Book Snapshots for Individual Exchanges**

	Bitfinex	Bitstamp	Coinbase	Poloniex	Kraken
		Panel A: Jan 2017–Oct 2017			
Avg. $ Spread	1.12	3.52	0.46	3.04	-
Avg. % Spread	0.0274%	0.1368%	0.0237%	0.1400%	-
Avg. Depth	2.19M	52.60M	830.92M	0.29M	-
		Panel B: Nov 2017–May 2019			
Avg. $ Spread	0.91	5.00	0.31	6.88	4.07
Avg. % Spread	0.0099%	0.0618%	0.0038%	0.0887%	0.0460%
Avg. Depth	4.40M	192.04M	1,809.90M	5.75M	4.05M

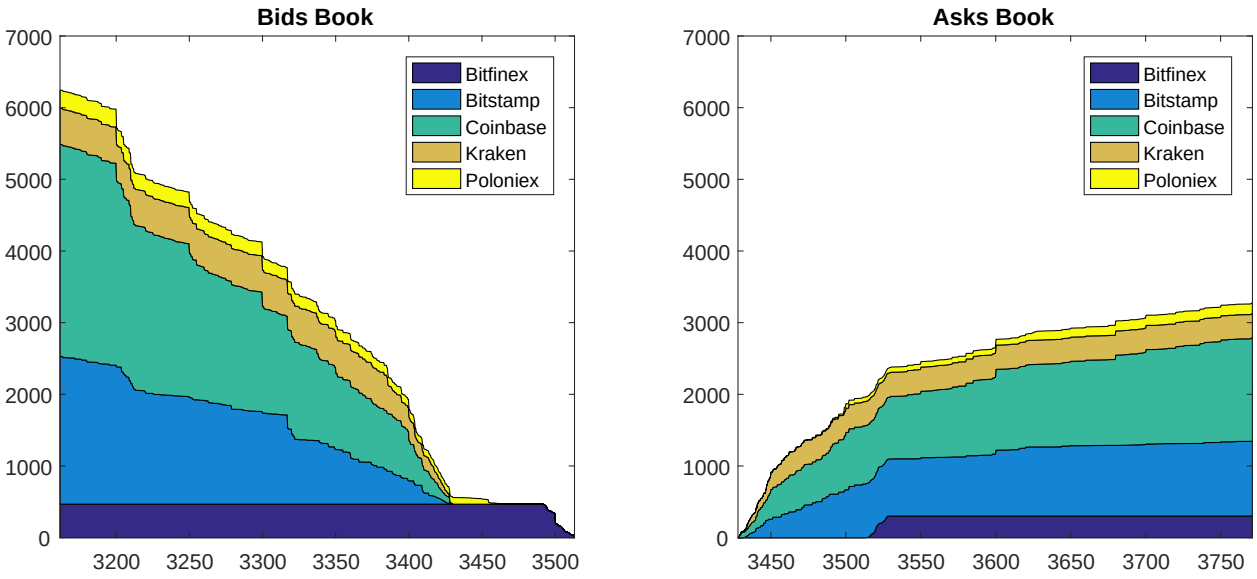
We report descriptive statistics of hourly order book snapshots for the five exchanges used herein. Panel A presents descriptive statistics for the period January 2017–October 2017, for four exchanges—excluding Kraken—and Panel B reports those for the remaining period for all five exchanges. $ Spread is measured as the difference between quoted best bid price and ask price, % Spread is measured as $ Spread divided by the quoted midprice, and Depth is measured as the total dollar volume in the limit order book.

Table 2: **ExLM of the Consolidated Order Book and Individual Exchanges**

V	Consolidated	Bitfinex	Bitstamp	Coinbase	Poloniex	Kraken
			Panel A: Jan 2017–Oct 2017			
100K	−223.69	39.06	58.12	45.96	86.15	-
500K	−128.85	118.00	182.87	188.39	111.83	-
1M	−48.53	156.77	317.93	413.72	-	-
2M	93.02	170.85	595.43	1,293.92	-	-
			Panel B: Nov 2017–May 2019			
100K	−147.89	7.05	23.70	9.12	51.10	26.39
		(78.22)	(64.98)	(55.41)	(68.89)	(60.87)
500K	−128.68	26.93	53.02	32.74	149.99	70.85
		(81.97)	(71.26)	(57.78)	(88.83)	(67.24)
1M	−110.15	44.93	82.50	60.55	402.54	126.31
		(79.10)	(75.66)	(59.89)	(96.66)	(72.49)
2M	−60.67	65.83	150.03	124.08	1,261.55	216.37
		(49.45)	(84.32)	(60.68)	(90.36)	(66.52)

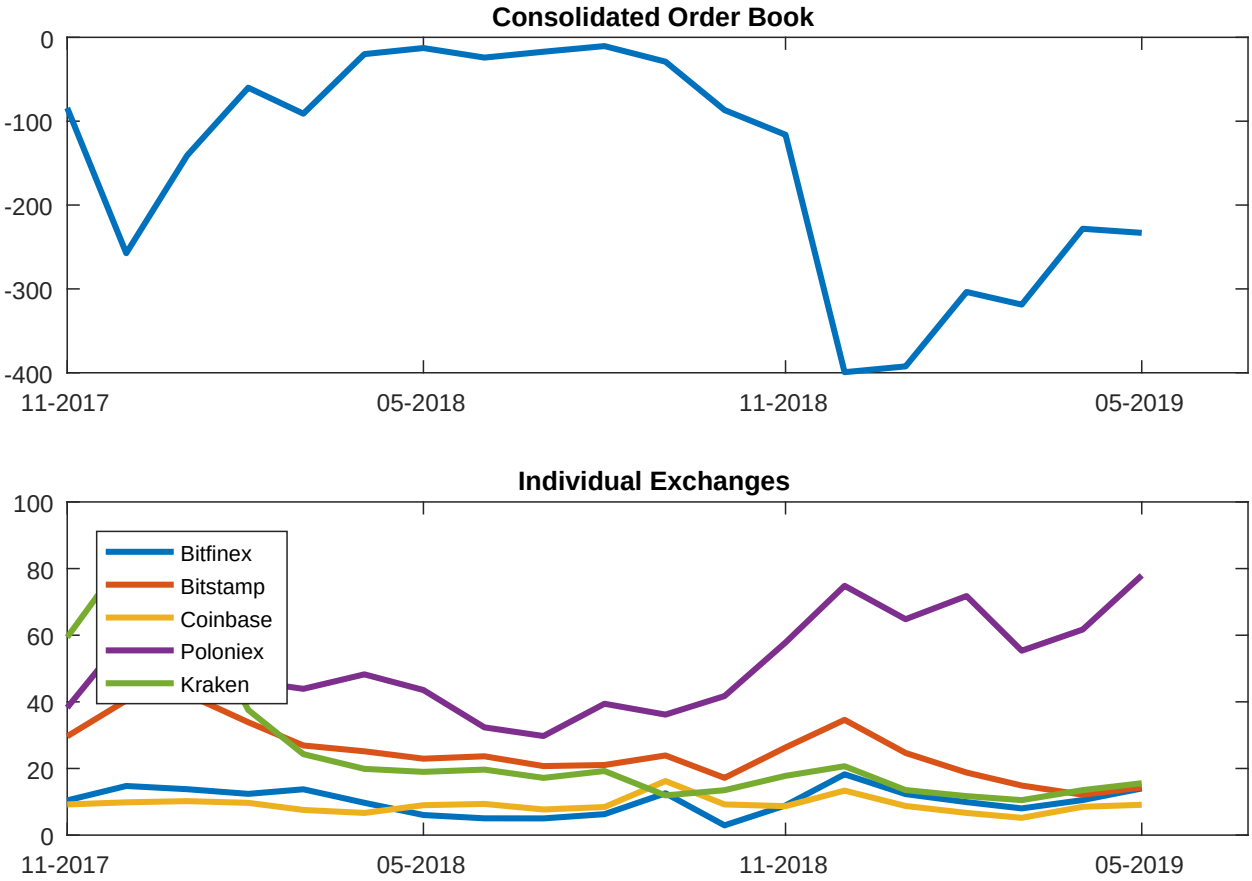
We report the ExLM computed by using Equation (3), for the five exchanges and the consolidated order book. The sample period is from January 2017 to May 2019. First, we report the arithmetic average of hourly ExLM for the consolidated order book and individual exchanges. The first panel reports the average ExLM during the early sample period of January 2017–October 2017 consisting of four exchanges only while the main panel covers all five exchanges. We also perform the test of difference in average XML for each individual exchange, compared with the consolidated order book. The t-stats are reported in parentheses.

Figure 1: **Snapshot of the Consolidated Order Book on February 6th, 2019 12:00 A.M.**



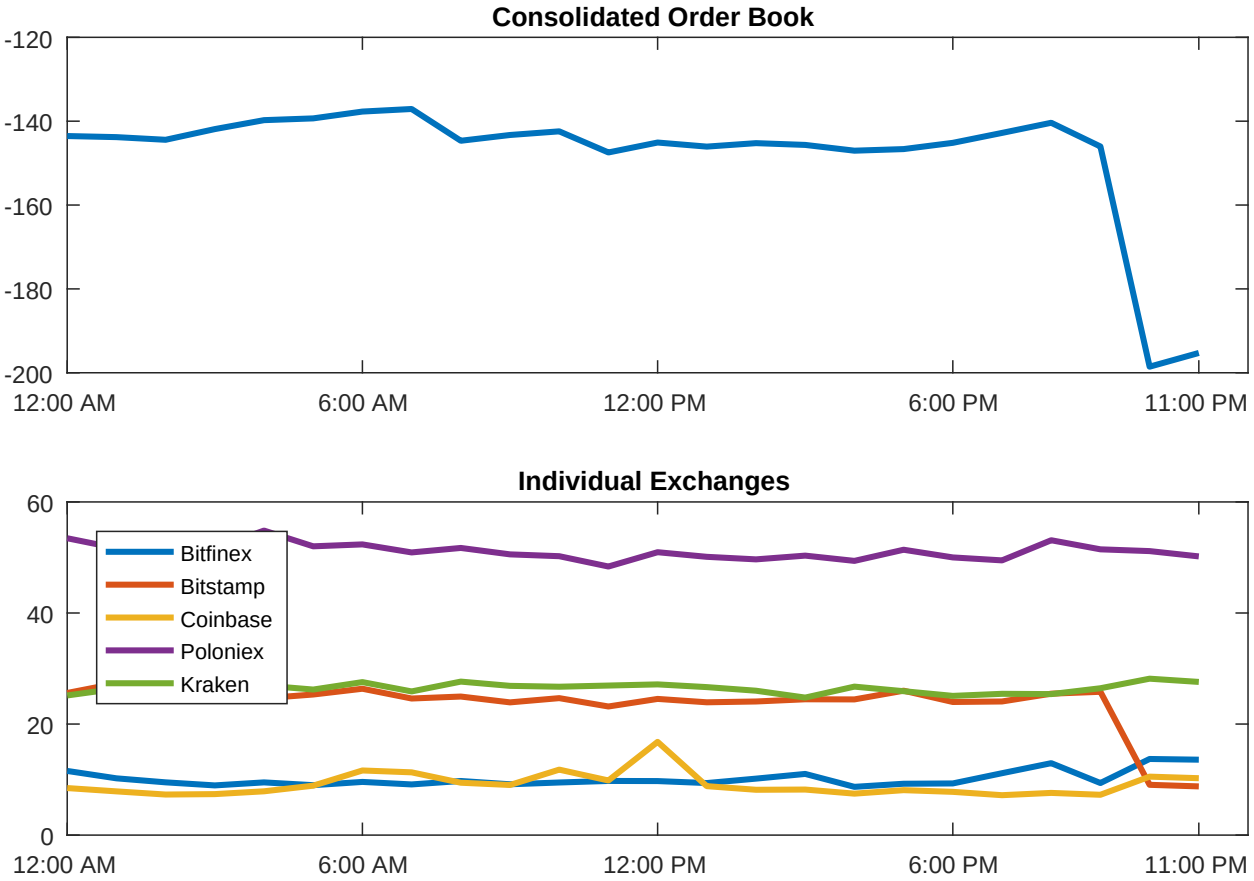
We plot the snapshots of the consolidated BTC/USD order book on February 6, 2019 at 12:00 A.M. UTC. The horizontal axis shows the quoted price level for the bids and asks book, and the vertical axis denotes the amount of Bitcoin that can be absorbed up to the corresponding price level.

Figure 2: **Time-series of Average ExLM by Month**



We plot the time-series of average monthly ExLM of order size 100K for the consolidated order book and the five individual exchanges over the sample period.

Figure 3: **Time-series of Average ExLM by Hour**



We plot the average ExLM of order size 100K at the end of each hour during the main sample period for the consolidated order book and individual exchanges.

A Appendix

Table A.1: **ExLM of the Consolidated Order Book and Individual Exchanges**

V	Consolidated	Bitfinex	Bitstamp	Coinbase	Poloniex	Kraken
			Median: Nov 2017–May 2019			
100K	−71.74	8.19	21.89	7.15	48.13	17.96
500K	−48.98	27.60	49.90	29.77	110.44	50.96
1M	−30.40	44.29	77.85	54.59	123.56	95.45
2M	−2.22	61.60	136.16	105.99	124.62	167.60
			Standard Deviation: Nov 2017–May 2019			
100K	332.31	243.29	130.39	40.01	27.02	30.45
500K	323.96	243.28	135.18	22.08	99.08	121.16
1M	327.72	244.21	144.58	32.74	431.62	190.94
2M	340.41	174.82	170.30	82.73	1,609.46	347.75
			Skewness: Nov 2017–May 2019			
100K	−35.63	−81.62	−76.92	54.09	1.16	2.95
500K	−40.40	−81.97	−79.47	10.62	1.64	57.21
1M	−41.88	−81.59	−76.98	5.64	1.13	57.85
2M	−49.44	−112.44	−66.06	19.68	1.05	53.25

We report the descriptive statistics of ExLM computed by using Equation (3), for the five exchanges and the consolidated order book. The sample period is from November 2017 to May 2019. Median, Standard deviation, and Skewness are reported.

Internet Appendix

Table IA.1: **Average ExLM by Month**

Month	Consolidated	Bitstamp	Bitfinex	Coinbase	Poloniex	Kraken
Nov-17	−84.24	10.42	29.65	9.20	38.27	59.39
Dec-17	−257.43	14.74	40.43	9.84	59.98	83.66
Jan-18	−140.69	13.78	42.24	10.20	53.06	72.49
Feb-18	−60.06	12.38	33.88	9.68	46.22	37.57
Mar-18	−91.05	13.75	26.90	7.55	43.90	24.30
Apr-18	−20.00	9.70	25.15	6.65	48.25	19.88
May-18	−12.77	6.03	22.93	8.98	43.54	18.98
Jun-18	−24.17	5.03	23.66	9.35	32.34	19.66
Jul-18	−17.19	5.01	20.72	7.69	29.74	17.18
Aug-18	−10.45	6.29	21.04	8.42	39.43	19.23
Sep-18	−29.03	12.55	23.91	16.23	36.17	11.91
Oct-18	−86.73	2.92	17.18	9.21	41.73	13.48
Nov-18	−116.19	8.91	26.31	8.69	57.81	17.78
Dec-18	−399.33	18.25	34.60	13.35	74.83	20.68
Jan-19	−392.42	12.31	24.66	8.74	64.80	13.52
Feb-19	−303.65	9.90	18.78	6.66	71.76	11.70
Mar-19	−318.72	8.01	14.88	5.19	55.35	10.50
Apr-19	−228.30	10.52	12.13	8.50	61.70	13.50
May-19	−233.18	14.00	14.30	9.10	77.95	15.57

This table reports the monthly average ExLM of order size 100K for the consolidated order book and five individual exchanges.

Table IA.2: **Average ExLM by Hour**

Time (UTC)	Consolidated	Bitstamp	Bitfinex	Coinbase	Poloniex	Kraken
12:00 AM	−143.54	11.56	25.60	8.47	53.46	25.15
1:00 AM	−143.80	10.23	27.32	7.88	51.67	26.36
2:00 AM	−144.44	9.50	26.03	7.31	51.35	25.58
3:00 AM	−141.89	8.95	27.72	7.38	51.68	26.24
4:00 AM	−139.76	9.49	24.64	7.89	54.84	26.95
5:00 AM	−139.33	8.99	25.32	8.90	52.01	26.21
6:00 AM	−137.71	9.58	26.36	11.64	52.35	27.55
7:00 AM	−137.09	9.13	24.60	11.30	50.91	25.88
8:00 AM	−144.67	9.75	24.95	9.43	51.71	27.64
9:00 AM	−143.29	9.15	23.90	9.03	50.56	26.88
10:00 AM	−142.42	9.47	24.67	11.79	50.23	26.72
11:00 AM	−147.46	9.75	23.16	9.84	48.37	26.93
12:00 PM	−145.09	9.73	24.53	16.79	50.95	27.14
1:00 PM	−146.06	9.37	23.92	8.82	50.12	26.65
2:00 PM	−145.24	10.17	24.06	8.16	49.66	26.00
3:00 PM	−145.66	11.02	24.46	8.20	50.33	24.77
4:00 PM	−147.04	8.69	24.44	7.47	49.39	26.74
5:00 PM	−146.66	9.25	26.01	8.09	51.39	25.92
6:00 PM	−145.16	9.31	23.97	7.79	50.01	25.07
7:00 PM	−142.80	11.15	24.07	7.19	49.48	25.45
8:00 PM	−140.38	12.95	25.47	7.60	53.10	25.39
9:00 PM	−146.04	9.38	25.81	7.26	51.46	26.45
10:00 PM	−198.55	13.71	9.06	10.53	51.15	28.17
11:00 PM	−195.28	13.58	8.77	10.25	50.19	27.59

This table reports the hourly average ExLM of order size 100K for the consolidated order book and five individual exchanges.