Price Manipulation in the Cryptocurrency Ecosystem

JT Hamrick
Dissertation Proposal Defense
25 March 2020

Thesis Statement

This thesis **documents the prevalence and impact of certain illicit financial schemes** within the cryptocurrency ecosystem. It describes a wide range of unmistakably criminal techniques, **including DDoS attacks, insider trading, and pump and dump schemes**. Additionally, because not all manipulations can be identified and not all fluctuations are intentional, it **develops a general-purpose method for identifying when a cryptocurrency is likely to be abandoned and resurrected**, which could be indicators of manipulation. The **primary impact observed has been fluctuations in pricing**, though volume is also considered. Again, in some cases these fluctuations are the result of clear manipulation, while in others the cause cannot be established.

Thesis Contributions and Talk Outline

- Ch. 2 – Cryptocurrency Primer (proposal)
- Ch. 3 – Gathering Datasets to Find Exchange Shocks (proposal)
- Ch. 4 – Identifying Suspicious Trades (proposal)
- Ch. 5 – Analyzing Shocks on the Mt. Gox Cryptocurrency Exchange (proposal)
- Ch. 6 – Measuring the Lifespan of a Cryptocurrency (proposal)
- Ch. 7 – The Rise and Fall of Tokens (new)
- Ch. 8 – Measuring the Impact of Cryptocurrency “Pump-and-Dump” Schemes (proposal)
- Ch. 9 – Market Manipulation Through Organized, Target-Based Trading (new)

Publications

1. **JT Hamrick**, Farhang Rouhi, Arghya Mukherjee, Amir Feder, Neil Gandal, Tyler Moore, Marie Vasek, Neil Gandal, and Marie Vasek. The economics of cryptocurrency pump and dump schemes. In 18th Workshop on the Economics of Information Security (WEIS), 2019.

2. Neil Gandal, **JT Hamrick**, Tyler Moore, and Tali Obermann. Price manipulation in the Bitcoin ecosystem. Journal of Monetary Economics, 95:86--96, May 2018.

3. Amir Feder, Neil Gandal, **JT Hamrick**, Tyler Moore, and Marie Vasek. The rise and fall of cryptocurrencies. In 17th Workshop on the Economics of Information Security (WEIS), 2018.

4. Amir Feder, Neil Gandal, **JT Hamrick**, and Tyler Moore. The impact of DDoS and other security shocks on Bitcoin currency exchanges: Evidence from Mt. Gox. In 15th Workshop on the Economics of Information Security (WEIS), 2016.

* Authors listed in alphabetical order for papers 2-4

Acknowledgements







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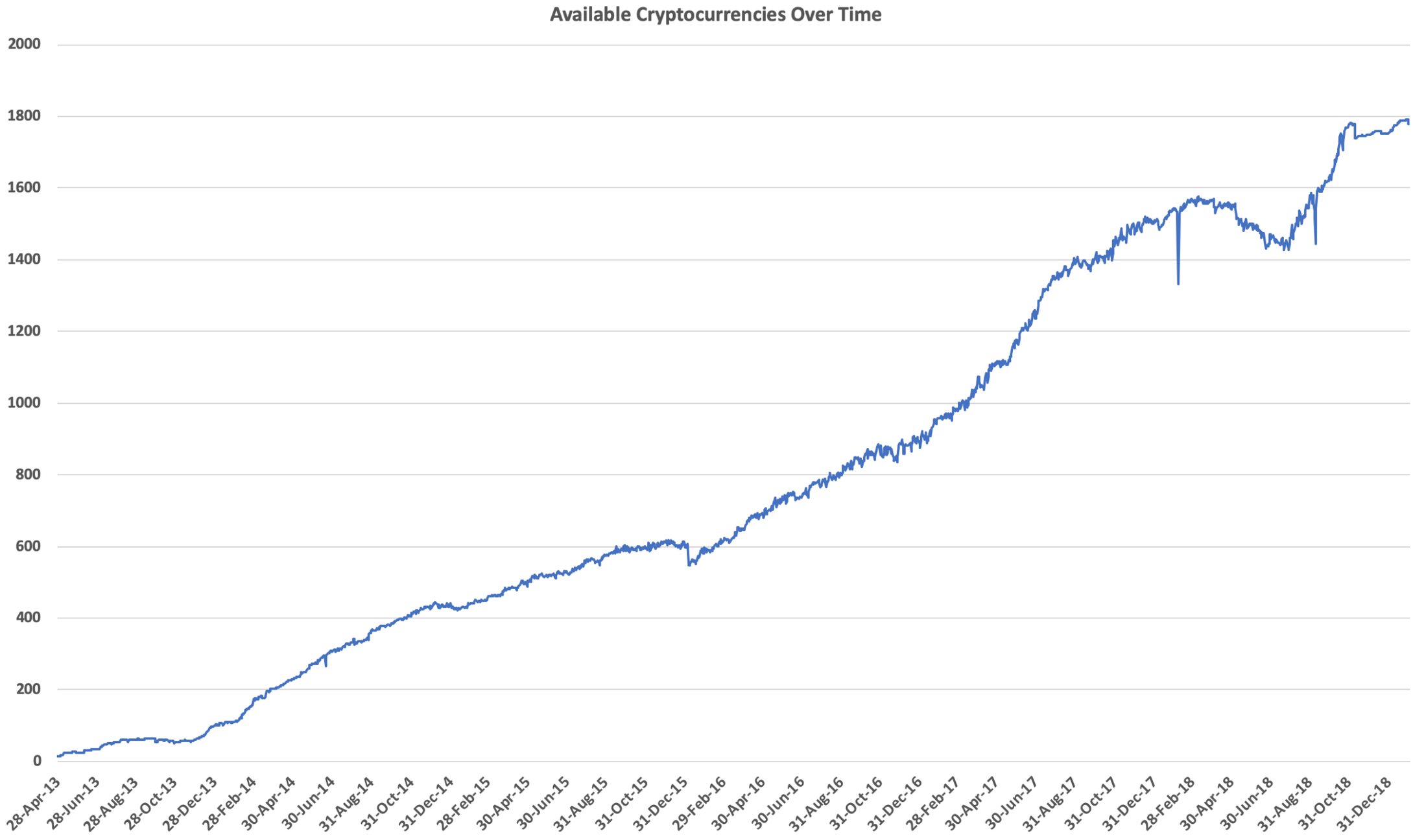
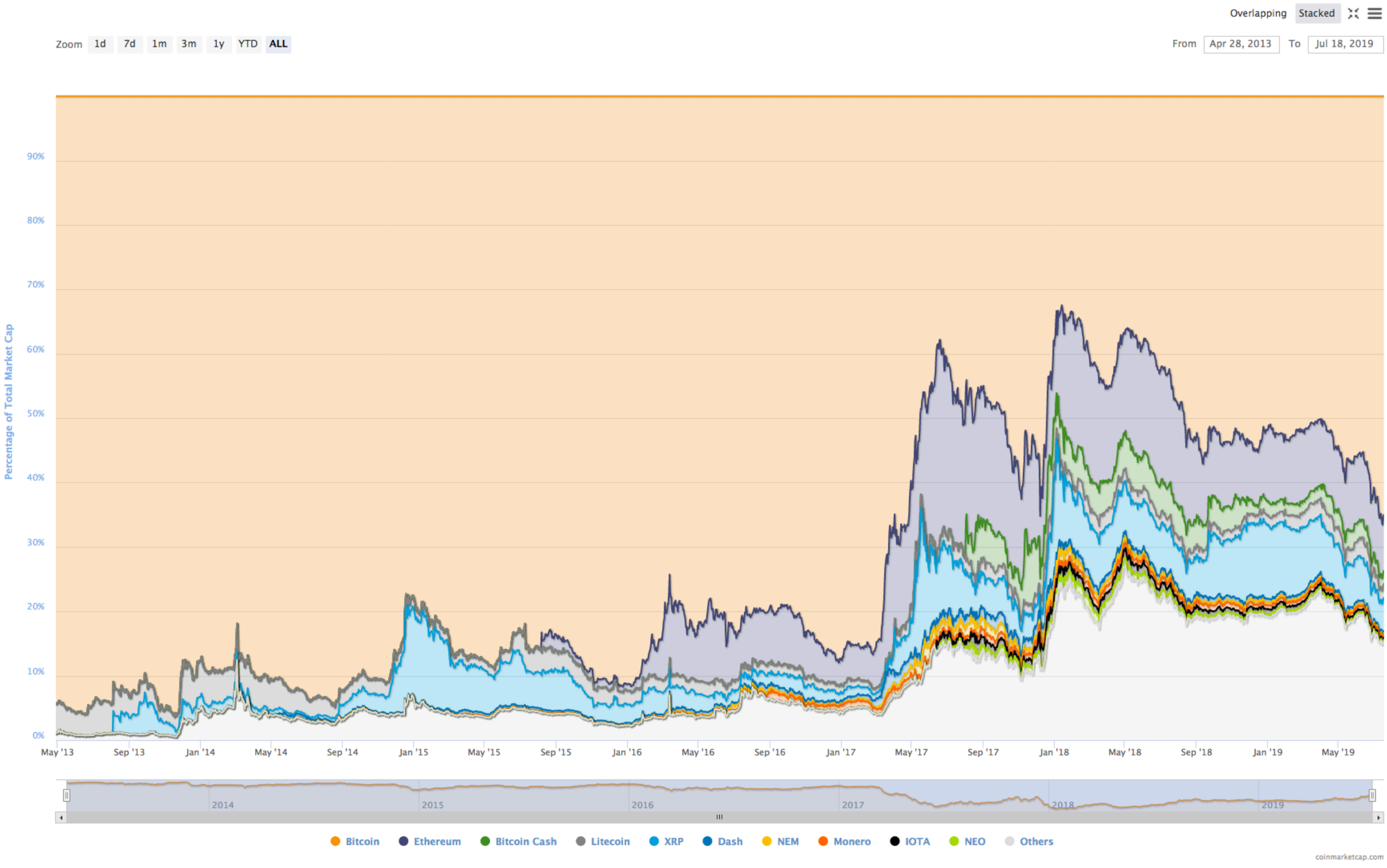
Steady Growth in New Cryptocurrencies



Relative Coin Market Share

Percentage of Total Market Capitalization (Dominance)



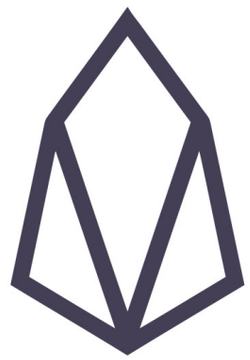
Coins vs. Tokens

Coins

Bitcoin

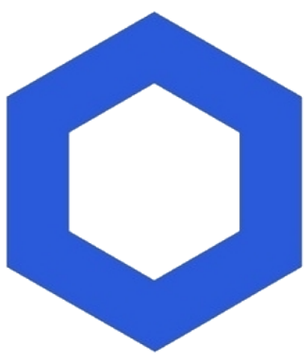
Ethereum

Monero



EOS

Tokens



Chainlink

Tether

Maker

BitTorrent

Mt. Gox Cryptocurrency Exchange

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Research Contributions

- Method for normalizing exchange data (Mt. Gox):
  - Developed exchange data deduplication strategies
  - Compared resulting dataset to publicly available trade data to ensure data remained consistent
- Method for collecting shocks data:
  - Locate candidate shocks on internet forums, social media sites, and news sites
  - Confirm shocks through manual inspection
  - Developed taxonomy for categorizing user outage reports

Why don’t we use blockchain data?

- Blockchains typically only contain on-chain transactions
- Many of the exchanges in operation store trade data in their own database for faster trading
    - Trades are stored to the blockchain when transferring cryptocurrencies to and/or from an exchange
- Many exchanges offer APIs through which off-chain trade data can be extracted (no user ID)
- Some web services aggregate data from many exchanges making collection easier (coinmarketcap.com)

How we got exchange data

Home

« Xilinx Virtex 7 (VC707 board) first steps

MTGOX 2014 HACK, DATABASE REVEALED, LIVE FROM MARK KARPELES'S REDDIT ACCOUNT!!

*** SAVE THIS POST, MIRROR THE FILES, REPOST, SHARE AND KEEP THIS DATA AVAILABLE ***

http://blog.magicaltux.net/wp-content/uploads/2014/03/MtGox2014Leak.zip

http://89.248.171.30/MtGox2014Leak.zip

First and foremost, this is not Mark Karpeles. Fuck that bitch-titted motherfucker.

It's time that MTGOX got the bitcoin communities wrath instead of Bitcoin Community getting Goxed. This release would have been sooner, but in spirit of responsible disclosure and making sure all of ducks were in a row, it took a few days longer than would have liked to verify the data.

Above you will finding download link and a mirror used without asking from Mark Karpeles very own blog.magicaltux.net.

Included in this download you will find relevant database dumps, csv exports, specialized tools, and some highlighted summaries compiled from data. Keeping in line with fucking Gox alone, no user database dumps have been included.

Repost and share this info before it's gone. Lots of people, including us, lost money and coins. Upvote this post.

We stole no bitcoins. There were none to steal. If you want to donate, you can keep us full of pizzas and beers by sending coins here, 1859rayqN1X7DYjD1BrAHm4vaQxoUhhzsN .

Balance SUM for ALL USERS by currency.
□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
Currency: AUD Balance: 924,124.65121
Currency: BTC Balance: 951,116.21905382 <– That fat fuck has been lying!!
Currency: CAD Balance: 320,184.36558
Currency: CHF Balance: 99,487.07308
Currency: CNY Balance: 297,775.78994
Currency: DKK Balance: 112,264.56207
Currency: EUR Balance: 5,634,625.59531
Currency: GBP Balance: 921,892.96793
Currency: HKD Balance: 740,519.14894
Currency: JPY Balance: 384,885,150.13700
Currency: NOK Balance: 91,346.00305
Currency: NZD Balance: 58,224.95320
Currency: PLN Balance: 1,645,194.67364
Currency: RUB Balance: 551,162.54477
Currency: SEK Balance: 15,335.84383
Currency: SGD Balance: 43,193.59706
Currency: THB Balance: 666,464.33497
Currency: USD Balance: 30,611,805.67481
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Total BTC Deposits: 19,065,241.307202
Total BTC Withdrawl: 18,563,466.149383

BTC Difference: 501,775.157819

□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

GEEK ATTITUDE

- *Hacking*
- *ooKoo*
- *PHP*

GENERAL

- *IRL*
  - *Japan*
  - *Tibanne*
    - *MTGox*
- *News*

UNCATEGORIZED

March 2014

M	T	W	T	F	S	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

« May

TAGS

BBC Birthday blog Bruteforce DNSd Domain domains FaceBook Flaming French Games GG.ST hack Hacker Cup Hacker Cup 2011 Internet IPv6 IRC Japan KalyHost Lessons Linux MagicalTux Microsoft Moving worldwide News Open Source OVH Paris PHP Plnetd pinetd2 Project Real life Registrar Router security Service software Spam Tibanne TuxTelecom whois XBox 360 五 OS

BLOGROLL

- Fy's blog
- Katan's blog
- Kiddo

Security shocks on Mt. Gox

- D1: Reported DDoS attacks
    - bitcointalk.org - 34 reports between February 2011 and October 2013
    - reddit.com/r/bitcoin - 8 reports between April 2013 and November 2013
    - google+/archive - 9 direct acknowledgements
- D2: Additional security shocks
    - 10 reports of non-DDoS shocks
- D3: Confirmed DDoS attacks
    - google+/archive - 9 direct acknowledgements

DDoS attacks reported on 37 days across all sources

Chapter 3 Conclusion

- Developed methodology for collecting DDoS data

- Developed methodology for sanitizing exchange data leak (Mt. Gox)

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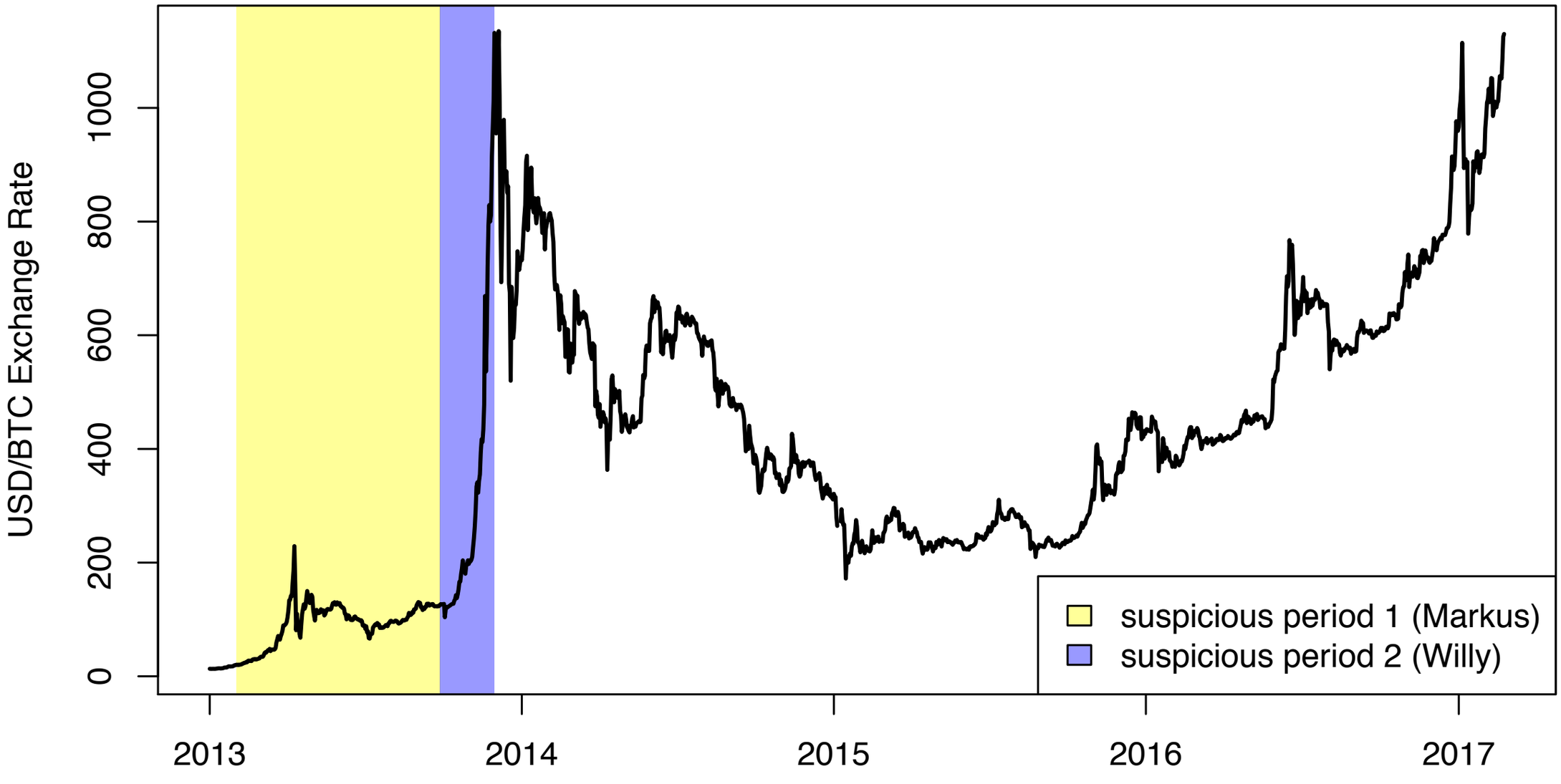
Research Contributions

- Method to identify suspicious trading activity:
  - Inferred bot accounts from user reports
  - Confirmed account existence through manual verification
- Analysis of gathered data:
  - Summary statistics of bot activity over time
  - Measured money moving in/out of accounts using leaked dataset

Price Manipulation



Suspicious Trader Summary

Markus

- Traded on 33 days
    - “Bought” 335,898 bitcoin
    - “Sold” 35,867.18 bitcoin (~4,018,681.65 USD)

Willy

- Traded on 50 days
    - “Bought” 268,132 bitcoin

Chapter 4 Conclusion

- Established scope of suspicious trading activity on the Mt. Gox bitcoin exchange

- Identified two actors that “purchased” approximately 600,000 BTC

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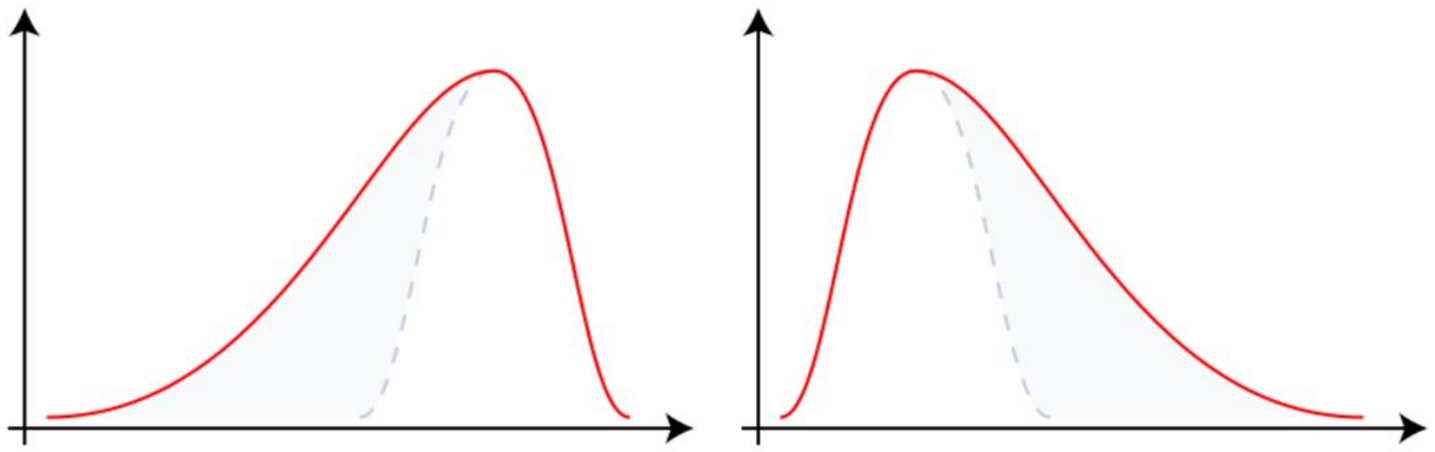
Research Contributions

Analysis of data from Chapters 3 and 4:

- Developed robust regressions to explain how shocks affect trades on the Mt. Gox cryptocurrency exchange

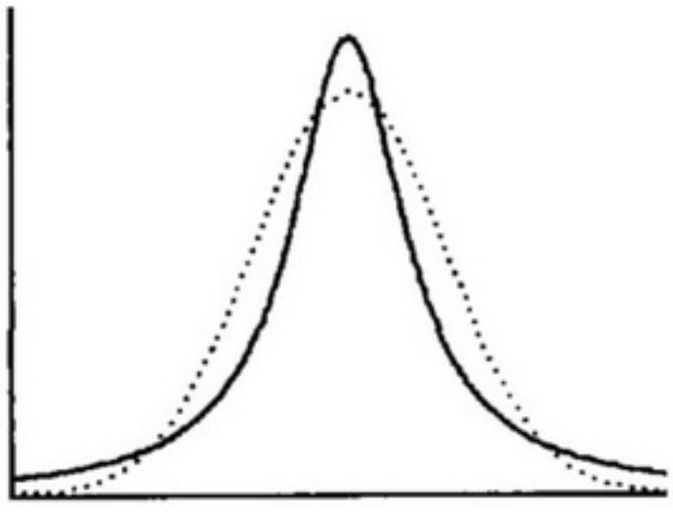
- Constructed regressions to explain how bots influenced the price of bitcoin

Skewness and Kurtosis

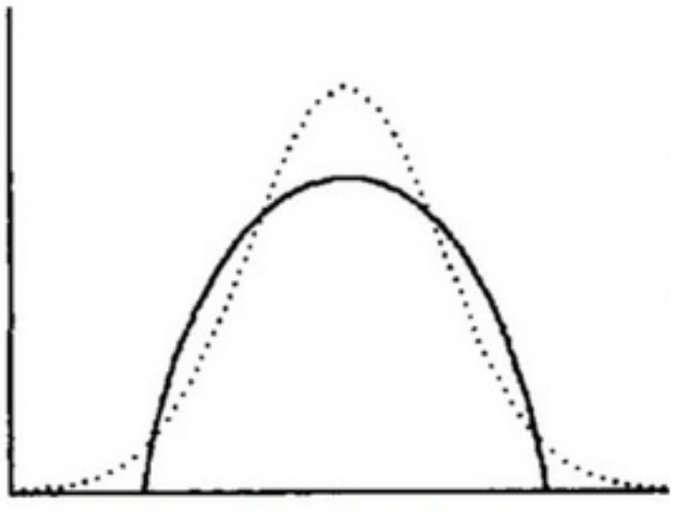


Negative Skew

Positive Skew



Positive kurtosis (leptokurtic)



Negative kurtosis (platykurtic)

Skewness and Kurtosis

DDoS attacks result in lower skewness and kurtosis

DDoS attacks result in lower skewness and kurtosis

Table 5.2: Skewness and Kurtosis

VARIABLES	(1) ln(Skewness)	(2) ln(Kurtosis)	(1.1) ln(Skewness)	(2.1) ln(Kurtosis)
D1	-0.276**	-0.560***		
	(0.094)	(0.184)		
D2	-0.0766	-0.160		
	(0.146)	(0.289)		
Users	-0.000144***	-0.000247***	-0.000129***	-0.000218***
	(1.97e-05)	(3.84e-05)	(2.41e-05)	(4.62e-05)
ln(Transaction Volume)	0.327***	0.640***	0.329***	0.643***
	(0.0280)	(0.0538)	(0.0276)	(0.0529)
Time	-0.000889***	-0.00167***	-0.00089***	-0.00167***
	(0.000113)	(0.000214)	(1.07e-04)	(2.05e-04)
Constant	-2.358***	-4.192***	-2.414***	-4.280***
	(0.435)	(0.834)	(0.428)	(0.820)
DDoS			-0.2298**	-0.4390**
			(0.112)	(0.214)
Lagged DDoS			-0.1155	-0.2406
			(0.111)	(0.212)
Other			-0.3806*	-0.7337*
			(0.218)	(0.417)
Observations	924	924	925	925
Adjusted R-squared	0.17	0.20	0.18	0.20

Standard errors in parentheses
Robust Standard errors are employed
*** p<0.01, ** p<0.05, * p<0.1

Internal Manipulation Regression Analysis

When Markus bought, price went up

When Willy bought, price went up

Table 5.10: Examining Percent Price Changes Within Mt. Gox and the other platforms

Dependent Variable / Independent Variables	Mt.Gox % Rate Change	Bitstamp % Rate Change	Bitfinex % Rate Change	BTC-e % Rate Change
"Markus"	0.0371**	0.0434***	0.0272*	0.0348**
	(3.18)	(3.55)	(1.66)	(2.90)
"Willy"	0.0433***	0.0423***	0.0469***	0.0413***
	(4.45)	(4.14)	(3.54)	(4.12)
DDoS	-0.0182	-0.00758	-0.00391	-0.00903
	(-1.40)	(-0.55)	(-0.22)	(-0.67)
Day After DDoS	-0.0144	-0.0128	-0.0167	-0.0111
	(-1.10)	(-0.94)	(-0.94)	(-0.83)
Other Attacks	0.0374	0.0234	0.0239	0.0235
	(1.43)	(0.85)	(0.57)	(0.87)
Constant	0.0071	0.0065	0.0032	0.0069
	(1.77)	(1.57)	(0.46)	(1.68)
N	365	365	244	365
adj. R^2	0.075	0.064	0.044	0.054

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Chapter 5 Conclusion

- Developed methodology for measuring impact of shocks on cryptocurrency exchanges
- Manipulations can have important, real effects
    - Insider trading likely caused price increase from $150-$1000 in two months
    - DDoS events associated with fewer big trades by users

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Research Contributions

- Analysis:
  - Developed algorithms for identifying peaks, periods of abandonment, and resurrection
  - Constructed summary statistics for cryptocurrency price movement around 2017 bitcoin bubble

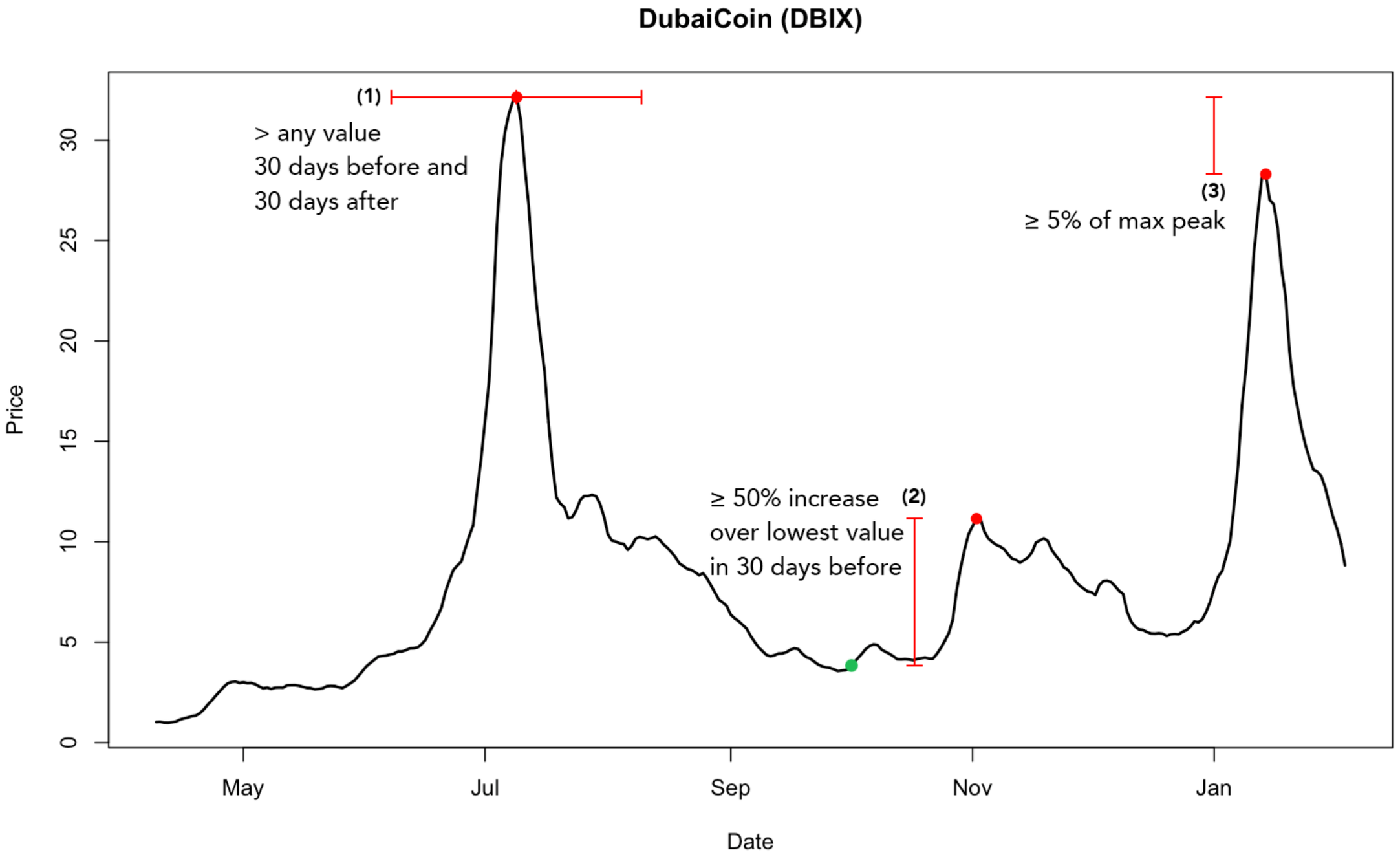
Beware the Middleman: Empirical Analysis of Bitcoin-Exchange Risk

Tyler Moore[1] and Nicolas Christin[2]

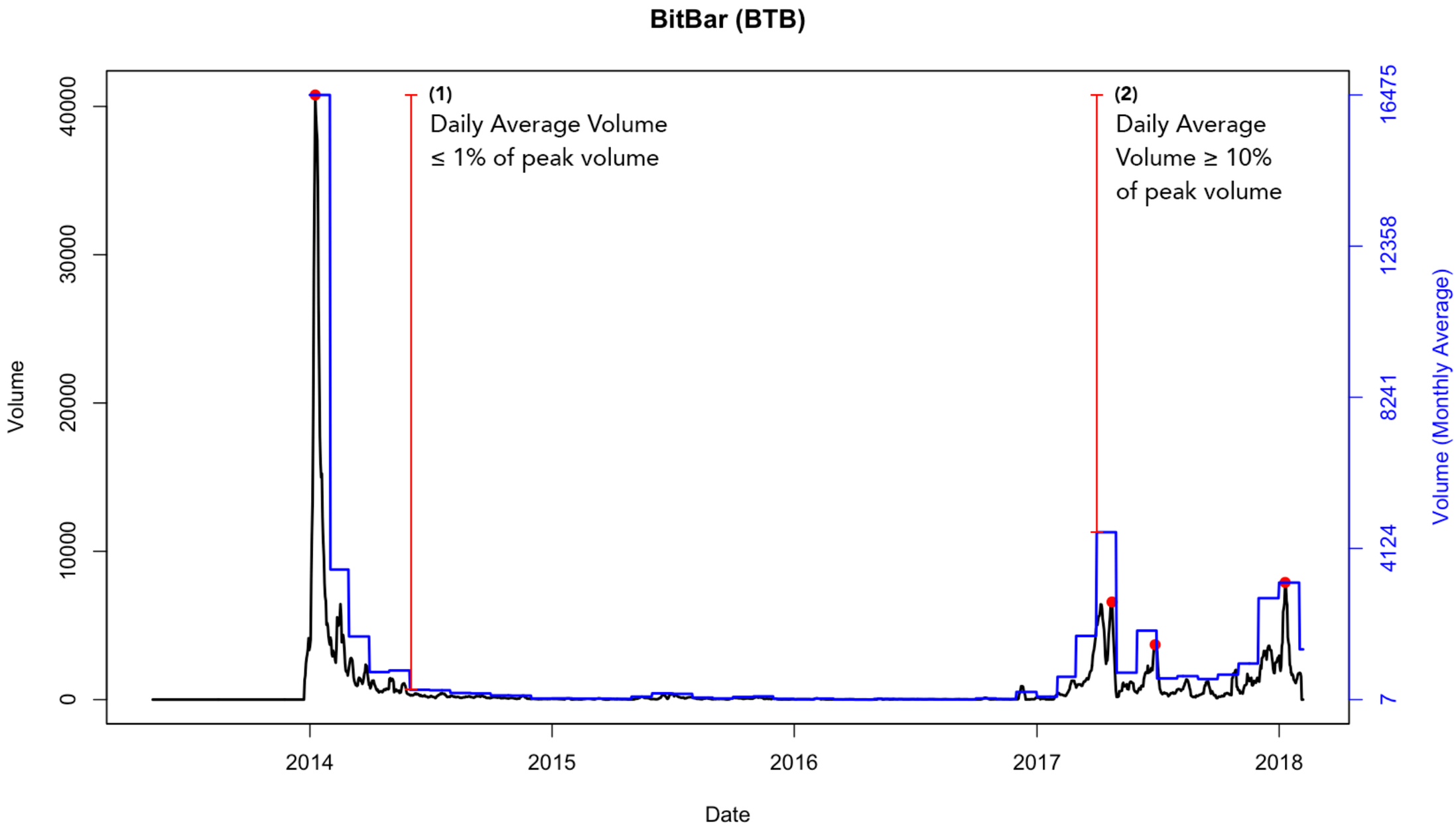
[1] Computer Science & Engineering, Southern Methodist University, USA, tylerm@smu.edu
[2] INI & CyLab, Carnegie Mellon University, USA, nicolasc@cmu.edu

Abstract. Bitcoin has enjoyed wider adoption than any previous crypto-currency; yet its success has also attracted the attention of fraudsters who have taken advantage of operational insecurity and transaction irreversibility. We study the risk investors face from Bitcoin exchanges, which convert between Bitcoins and hard currency. We examine the track record of 40 Bitcoin exchanges established over the past three years, and find that 18 have since closed, with customer account balances often wiped out. Fraudsters are sometimes to blame, but not always. Using a proportional hazards model, we find that an exchange's transaction volume indicates whether or not it is likely to close. Less popular exchanges are more likely to be shut than popular ones. We also present a logistic regression showing that popular exchanges are more likely to suffer a security breach.

Algorithm (peak)



Algorithm (resurrection)



Results

	overall	<$1M	$1–10M	$10–100M	$100M-1B	>$1B
# coins	1 082	374	344	183	124	57
# price peaks (total)	3 508	1 426	1 022	531	376	153
# price peaks (median)	3	4	3	2	3	3
% price increase 1st peak (median)	749	418	583	999	1 936	3 441
# volume peaks (total)	3 828	1 734	1 064	468	406	156
# volume peaks (median)	3	4	2	2	3	3
% volume increase 1st peak (median)	3 714	917	1 561	6 915	24 992	90 530
# coins abandoned	475	239	154	50	32	0
% coins abandoned	44	64	45	27	26	0
# abandonments	642	347	192	62	41	0
days abandoned (median)	182	153	184	242	426	—
# coins resurrected	336	183	103	25	25	—
% coins resurrected	71	38	27	13	19	—
# resurrections	452	261	135	30	26	—
months to resurrection (median)	6	5	6	10	19	—
# coins permanently abandoned	190	86	57	32	15	0
% coins permanently abandoned	18	23	17	17	12	0

Table 6.1: Summary statistics on coin peaks, abandonment and resurrection, broken down by total trading volume per coin.

Chapter 6 Conclusion

- Developed methodology for identifying peaks, abandonment, and resurrection
- Analysis:
  - Lower volume coins are at elevated risk of abandonment
  - Many coins “ride the wave” created by increasing prices elsewhere

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Research Contributions

- Developed methods for combining multiple data sources into single set

- Established metrics for token ICO success and returns over time

- Generated summary statistics for token price movement around 2017 bitcoin bubble

Data Sources

- coinmarketcap.com
  - 1,894 tokens between March 2014 and October 2019
  - ~ 737,000 daily records
- ICO Data
  - Foundico - 3,027
  - ICORating - 4,551
  - ICObench - 5,672
  - TokenData - 2,240

ICO Data Combination

	Complete Agreement			Majority Agreement			No Agreement		
Data Source	#	%	Sig.	#	%	Sig.	#	%	Sig.
Foundico	0			0			0		
ICObench	718	49.52		67	47.18		1,205	45.10	
ICORating	715	49.31		69	48.59		1,201	44.95	
TokenData	17	**0.01**	(-)	6	4.23		266	**9.96**	(+)

Table 7.2: ICO Price representation by source. Statistically significant under and over-representations are indicated in bold with a (+/-).

	Complete Agreement			Majority Agreement			No Agreement		
Data Source	#	%	Sig.	#	%	Sig.	#	%	Sig.
Foundico	408	37.67		235	39.17		440	27.08	
ICObench	321	29.64		191	31.83		429	26.40	
ICORating	150	13.85		63	10.50		480	29.54	
TokenData	204	**18.84**	(-)	111	**18.50**	(-)	276	**16.98**	(+)

Table 7.3: Amount raised representation by source. Statistically significant under and over-representations are indicated in bold with a (+/-).

ICO Data Combination

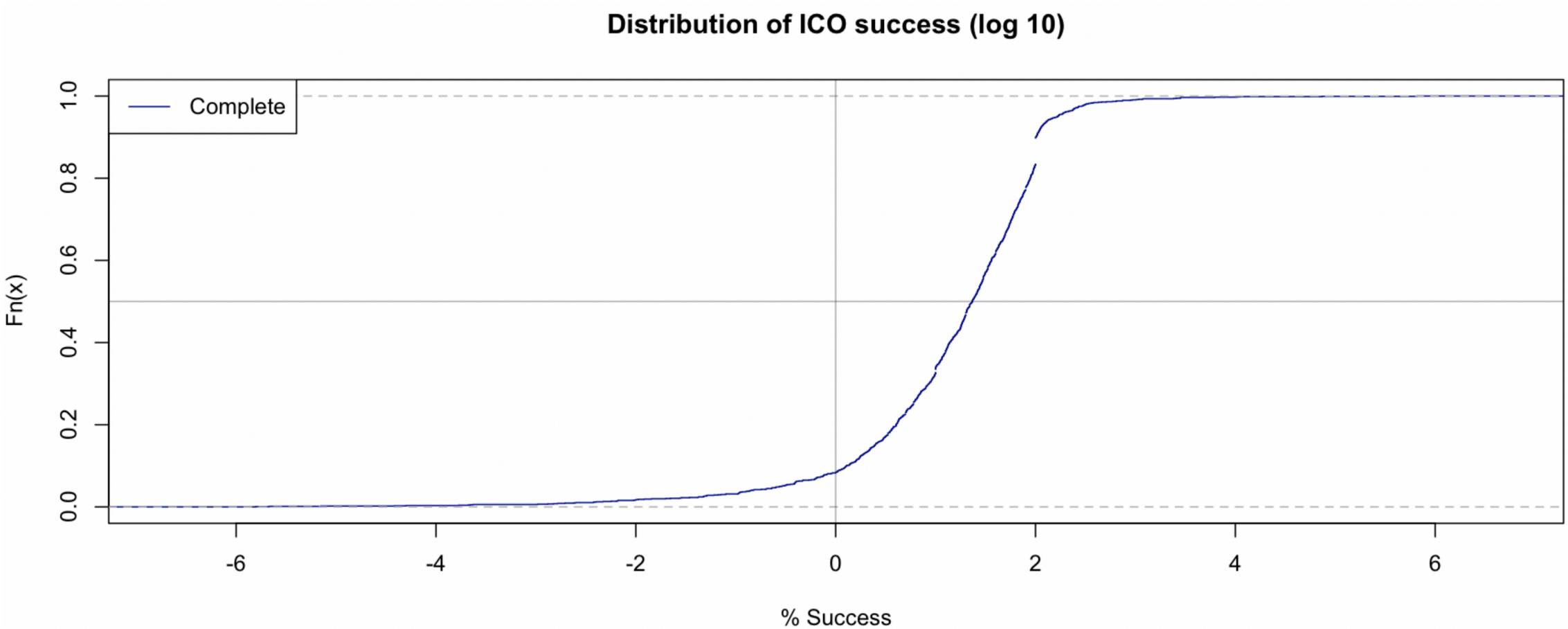
A. If only one value is reported between all sources take that value.

B. If all sources report the same value take that value.

C. If a majority of the sources report the same value (2/3, 3/4, or in some cases 2/4) take the majority value.

A. d) If no majority or complete agreement exist take the median of all values reported.

ICO Success - Hardcap



Hardcap Success and Returns

	Unsuccessful ICO			Successful ICO			All ICO		
	Mean	Median	Max	Mean	Median	Max	Mean	Median	Max
First Day CMC	14.116	-56.639	2,111.51	68.17	-14.52	1,956.94	355.23	-22.67	88,700.00
ICO Start + 90 Days	101.83	-58.27	1,986.17	30.23	-41.28	1,340.99	123.32	-24.23	7,416.67
ICO Start + 6 months	58.27	-81.78	10,582.73	26.71	-75.17	2,357.70	170.29	-60.48	11,049.50
Last Day CMC	-71.43	-95.27	830.00	-74.63	-94.08	459.24	126.20	-93.36	81,600.00

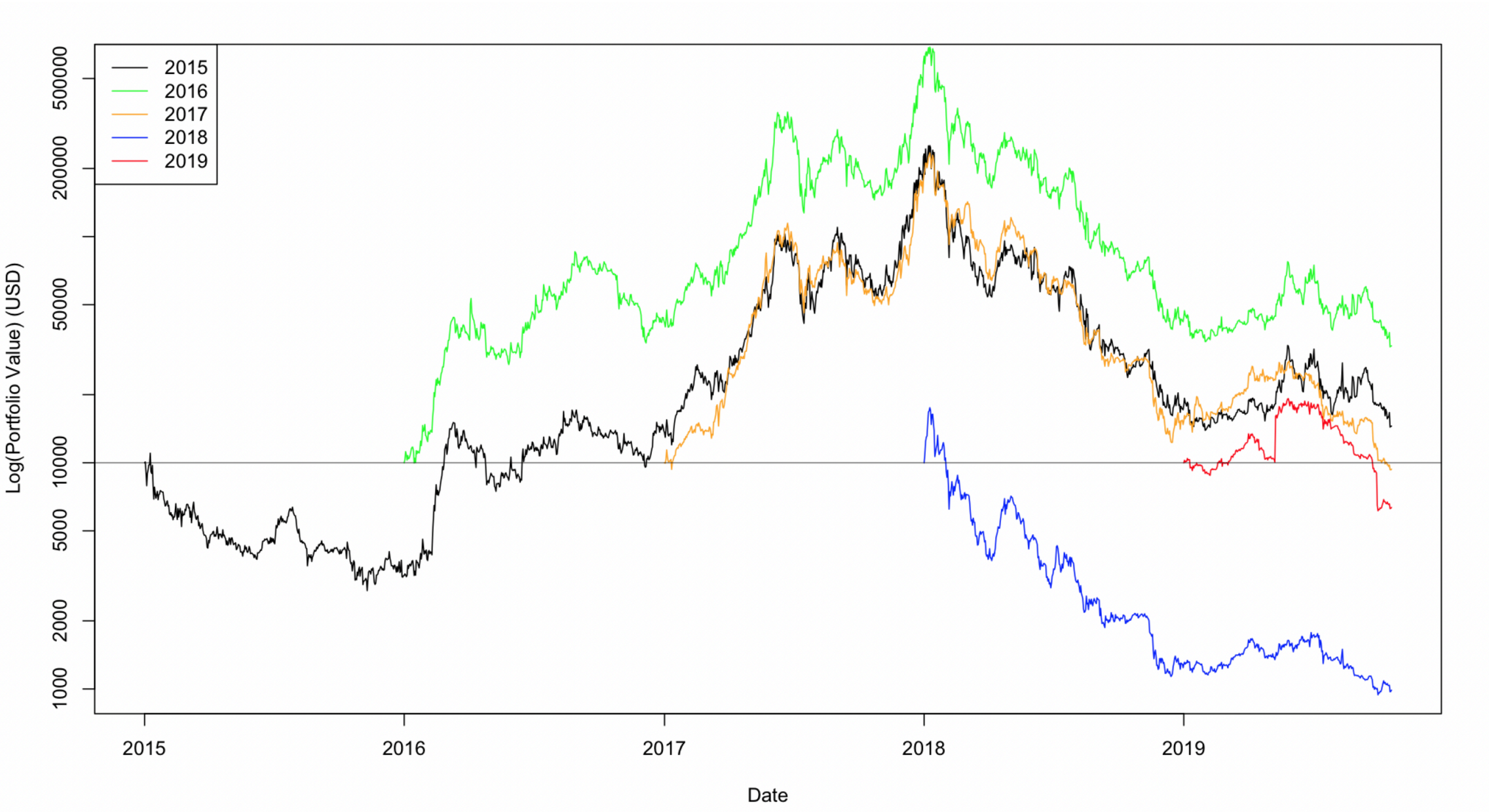
Table 7.7: Summary statistics on token returns split by ICO success (binary).

Success - Pseudo Trading

Token	Market Capitalization	Close (USD)	% MC	USD Bought	Shares Bought
bitcny	170,366	0.162797	0.43	43.11	264.82
bitusd	856,957	1.010000	2.17	216.86	214.71
maidsafecoin	24,447,786	0.054022	61.87	6,186.67	114,521.27
nushares	4,135,008	0.006819	10.46	1,046.39	153,452.17

Table 7.8: Subset of tokens purchased 2015 for portfolio

Success - Pseudo Trading



Token Rise and Fall

	overall	<$1M	$1–10M	$10–100M	$100M-1B	>$1B
# tokens	725	126	191	176	161	71
# price peaks (total)	1,304	246	331	294	295	138
# price peaks (median)	2	2	2	1	1	2
% price increase 1st peak (median)	279	233	281	201	295	608
# volume peaks (total)	1,423	284	390	312	307	130
# volume peaks (median)	2	2	2	1	1	2
% volume increase 1st peak (median)	1,427	405	663	689	2,964	8,442
# tokens abandoned	53	22	21	6	3	1
% tokens abandoned	7	17	11	3	2	1
# abandonments	57	25	22	6	3	1
days abandoned (median)	328	341	300	288	390	182
# tokens resurrected	22	7	10	3	1	1
% tokens resurrected	42	5	5	2	1	1
# resurrections	23	8	10	3	1	1
months to resurrected (median)	3	3	3	2	3	2
# tokens permanently abandoned	34	17	12	3	2	0
% tokens permanently abandoned	5	13	6	2	1	0

Table 7.10: Summary statistics on token peaks, abandonment and resurrection, broken down by total trading volume per coin.

Token Listing on coinmarketcap.com

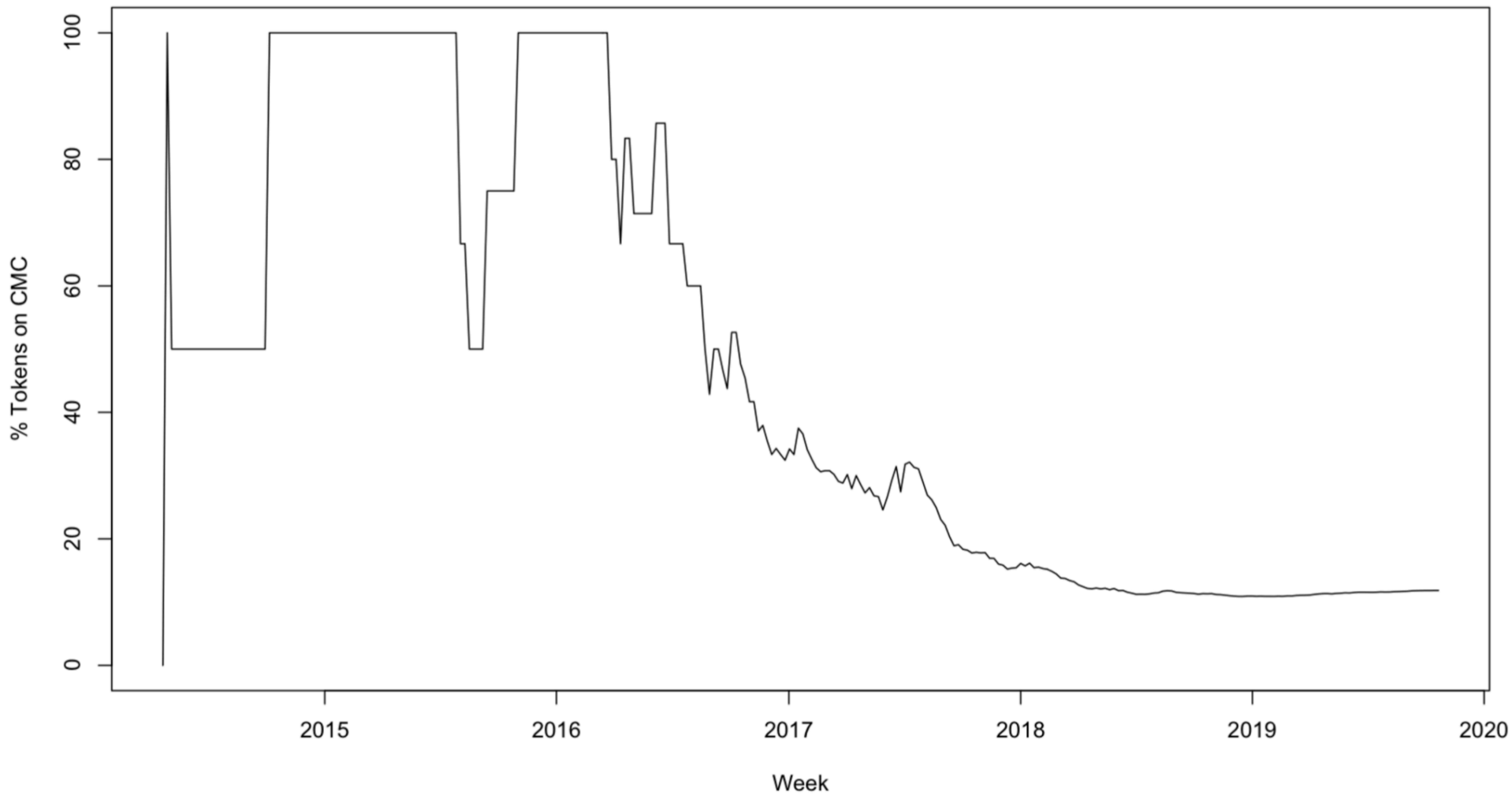


Figure 7.5: Percent of ICO tokens that make it to CMC.

Price Movement Following Peak

- 9 out of 10 tokens lost more than 40% of their value in the 30 days following a peak

- Half of all tokens lost 60-70% of their value in the 30 days following a peak

- Only 2% of token’s trading volume dropped to 0

Traders Ride The Wave

	# Tokens Abandoned	# Tokens Resurrected	# Tokens Created	Trade Volume	log_{10}(Average BTC Price)	# Price Peaks	# Volume Peaks
# Abandoned	1						
# Resurrected	0.47	1					
# Created	0.75	0.78	1				
Trade Volume	0.35	0.72	0.71	1			
log_{10}(Average BTC Price)	0.65	0.75	0.81	0.90	1		
# Price Peaks	0.37	0.75	0.85	0.78	0.67	1	
# Volume Peaks	0.48	0.80	0.91	0.83	0.77	0.99	1

Table 7.11: Monthly correlations between key variables in the ecosystem.

Chapter 7 Conclusion

- Even with additional value tokens can also be abandoned
- Tokens also ride “the wave” of success
- 90% of tokens lose more than 40% of value following a peak

Thesis Contributions and Talk Outline

- Ch. 2 – Cryptocurrency Primer (proposal)
- Ch. 3 – Gathering Datasets to Find Exchange Shocks (proposal)
- Ch. 4 – Identifying Suspicious Trades (proposal)
- Ch. 5 – Analyzing Shocks on the Mt. Gox Cryptocurrency Exchange (proposal)
- Ch. 6 – Measuring the Lifespan of a Cryptocurrency (proposal)
- Ch. 7 – The Rise and Fall of Tokens (new)
- **Ch. 8 – Measuring the Impact of Cryptocurrency "Pump-and-Dump" Schemes (proposal)**
- Ch. 9 – Market Manipulation Through Organized, Target-Based Trading (new)

Research Contributions

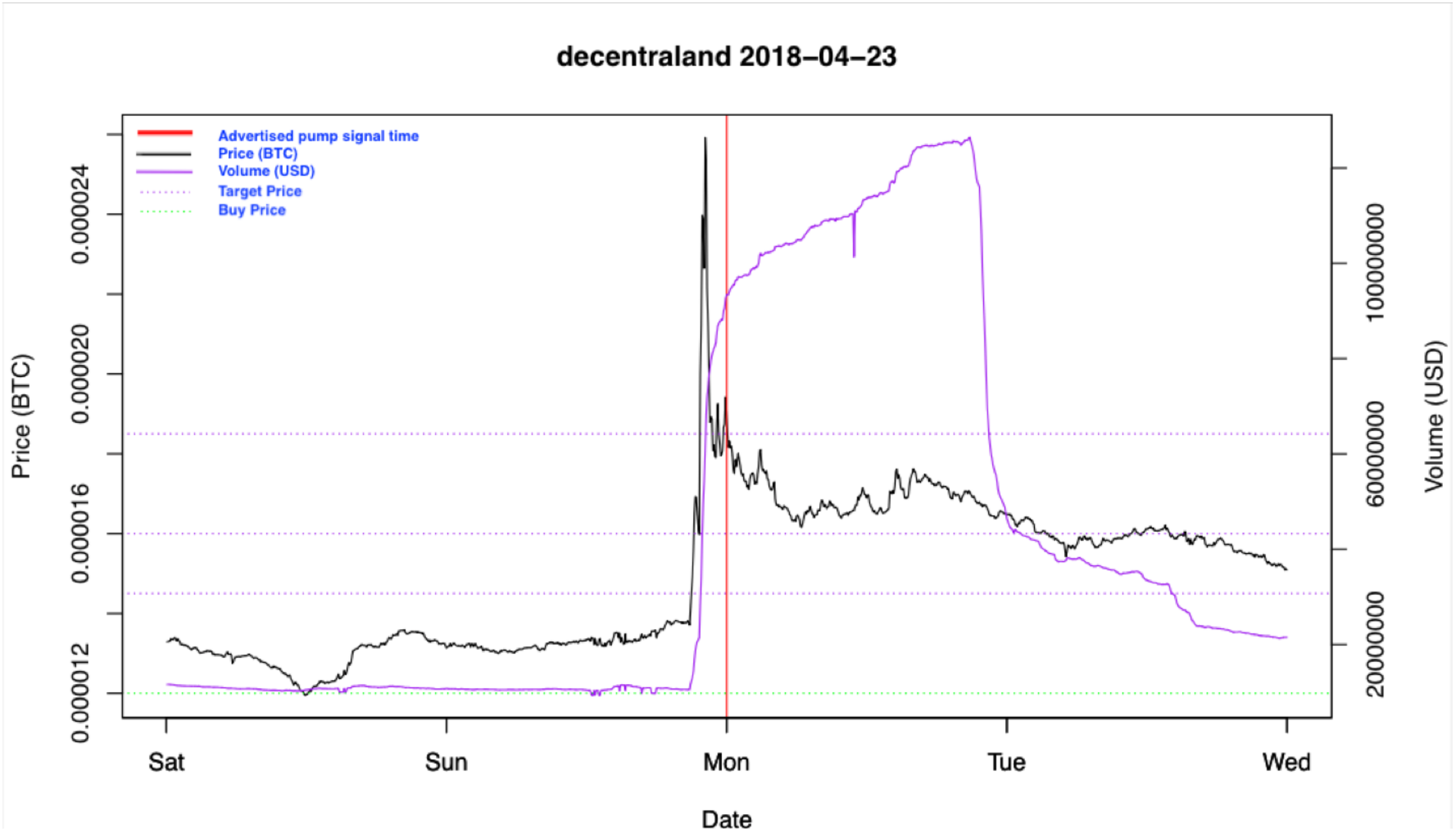
- Establish prevalence of pump-and-dump schemes
- Method to collect and categorize pump signals from chat apps
    - Developed regular expressions for pulling pump data from inconsistent post formats
- Analysis of gathered data:
    - Used regressions to explain pump-and-dump success

Data Collection

- Discord/Telegram - pump signals (Transparent, Obscured, Copied)
  - Master thread on bitcointalk.org - “Discord groups with more than 100k members”
  - Android app tracking groups with more than 4k members
  - ~4,800 distinct pump signals covering 248 currencies between January 2018 and July 2018
    - Telegram - 3767 signals on 30 channels (12% T, 88% O)
    - Discord - 1034 signal in 54 groups (11% T, 42% O, 40% C)

Pump Signal Execution

Identifying Pump Timing



Price Increases

Table 7.3: Median Price Increases by Coin Rankings.

	Discord				Telegram			
	Coins		Signals	Price	Coins		Signals	Price
Rank	#	%	#	Inc %	#	%	#	Inc %
≤ 75	52	69.33	342	3.51	56	74.67	1,000	4.81
76-200	58	46.40	257	5.22	62	49.60	736	6.46
201-500	75	25.00	285	5.32	84	28.00	948	8.10
> 500	73	5.33	150	23.23	176	11.46	1,083	18.74

Explaining Success in Increasing Price

More exchanges associated with lower % price increase from pump

Lower rank associated with higher % increase from the pump

More observers associated with higher % price increase from pump

	Dependent Variable	
Independent Variables	Discord % Price Increase log/log	Telegram % Price Increase log/log
Exchanges	-.14*** (.06)	-.021*** (.045)
Pair Count	-.037* (.051)	.00056 (.040)
Rank	.0012*** (.00018)	.00061*** (.000091)
Server Member count	.010*** (.020)	
Observations	1034	3767
Adjusted R^2	.29	.28

Standard errors in parentheses:clustered standard errors at the level of the coin
*** p<0.01, ** p<0.05, * p<0.1

Chapter 8 Conclusion

- Developed methodology for establishing scope of cryptocurrency pump and dump schemes
- All cryptocurrencies are pump targets
- Median success rate (Telegram) 5.1%, (Discord) 3.5%

Thesis Contributions and Talk Outline

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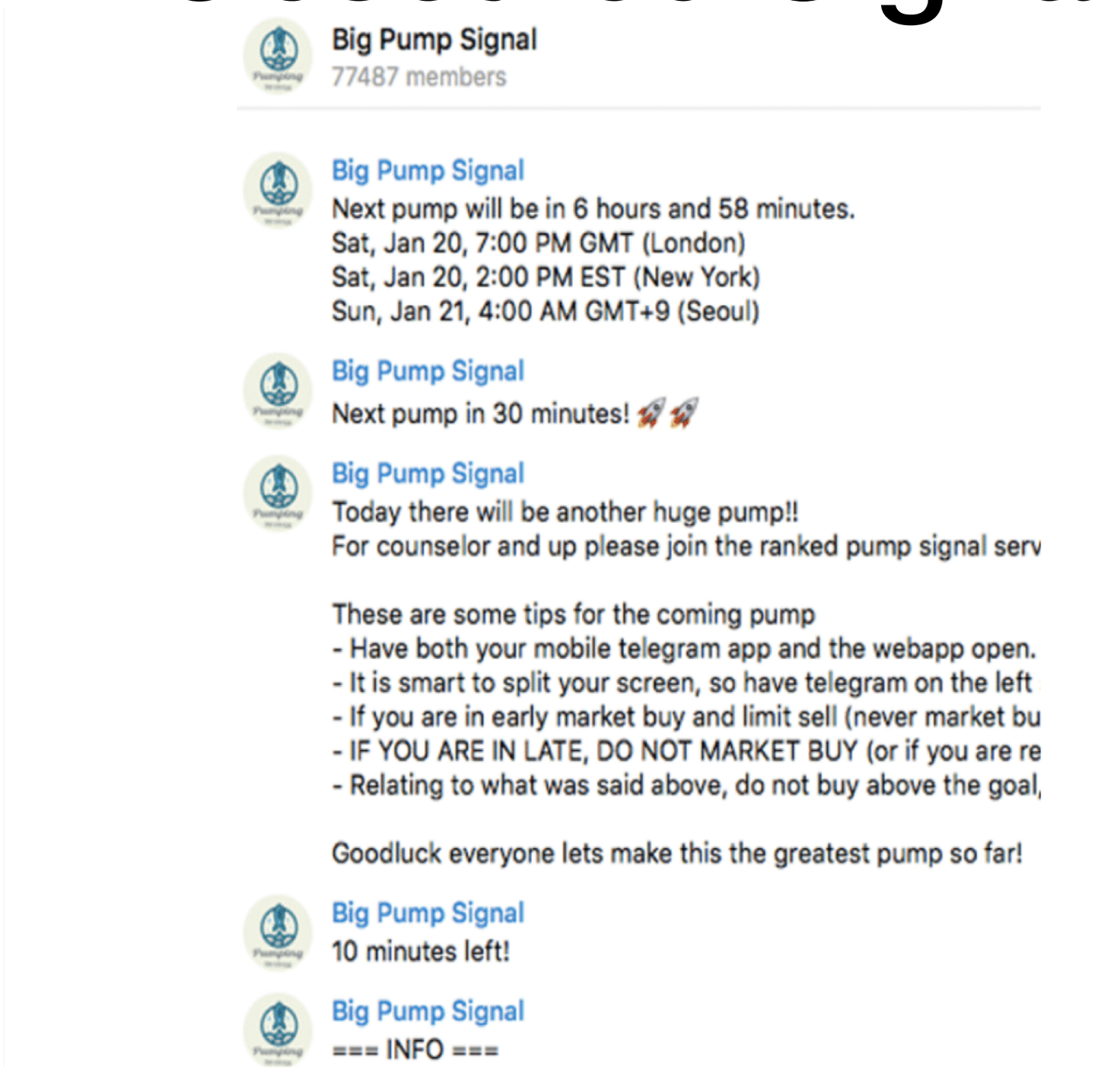
- Ch. 7 – The Rise and Fall of Tokens (new)
- Ch. 8 – Measuring the Impact of Cryptocurrency “Pump-and-Dump” Schemes (proposal)
- **Ch. 9 – Market Manipulation Through Organized, Target-Based Trading (new)**

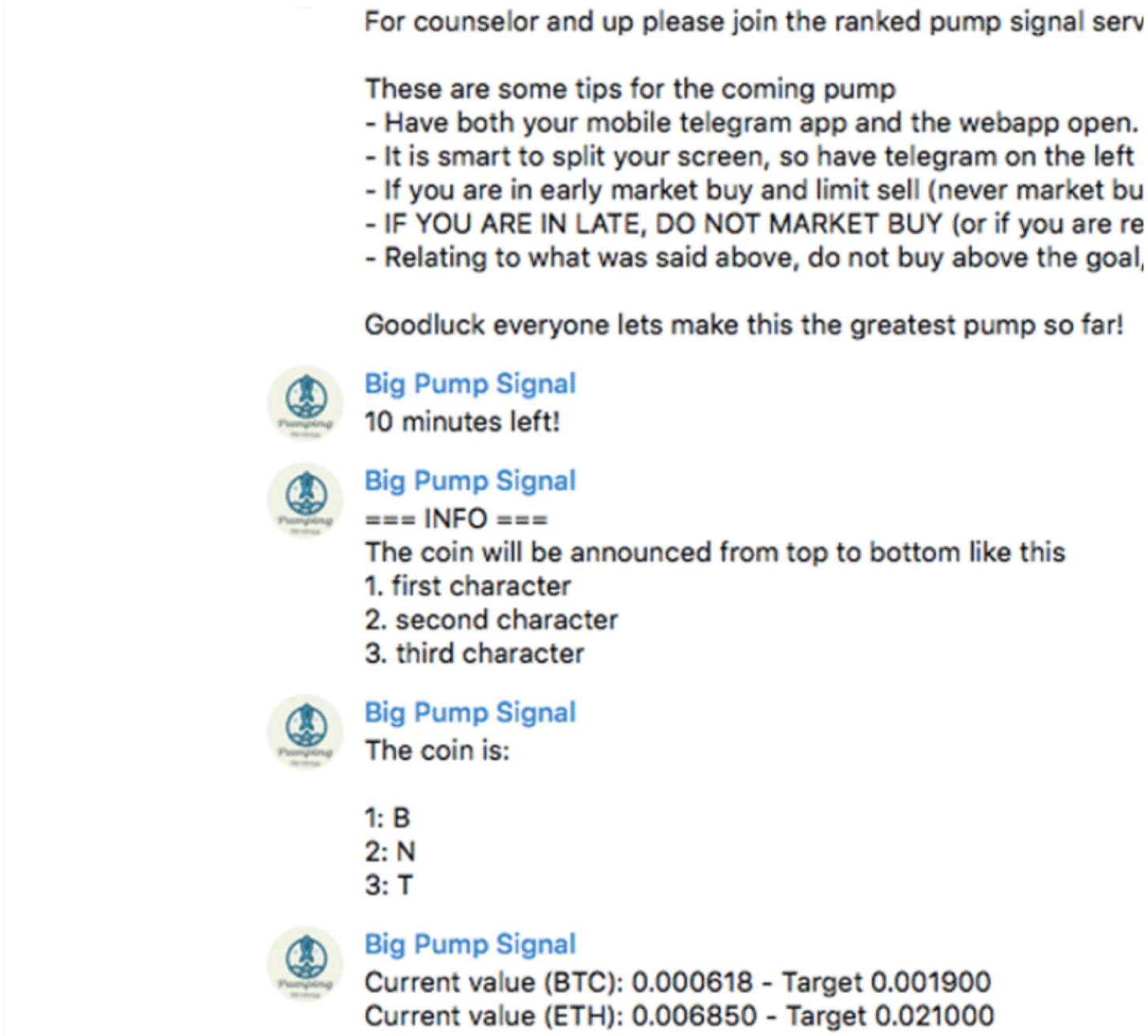
Research Contributions

- Defined methodology for identifying trading cycles
- Constructed summary statistics for price movements through trading cycles
- Established rates of success for target-based pump signals

Transparent Signal vs. Obscured Signal



Transparent Signal vs. Obscured Signal



Transparent Signal vs. Obscured Signal

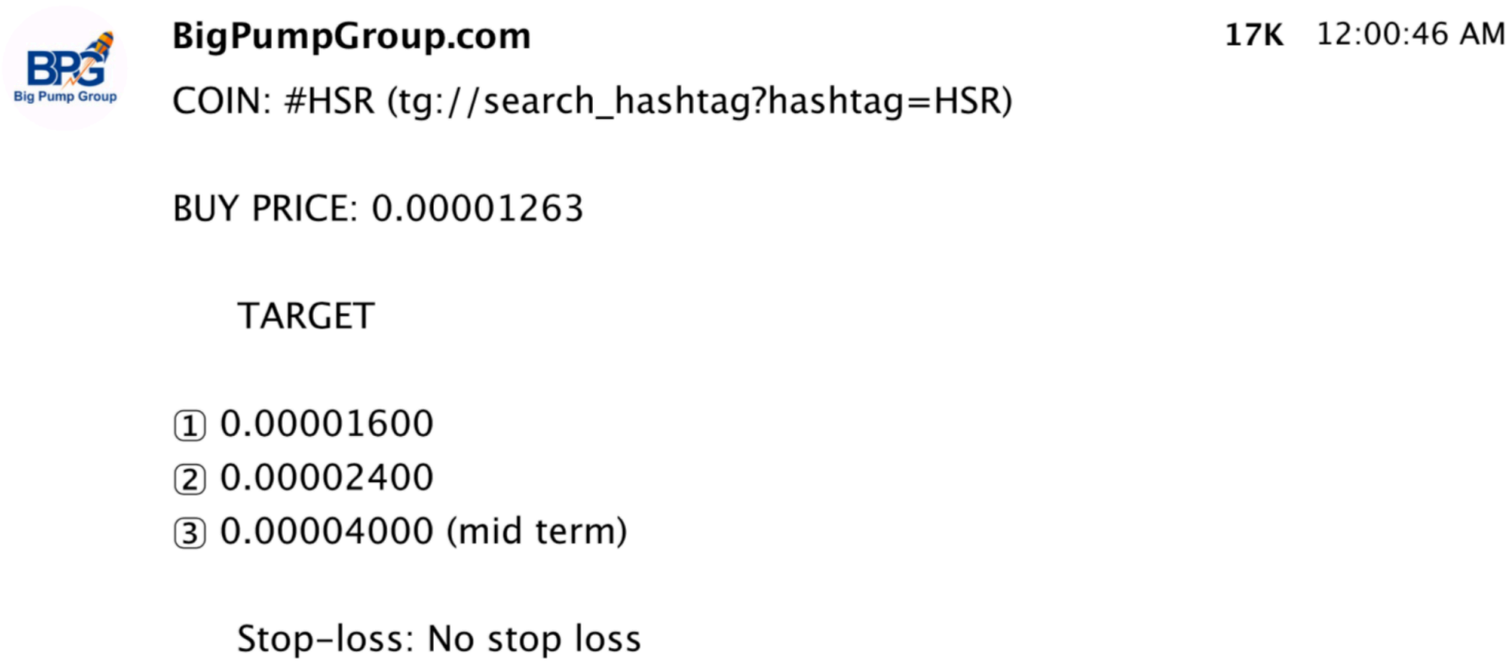
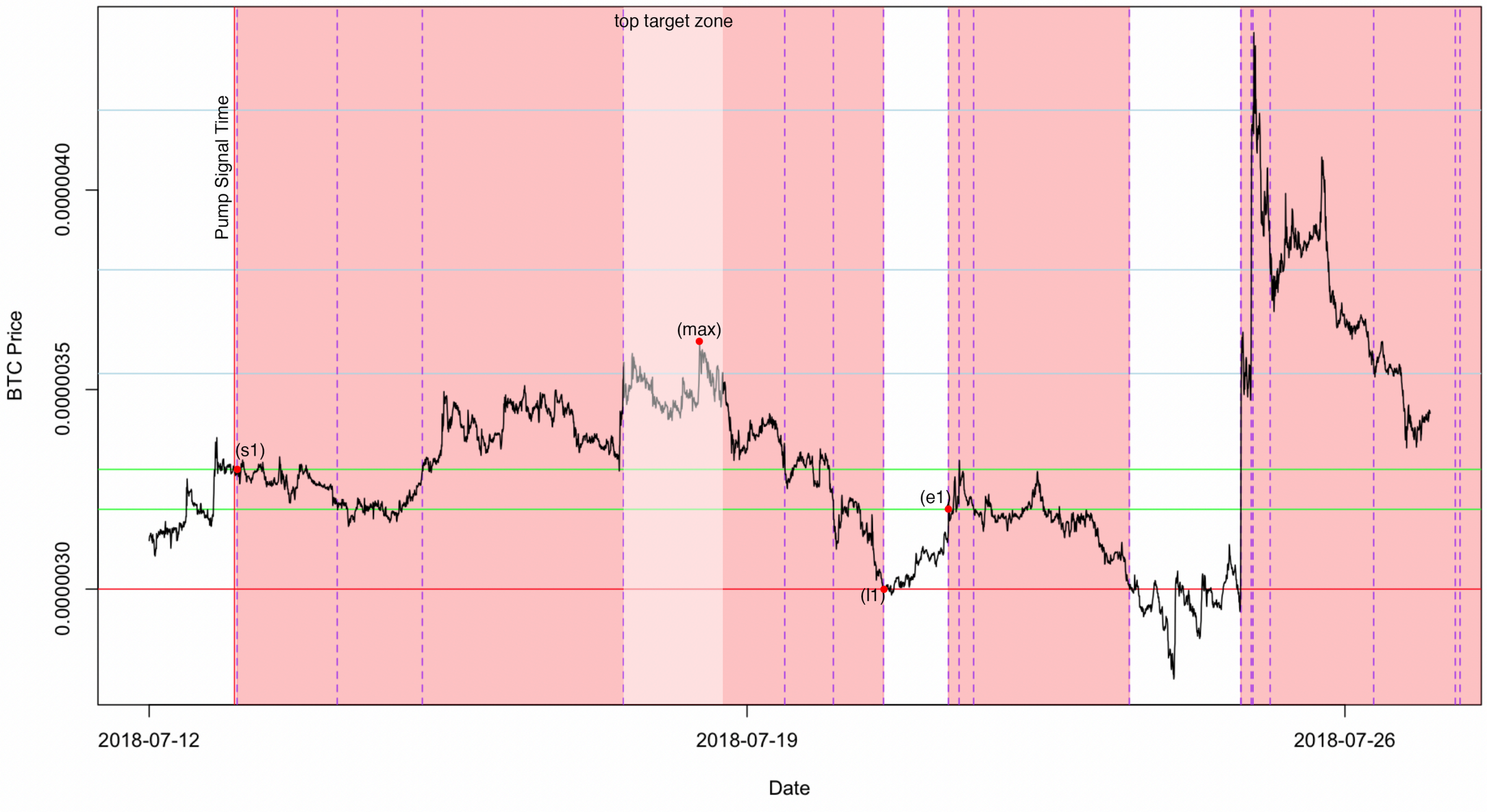


Figure 9.4: Example pump signal from Big Pump Group.

Data Collection

- coinmarketcap.com
  - ~5 minute increment data (145,000,000 records)
    - 293 cryptocurrencies, 220 exchanges
    - January 2017 to November 2019
- Pump signals - 3,683 (1,252 complete)
  - Extended data - July 2017 through January 2019

Identifying Trade Cycles



First Target

- 73% cross a buy target
- 8% never crossed a target
- 1% had no data for the time period
- 17% cross a sell target (Sell1 - Sell11)

Pump Success

Measure	Successful	Unsuccessful
First cycle only	647	605
Overall (cutoff at next signal)	716	536
Overall	1,002	250

Table 9.2: Success based on inclusion or exclusion of trading cycles.

Cycle Metrics

Price Movements

	Range	Min	Max	Median	Mean	Success
Start to max value	0.7	963.8	29.6	54.2	TRUE
Max value to stop-loss	-1.7	-2,510,825.0	-51.9	-4,363.5	TRUE
Start to max value	0.0	395.2	2.7	5.3	FALSE
Max value to stop-loss	-0.6	-1,154.2	-13.6	-20.5	FALSE

Table 9.4: Percentage price movements between points of interest.

Chapter 9 Conclusion

- Pump campaign success can be the result of slow movements
- 51.7 % of target pump signals are successful
- Median percentage price increase 29.6% (successful), 2.7% (unsuccessful)

Thesis Statement

This thesis **documents the prevalence and impact of certain illicit financial schemes** within the cryptocurrency ecosystem. It describes a wide range of unmistakably criminal techniques, **including DDoS attacks, insider trading, and pump and dump schemes**. Additionally, because not all manipulations can be identified and not all fluctuations are intentional, it **develops a general-purpose method for identifying when a cryptocurrency is likely to be abandoned and resurrected**, which could be indicators of manipulation. The **primary impact observed has been fluctuations in pricing**, though volume is also considered. Again, in some cases these fluctuations are the result of clear manipulation, while in others the cause cannot be established.

Thesis Conclusion

- Identified internal and external exchange manipulations
  - Shocks drive away big fish
  - Bots associated with price increases
- Developed generalized rule for points of interest in financial time series data
- Identified coin and token based pump and dump schemes

Questions?