A First Peek at Trading Data from one of the World's First Blockchain Exchanges[*]

Katya Malinova, Andreas Park, and Jinhua Wang[†]

University of Toronto

This Version: January 9, 2017

Abstract

LykkeX is a FinTech company that describes itself as a "global marketplace on the blockchain." For time horizon of our analysis, LykkeX allows the trading of a small number of securities. The main feature of LykkeX is that all trades are settled on a public blockchain, making use of so-called colored coins or tokens. Trades of colored coins are conceptually similar to trades of ADRs, and thus in principle, LykkeX allows the trading of any kind of security. This note describes basic features of trading on LykkeX for the time period from August-November 2016.

[*]We thank LykkeX for making their trading data publicly available at this address `https://lykke.com/city/tradelog`

[†]`katya.malinova@utoronto.ca, andreas.park@rotman.utoronto.ca, and jinhua.wang@mail.utoronto.ca`

I. The Basic Premise of Lykke.

LykkeX describes itself as a marketplace that allows its market participants to trade essentially any security, using colored tokens/coins. Such a colored token/coin is akin to an American Depository Receipt (ADR). A common purpose of an ADR is to allow U.S. investors to invest in a foreign-country issued security in the U.S., where, loosely, the investor buys the newly created domestic security in lieu of the real security. An ADR and, likewise, a colored coin, is a promise that the token can be exchanged for the real security if need be.

At this point in time, LykkeX allows trading of a few currencies and Lykke's own shares (LKK). The idea is that individuals can interact directly on the exchange without using any financial institution.

This setup marks a significant departure from the current world of trading. Investors who want to trade a stock in a company that is publicly listed on a traditional exchanges (such as the NYSE or the LSE) need to use multiple intermediaries because they cannot access the exchange directly. Instead, are legally obliged ti use the services of a broker that is a member or registered participant of the exchange. There are, of course, numerous legacy reasons for the traditional arrangement, most notably that a stock trade involves the selling of a security which has to be delivered to the buyer, and the exchange of money, which has be transferred from the buyer to the seller. The back office arrangements for the settlement of these traditional transactions are rather complex and the arrangements for the settlement of transactions have not changed much for decades.

In contrast, the exchange of items that are registered on a blockchain is rather straightforward: ownership is transferred when the transaction has been recorded on the blockchain. Additionally, for a trade that requires the exchange of a security and of

a payment, the transaction has to be recorded "atomically" meaning that the transfer of money and the security are recorded in the same block or, using the colored token, in the same transaction. Such transactions do not require a financial institution other than the entity that arranges the atomic trade. For more details on the mechanics, we refer the reader to LykkeX's White Paper.[1] To be able trade on LykkeX, one needs a LykkeX wallet which, in essence, is the equivalent of an account.

To the best of our knowledge LykkeX is the first entity that allows security trading using a public blockchain, but since as entry in this market is not restricted, we expect other firms to offer similar services in the future; an example is the FinTech Godzillion.io, which operates a limit order market based on Ethereum's smart contracts.

II. Available Data

In late November 2016, LykkeX launched a competition to spark analysis of its trading data and it made all transactions available in a simple tabled file on its website. The currently available data spans August — November 2016; this note is based on this data. There are a several small issues with this data: time stamps for trades are at millisecond granularity for August to October and second granularity for November. We also believe that buys and sells for the US-dollar–Bitcoin pair are recorded in reverse for November 2016. Finally, settlement times for registration on the Blockchain are only available for a subset of transactions (see below).

At this point in time, LykkeX allows the trading of a select number of currencies only, namely USD, JPY, CHF, GBP, EUR, and BTC (Bitcoins). There are also three trades in an asset referred to as Germany30, which we presume to be a 30-year German government bond. Finally, Lykke has also issued shares of its company and registered

[1] `https://lykke.com/Whitepaper_LykkeExchange.pdf`

them on the Blockchain. Formally, Lykke issued coins, , denoted by LKK, where 100 LKK coins make up 1 share of Lykke. The coins are additinally divisible to six decimal places. High divisibility appears to be a standard feature of digital assets; Bitcoins are divisible to 8 decimal places (thus Lykke shares are similar) (the smallest Bitcoin unit is also referred to as a Satochi).

Table I summarizes the number of transactions for the above securities. In total there have been 3,457 transactions. Most of these, 75%, involve Bitcoins on one side of the trade, 50% involve US dollars, and 41% involve Lykke's own shares.

LykkeX describes itself as a currency exchange. LKKs, however, are formally equity shares. Likewise, it is debatable whether or not Bitcoin is a currency. Although Bitcoin is accepted as a method of payment by internet merchants, its formal structure and common usage by speculators makes it synonymous to a commodity. In line with this view, the U.S. Commodity Futures Trading Commission (CFTC) has ruled Bitcoins and other digital currencies to be commodities. Of the 3,457 transactions in the data, only 301 transactions are true "genuine" currency transactions in that they do not involve LKK or BTC.

As is well-known, the Bitcoin Blockchain affords a high degree of transparency of ownership and activities, and this transparency extends to LykkeX's data. Namely, each trade identifies the initiating trader by this trader's public ID that would be used for the settlement on the Bitcoin Blockchain; formally in the LykkeX data this ID is referred to as the "wallet ID."

III. Market Structure

At this point in time, LykkeX is set up as a specialist market, which means that all trades involve a market maker. Each trade involves two assets: the one that the trader

wants to buy and the one that the trader uses to pay for the purchase. The market maker then buys the asset that the trader uses for the purchase and it sells the asset that the trader wants to buy. For instance, suppose the trader wants to buy a share of LKK and pay with Swiss Francs. The market maker then sells LKK and buys CHF. Although LykkeX describes limit orders on its website, our understanding of the data is that all trades in the data involve the market maker, and all trades occur at the quotes that the market maker offers. It is our understanding that LykkeX charges no formal fees for the transaction; however, the market maker presumably sells at prices that are higher than those at which the market maker buys and thus there is the implicit cost of the bid-ask spread. As part of our analysis, we will try to assess this implicit cost.

IV. Settlement

After a transaction has been agreed upon (and has been recorded as a trade in the data), the exchange of securities is settled (i.e., recorded) on the Bitcoin Blockchain. Panel A: Figure 1 displays LykkeX's architecture; this figure is taken from their own white paper that describes the concept, Panel B highlights the Blockchain settlement.

Importantly, settlement on the Blockchain is not instantaneous: a transaction needs to be verified and then arranged in a block which then requires mining. On the Bitcoin blockchain, a new block is created every 10 minutes. For 1,995 of the 3,457 transactions, the data specifies the delay time between trade arrangement and blockchain settlement. This data is only provided as of October, and not all transactions after October have this information. According to the data, the average Blockchain settlement time is about 25 minutes.[2] This time declines over the sample horizon: in October it is 48 minutes,

[2]The data series for the times are not consistent: the settlement time in minutes should be the time in hours multiplied by 60, but it is the 60×24; we believe that the minute number is the correct

in November it is 9 minutes. We have not cross-checked with the Bitcoin/Coinprism token transaction data but it is possible that Lykke started offering higher incentives to miners to speed up settlement.

V. The Role of the Market Maker

In its most basic form, a market maker earns its income from the bid-ask spread. A market maker's ability to provide liquidity is limited by its capital commitment and as such a market market should not carry large inventories over longer stretches of time. In the case of LykkeX, the market maker would have to assume inventories at the beginning of the sample to "prime the pump." Over time, however, we would expect that the market maker's inventory shrink other its market-making activities would not be sustainable in the long run. We thus compute the market maker's inventory across time, where our measure of interest is the cumulative net inventory (volume bought minus volume sold) per unit traded. Figure 2 plots the time series of the market maker inventories for the three most frequently traded securities, LKK, USD, and BTC; the transactions involved cover 96% of all transactions. As can be seen and as one would expect, these inventories decline over time, indicating that the market maker is successful at reducing its risk exposure.

VI. Trading Costs

Assessing trading costs with the present data is difficult: the data provides only transaction information, there is no information on the quotes that were prevailing at the time of the transaction. It is not straightforward to compute the bid-ask spread

estimate, based on a few observations that provide the blockchain settlement time.

that the market maker offered. Although there are several trading costs measures in the market microstructure literature that require only knowledge of transactions, these measures assume that transactions are sufficiently frequent and that researchers have access to all transactions for a particular instrument. Here, transactions are infrequent, and, with the exception of trades for Lykke shares, the data does not cover all market interactions in an instrument or currency pair. For example, Bitcoins can be exchange for US-dollars on various venues, and not just on Lykke. Our analysis must thus be taken with a grain of salt.

We focus on two measures. First, we compute Roll's (1984) measure of transaction costs, which is based on the autocovariance of price changes; see Hasbrouck (2007) for a detailed description. This measure is based on the presumption that the arrival process of orders is not autocorrelated and that there is an inventory-managing market maker; together this would imply that price changes are negatively autocorrelated. We compute this measure for daily, weekly and monthly series. Second, we compute the difference of the daily average buying (offer) and selling (bid) prices. We scale these measures by the average daily/weekly/monthly prices. A confounding factor is the concept of time: for securities traded on a regulated exchange, there are regular trading hours, and there is a well-defined "local" market. For LykkeX, transactions can be arranged 24 hours a day, 7 days a week, and "local" is in principle not well-defined because LykkeX is a global marketplace. Overall, our trading costs measures are far from perfect, and provide only a loose indication of prevailing trading costs.

As Table I shows, for most pairs of securities there are only very few trades. With sparse trades, the above measures have limited value, and we will thus focus on those pairs that have the most trades: USD/BTC, USD/LKK, and BTC/LKK. An additional

advantage of this restrictions is that trades of USD against LKK and BTC can be thought of as standard trades of a speculative security; BTC against LKK are effectively trades of two speculative assets — arguably a novelty in terms of microstructure research.

In our analysis we combine trades by pairs of securities. In the data, when security x is *bought* in exchange for security y at an exchange price p, the comparable price for *selling* security x in exchange for security y would be (close to) $1/p$, and we thus need to convert the prices for pairs to be in a common direction. Tables II provide Roll's measure on a daily, weekly and monthly frequency, respectively, and the spread estimates. We provide the measures both as a raw estimate in the respective currency (USD and BTC) and in basis points of the average price (daily, monthly, or weekly).

The estimates of the different measures are fairly consistent in magnitude for each of the three securities (considering the noisy nature of the data). LKK trades have a transaction cost estimate (Roll measure or spread) of around 150-200 bps. To put this number into perspective: At its initial offering, 1 LKK was worth 0.05CHF $\approx$ 5 US pennies. On regular markets, penny stocks (i.e., stocks with prices below one USD), commonly trade at half-penny minimum tick sizes. Thus 1 LKK coin that would trade at the minimum U.S. market tick size would have a minimum bid-ask spread of 1,000bps.

Our estimates for the cost of trading BTC differ by method; for Roll's measure, we estimate a cost of 300bps, for spreads, we estimate around 80bps. Again, these measures are noisy and to put these estimates into perspective: for private currency transactions, individuals pay a "cash" premium in North America (even for inter-bank transfers) for up to 4% or 400bps. Oanda, a provider of retail FX trading services, however, also claims to charge only a few basis points as spreads. We add two considerations: first, our estimates are not based on quotes, because we do not have such data. Since the

price of BTC his highly volatile, intraday fluctuations can make the difference of average bid and ask prices too large or too small, making our estimates very noisy. Second, for the month on November, when trading was most active, we estimate a much smaller spread of only 3.9 bps.

VII. Market Making and Trader Interaction

LykkeX is currently set up as a specialist market as all trades go through a market maker. Such a setting is useful for the early stages of a market to ensure that market participants can find liquidity. For more established markets with frequent trading, a specialist setup is unusual. First, the market maker may have to commit too much capital to satisfy the intra-day trading needs of all customers, in particular when settlement is immediate. Second, the market maker acts is a monopolist, and historically most established markets, including the "classic" specialist market NYSE, eventually abandoned the specialist setup in favour of an open limit order book.

So what would happen if instead there was no market maker and traders submitted limit orders? To answer this question, we combined/matched consecutive and off-setting buy and sell orders by the traders, where we implicitly assume that a trader would keep his/her original order in the book until an offsetting order arrives.[3] We are then interested in two issues.

First, we compute the average time that a trader would need to wait for off-setting orders. Table III provides these estimates by security and month, where one needs to keep in mind that LykkeX is open 24 hours, 7 days a week, and that a large order may require multiple off-setting orders (thus the number of trades is not simply the total

[3]The source code for the hypothetical trader interaction can be found at https://github.com/ginward/LykkeBlockchain

number divided by factor 2). Generally, median hypothetical wait times decline notably as more traders use the market. For instance, for USD/BTC trades, the wait time from September and October to November drop from around 5 hours to around 15 minutes.

Second, one novel feature of trading with a public blockchain is that trader activities are visible. Thus one can imagine in principle a setup where traders contact one another directly using the visible wallet IDs, and very active traders may then become endogenous (and possibly competitive) market makers.[4] We thus constructed the hypothetical interaction structure of traders assuming the same frequency of their trades. Figure 3 displays these hypothetical interactions, where the figure only shows traders that trade at least 5 times. As can be seen, there are several highly active IDs that have the capacity to become endogenous market makers if LykkeX were to move away from its current Specialist structure.

VIII. Conclusion

LykkeX is a new trading venue that allows investors to interact directly with one another and that settles trades on the Bitcoin blockchain. With this setup, many of the entities that are currently necessary for a securities transaction, such as as brokers, clearing houses, custodian banks, the central bank, depository houses, a record-keepers of beneficiary ownership, become redundant, and settlement of transactions occurs within minutes, not days. The marketplace is, however, at a very early stage and thus transactions are infrequent. This note provides a first look at the existing transaction data.

An interesting feature of LykkeX is that it uses colored coins, and thus, at least in principle, market participants can trade any of the world's securities, provided that

[4]See Malinova and Park (2016) for a formal theoretical model.

someone is willing and able to credibly create the token. Thus it imaginable that in the future, individuals can trade and quickly settle any financial security that already exists while circumventing large parts of the current financial system's backoffice structure.

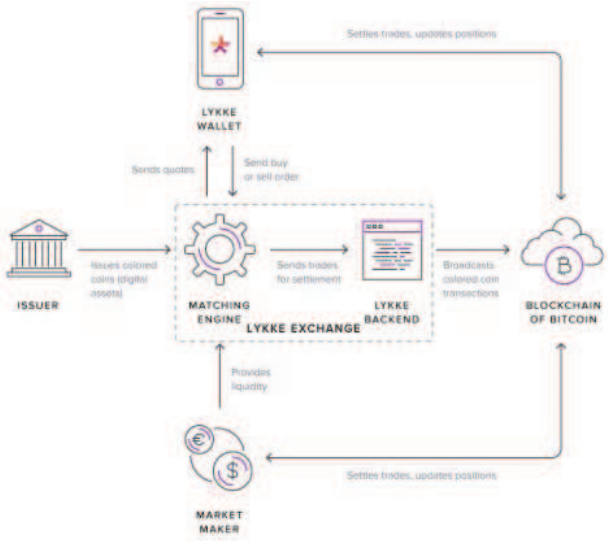
LykkeX is the first trading venue that settles trades on a public blockchain. In contrast to current trading arrangements, a public blockchain is only pseudo-anonymous, and market participants enjoy a very high level of transparency of their peers' activities. The venue is still at a very early stage, and without more detailed data it is impossible to assess whether, for instance, trading on LykkeX is cheaper or faster than elsewhere. Overall, however, trading costs seem in line with costs elsewhere in the market, and compared to traditional markets, settlement of trades occurs much faster: around $t +$ 10 minutes in November 2016 — as opposed to $t + 3$ days as is common in modern markets. Over time, we expect that LykkeX will reduce the role of its market maker and instead allow peer-to-peer as opposed to peer-to-market maker interactions. Our analysis indicates that there are already some traders that may emerge as endogenous liquidity providers.

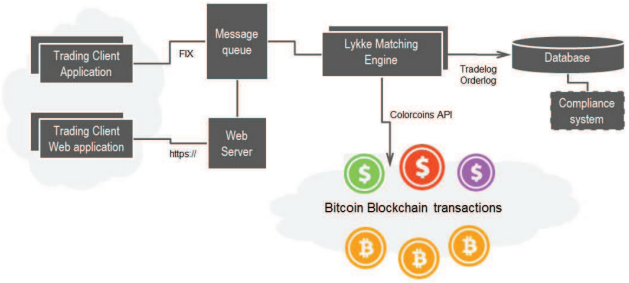
We look forward to seeing the future evolution of this initiative, and we hope that LykkeX continues to provide its trading data to the public.

REFERENCES

Hasbrouck, Joel, 2007, *Empirical Market Microstructure* (Oxford University Press).

Malinova, Katya, and Andreas Park, 2016, Market design with blockchain technology, Working paper University of Toronto http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2785626.





Panel A *Panel B*

Figure 1
LykkeX's Architecture

The panels plot the flow of interactions on LykkeX; the Figures are taken from LykkeX's White Paper and their website respectively.

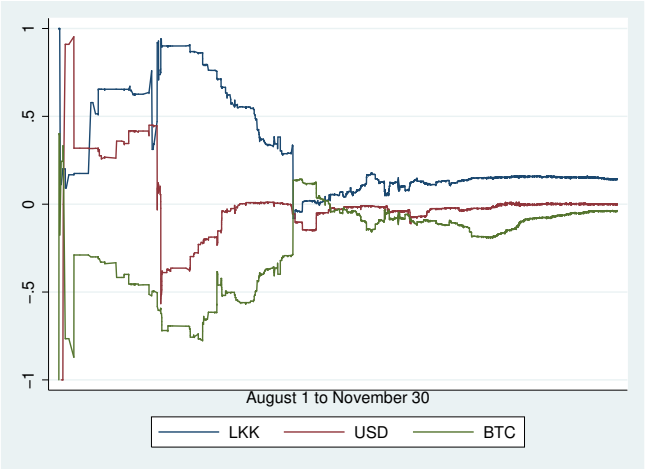


Figure 2
Market Maker Inventories

The figure plots the time series of LykkeX's market maker's inventory across the sample horizon from August 1, 2016 to November 30 for the three most commonly traded securities: Bitcoins (BTC), US-dollars (USD), and LykkeX's shares (LKK). Inventory is computed as the difference of market maker buying and selling volume, scaled by total volume.

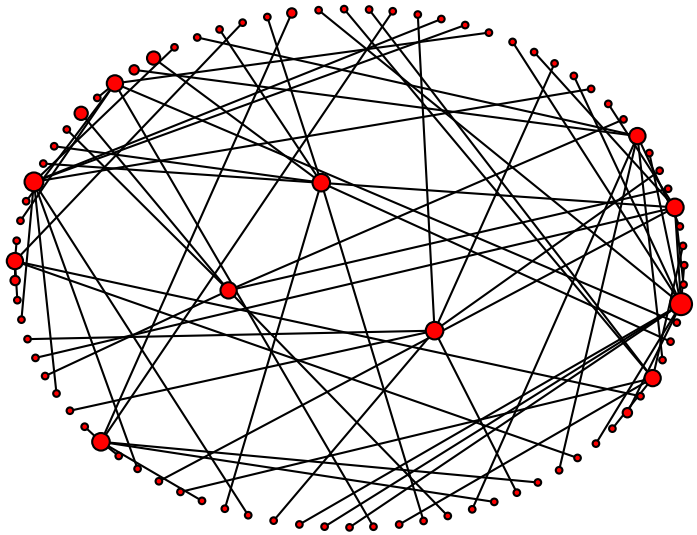


Figure 3
Hypothetical Trader Network

Each dot represents a unique trader. The more frequent a trader trades in the hypothetical setting without a market maker, the bigger is size of the dot; the plot included only traders that trade at least 5 times, and only trades for USD/LKK, USD/BTC, and LKK/BTC are included. The lines that connect the dots represent the hypothetical trades.

Table I
Distribution of Transactions

The table lists the number of transactions of asset-pairs for the sample horizon from August 1, 2016 to November 30, 2016. The last column captures the fraction of transactions that involve the first-column asset on either side (the shares thus add to 200% because volume is implicitly double-counted).

	BTC	CHF	EUR	GBP	Ger30	JPY	LKK	USD	Sum	Total involving
BTC	0	92	56	12	0	5	418	734	1317	75%
CHF	118	0	24	7	0	8	89	26	272	16%
EUR	82	31	0	12	1	3	30	33	192	11%
GBP	13	14	19	0	0	6	26	10	88	4%
Ger30	0	0	2	0	0	0	0	0	2	0%
JPY	8	9	4	3	0	0	18	5	47	2%
LKK	448	91	48	19	0	6	0	85	697	41%
USD	624	33	37	9	0	5	134	0	842	50%
Sum	1293	270	190	62	1	33	715	893	3457	200%

Table II
Roll's Measure of Transaction Prices

The table lists the estimations for Roll's measure of transaction prices for the three most frequently traded security pairs: USD/LKK, USD/BTC, and LKK/BTC. We compute the measures at the daily and monthly frequency as well as for the whole sample. The presented numbers are simple averages of the daily and monthly estimates respectively.

		Roll daily	Roll weekly	Roll Monthly	Spread
Panel A: in units of currency					
USD/LKK	Avg	0.62	0.38	0.40	0.27
	Stdev	0.76	0.37	0.40	0.56
	Obs	11	12	4	83
USD/BTC		9.54	20.65	27.41	4.62
		29.63	30.01	25.85	16.31
		40	14	4	85
LKK/BTC		0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00
		62	12	3	99
Panel B: In bps of average price					
USD/LKK		320.3	191.0	202.1	137.4
		393.1	189.2	203.2	291.3
		11	12	4	83
USD/BTC		300.9	671.2	888.0	77.8
		968.4	987.8	829.1	282.3
		40	14	4	85
LKK/BTC		288.7	419.1	517.0	208.6
		807.0	464.0	288.8	676.6
		62	12	3	99

Table III
Hypothetical Trades in absence of the Market Maker.

The table provides information on the wait times in hours and the possible interactions that would arise if LykkeX would operate without a market maker, assuming that traders are willing post limit orders, accept existing limit order prices, and wait until they receive a complete fill.

Pair	Month	Median	Average	StDev	Possible trades
USD/LKK	Nov	3.36	4.77	4.14	9
	Oct	6.98	8.42	6.23	28
	Sep	4.76	5.66	4.63	25
	Aug	10.67	10.67	3.65	2
USD/BTC	Nov	0.24	0.88	1.75	977
	Oct	5.06	6.59	4.74	28
	Sep	4.53	5.47	4.12	13
	Aug	1.46	2.42	2.62	6
LKK/BTC	Nov	5.04	6.37	5	140
	Oct	4.52	6.07	5.35	222
	Sep	3.07	4.65	5.17	91
	Aug	2.57	3.38	3.07	3
All others	full sample				290