Information Processing in a Transparent Market: Evidence from a DeFi Protocol

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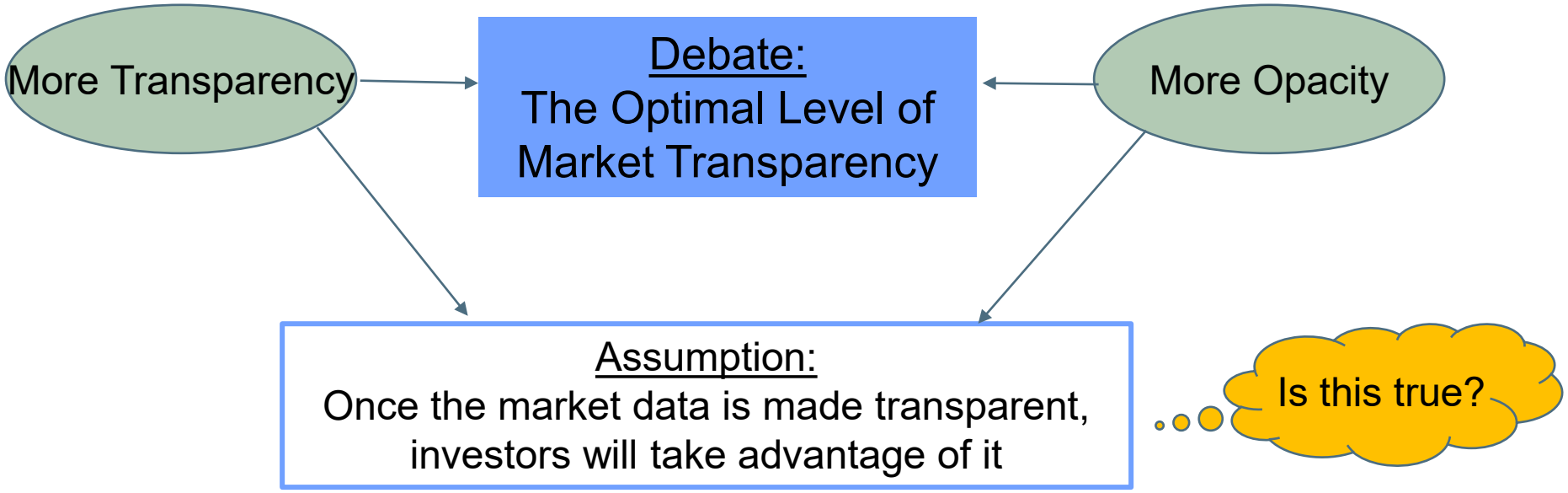
Motivation


More Transparency
Debate:
The Optimal Level of
Market Transparency
More Opacity
Assumption:
Once the market data is made transparent,
investors will take advantage of it
Is this true?

Research Question

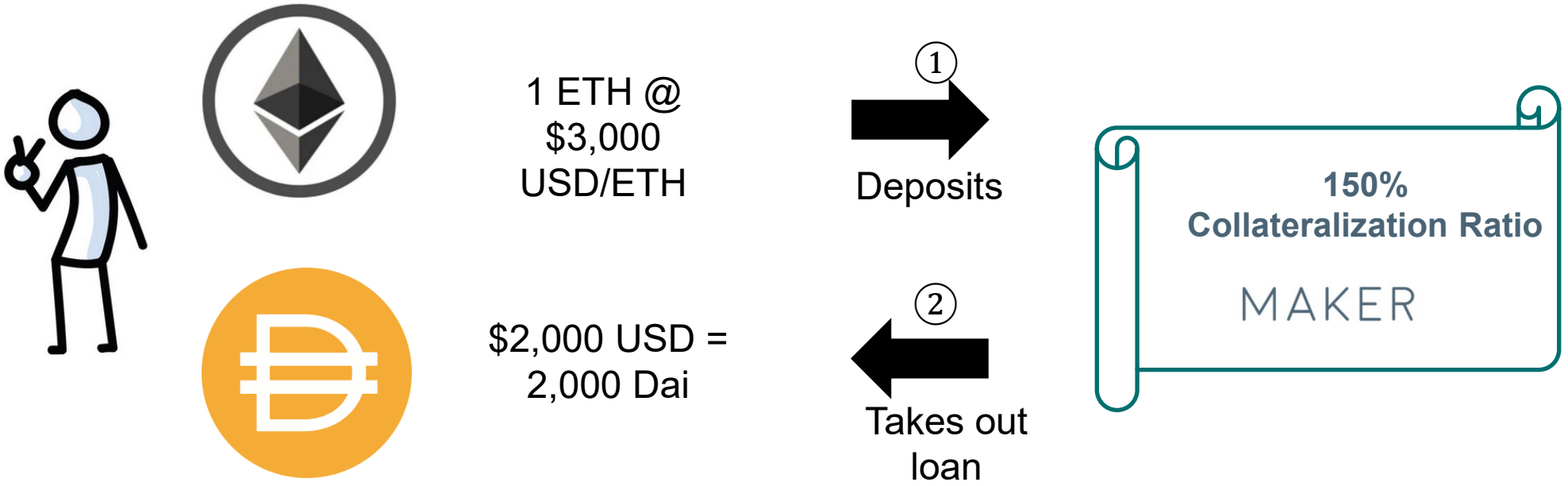
- By taking advantage of a market with real-time trade transparency that rarely exists before, we examine whether traders mimic others' trading activities in real time.

Our Setting: the MakerDao Protocol

- One of the earliest DeFi (decentralized finance) platforms, established on December 18, 2017
- Purpose of the Defi Market
  - Allow cryptocurrency holders to deposit their cryptocurrencies (i.e., Ether aka. ETH) and borrow stable coins pegged to USD (i.e., Dai)
    - For their liquidity needs
    - For Speculations
- A set of smart contracts (i.e., codes that perform actions automatically based on predefined criteria, for example, "pay X to C, if event A happens") to facilitate transactions on the Ethereum blockchain.
  - Public and permissionless
  - Decentralized
  - Loans are overcollateralized

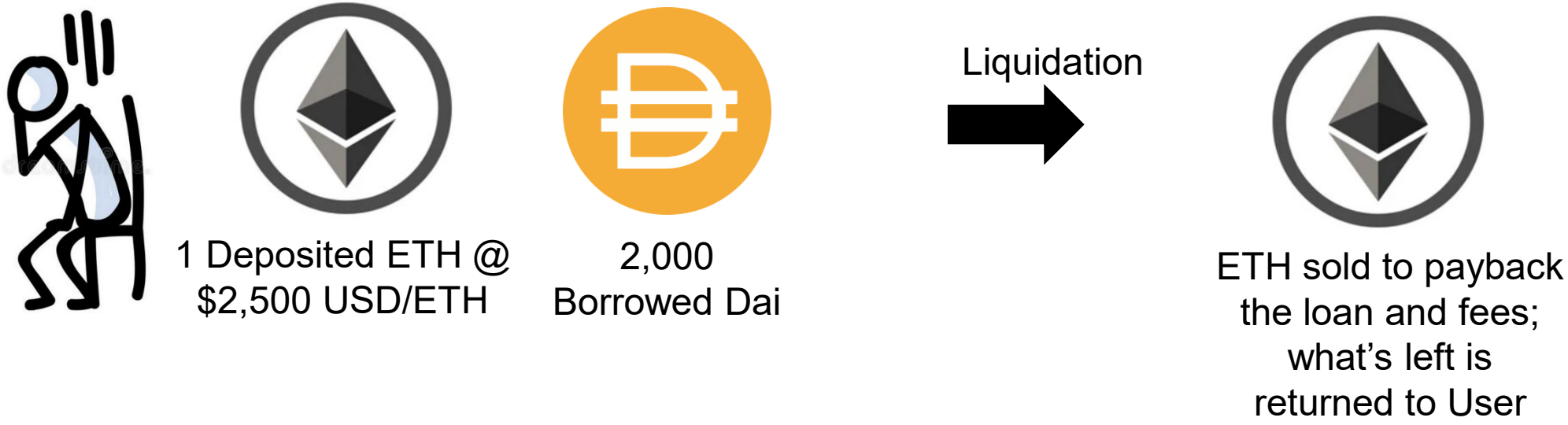
The MakerDao Loan Contract

- The amount that the user can borrow depends on the collateralization ratio (= collateral in USD/ value of Dai in USD)



Liquidation

- If the collateralization ratio is below 150% (for example, when the value of ETH suddenly drops), the user can face a liquidation event: ETH in the account is sold to cover the loan, interest, and liquidation expense (13% fee).



Data

- MakerDao's official Dai 1.0 API:
  - All loans using "Single Dai Collateral" smart contracts
  - Sample Period: December 2017 to May 2020
  - When a user takes out his first loan, he needs to open a CDP ("collateralized debt position")

Total number of MakerDao CDPs	155,406
Delete CDPs with zero principal	(9,270)
Delete all open CDPs	(114,857)
Total number of closed CDPs	31,279
Total number of loans based on the total number of closed CDPs	57,941
Delete loans that use relayer wallets	(23,487)
Total number of loans that do not use proxy wallets	34,454
Delete loans whose wallet holder has fewer than 2 loans during the sample period	(23,798)
Delete loans whose total principal is less than 1 USD	(2,594)
Final sample of loans	8,062

Leveraged Trading (Looping)

- One of the most popular trading strategies in our dataset is to
  - Deposit ETH to borrow Dai
  - Convert back to ETH
  - Deposit back to the loan contract to take out more Dai
- This process increases investors' exposure to ETH and can be profitable if the value of ETH appreciates while the traders hold the loan.

Transaction Time (EST)	Collateral (Dai)	Collateral (ETH)	Principal (Dai)	Repayment (Dai)	Transaction Type
2019-03-02 18:53:37					Opening CDP
2019-03-02 18:53:37	17,529.07	133			Place collateral
2019-03-02 18:53:37			6,000		Borrow loan
2019-03-02 19:05:51	5,815.37	44			Place collateral
2019-03-02 19:10:16			1,000		Borrow loan
2019-03-02 19:13:12	964.82	7.3			Place collateral
2019-03-02 19:19:48	2,489.36	18.67			Place collateral
2019-03-02 19:22:48			1,500		Borrow loan
2019-03-02 19:25:55	1,447.28	10.85			Place collateral
2019-03-12 18:00:47			2,000		Borrow loan
2019-03-12 18:06:12	1,959.27	14.87			Place collateral
2019-03-31 11:56:40			2,000		Borrow loan
2019-03-31 12:06:12	1,922.18	13.624			Place collateral
2019-07-18 19:02:52				12,500	Repay loan
2019-07-18 19:02:52				609.97	Interest Expense
2019-07-18 19:02:52	55,082.81	242.84			Return Collateral

Return Calculation

Transaction Time (EST)	Collateral (Dai)	Collateral (ETH)	Principal (Dai)	Repayment (Dai)	Transaction Type	Cash Balance (MakerDao Funds	External Cash Used
2019-03-02 18:53:37					Opening CDP		
2019-03-02 18:53:37	17,529.07	133			Place collateral		17,529.07
2019-03-02 18:53:37			6,000		Borrow loan	6,000	
2019-03-02 19:05:51	5,815.37	44			Place collateral	184.63	
2019-03-02 19:10:16			1,000		Borrow loan	1,184.63	
2019-03-02 19:13:12	964.82	7.3			Place collateral	219.81	
2019-03-02 19:19:48	2,489.36	18.67			Place collateral		2,269.55
2019-03-02 19:22:48			1,500		Borrow loan	1,500	
2019-03-02 19:25:55	1,447.28	10.85			Place collateral	52.72	
2019-03-12 18:00:47			2,000		Borrow loan	2,052.72	
2019-03-12 18:06:12	1,959.27	14.87			Place collateral	93.45	
2019-03-31 11:56:40			2,000		Borrow loan	2,093.45	
2019-03-31 12:06:12	1,922.18	13.624			Place collateral	171.27	
2019-07-18 19:02:52				12,500	Repay loan		12,329
2019-07-18 19:02:52				609.97	Interest Expense		609.97
2019-07-18 19:02:52	55,082.81	242.84			Return Collateral		

The Value of Collateral Returned

Money Used

$$(55{,}082.81 - 32{,}737.32)/32{,}737.32 = 68.26\%$$

Performance Measurement

- Return

$$\frac{Ending\ collateral\ value + ending\ cash\ balance\ - cash\ used}{cash\ used}$$

  - Assumptions:
    - When investors lock in additional collateral (i.e., engage in leveraged trading), they use the money they borrow from Maker first before accessing their own cash reserves. (“return maximization”)
    - Users’ funds stay within the Maker platform. (“technical constraints”)

- Liquidation Indicator

Performance Determinants

Regressions	I		II		Regressions	I		II	
	return	tstat	return	tstat		liquidated	tstat	liquidated	tstat
order	-0.001	-0.69	-0.001	-1.04	order	-0.034	-1.74	-0.016	-0.80
collateralization	0.013	3.92	0.012	3.86	collateralization	-0.568	-4.53	-0.581	-4.74
leverage	0.003	0.26	0.003	0.22	leverage	1.837	14.21	1.939	15.03
principal	0.006	3.38	0.005	2.67	principal	-0.210	-12.09	-0.197	-10.87
duration	-0.000	-2.69	-0.000	-2.60	duration	0.008	14.02	0.007	13.55
volatility	-1.033	-3.67	-1.029	-3.69	volatility	11.322	5.87	11.366	5.81
volatility_missing	-0.000	-0.00	-0.003	-0.21	volatility_missing	-1.005	-5.80	-0.860	-4.83
eth_return			1.986	13.32	eth_return	-19.842	-11.24	-20.189	-11.21
age			0.000	0.68	age			-0.000	-0.47
NA_trading_hours			0.007	0.62	NA_trading_hours			-0.093	-0.82
NA_regular_hours			0.021	1.33	NA_regular_hours			-0.351	-2.03
num_txhash			0.001	1.41	num_txhash			-0.048	-4.68
Observations	8062		8062		Observations	8062		8062	
R-squared	0.259		0.259		R-squared	0.315		0.323	
Month-year FE	Yes		Yes		Month-year FE	Yes		Yes	
Clustering	Wallet		Wallet		Clustering	Wallet		Wallet	

Performance Persistence

$$Return_{i,t} = b_0 + b_1 Return_{it-1} + b_2' \, LoanCharacteristics_{it} + b_3' \, controls_{it} + \, monthYearFE_t + e_{it}$$

$$Liq_{i,t} = b_0 + b_1 Liq_{it-1} + b_2' \, LoanCharacteristics_{it} + b_3' \, controls_{it} + \, monthYearFE_t + e_{it}$$

Performance Persistence-Returns

Regressions	I		II	
	return	tstat	return	tstat
return(-1)	0.094	4.69	0.094	4.70
order	-0.000	-0.32	-0.001	-0.70
collateralization	0.008	2.43	0.008	2.42
leverage	-0.010	-0.75	-0.010	-0.78
principal	0.005	2.76	0.005	2.13
duration	-0.000	-2.10	-0.000	-1.99
volatility	-1.353	-4.11	-1.352	-4.16
volatility_missing	-0.014	-1.06	-0.017	-1.23
eth_return	1.747	10.28	1.745	10.22
age			0.000	0.33
NA_trading_hours			0.009	0.63
NA_regular_hours			0.019	1.03
num_txhash			0.001	1.17
Observations	5517		5517	
R-squared	0.272		0.272	
Month-year FE	Yes		Yes	
Clustering	Wallet		Wallet	

- Persistence in return: last loan return positively predicts current loan return.
- One standard deviation increase in last loan return increases next loan return by 3.2%

Performance Persistence-Liquidations

Regressions	I		II	
	liquidated	tstat	liquidated	tstat
liquidated(-1)	2.253	21.71	2.231	21.41
order	-0.045	-2.95	-0.032	-2.01
collateralization	-0.424	-5.26	-0.434	-5.31
leverage	1.531	12.19	1.598	12.53
principal	-0.215	-11.46	-0.201	-10.19
duration	0.008	13.35	0.008	13.00
volatility	13.674	5.00	14.200	5.14
volatility_missing	-0.856	-3.78	-0.697	-3.03
eth_return	-18.477	-8.09	-18.883	-8.31
age			-0.000	-1.27
NA_trading_hours			-0.120	-1.01
NA_regular_hours			0.013	0.06
num_txhash			-0.036	-3.90
Observations	5517		5517	
Pseudo R-squared	0.425		0.429	
Month-year FE	Yes		Yes	
Clustering	Wallet		Wallet	

- Persistence in liquidation events: previous liquidation event positively predicts current liquidation.
- Previous liquidation increases the probability of current liquidation by almost 23%.

Mimicking of Superior Performers and Information Processing Costs

- HYPOTHESIS 1*: Investors do not incorporate traders' past performance in their following decisions.*

- HYPOTHESIS 2: *If acquisition and integration costs are a barrier to investors' ability to* ***process historical data****, then a reduction in these costs, for example by providing free, aggregated and easily digestible information on traders' past activity, would increase the likelihood that traders use other traders' past performance in their following decisions.*

- HYPOTHESIS 3: *If data awareness, acquisition, and integration costs are a barrier to investors' ability to* ***mimic other traders in real-time****, then an increase in these costs would decrease the ability of investors to efficiently mimic others.*

Do Investors Mimic Those with Superior Past Performance in Real Time?

The Following Measure

Transaction Time (EST)	Collateral	Collateral	Principal (	Repaymer	Transaction Type
3/2/2019 18:53					Opening CDP
3/2/2019 18:53	17,529.07	133			Place collateral
3/2/2019 18:53			6,000		Borrow loan
3/2/2019 19:05	5,815.37	44			Place collateral
3/2/2019 19:10			1,000		Borrow loan
3/2/2019 19:13	964.82	7.3			Place collateral
3/2/2019 19:19	2,489.36	18.67			Place collateral
3/2/2019 19:22			1,500		Borrow loan
3/2/2019 19:25	1,447.28	10.85			Place collateral
3/12/2019 18:00			2,000		Borrow loan
3/12/2019 18:06	1,959.27	14.87			Place collateral
3/31/2019 11:56			2,000		Borrow loan
3/31/2019 12:06	1,922.18	13.624			Place collateral
7/18/2019 19:02				12,500	Repay loan
7/18/2019 19:02				609.97	Interest Expense
7/18/2019 19:02	55,082.81	242.84			Return Collateral

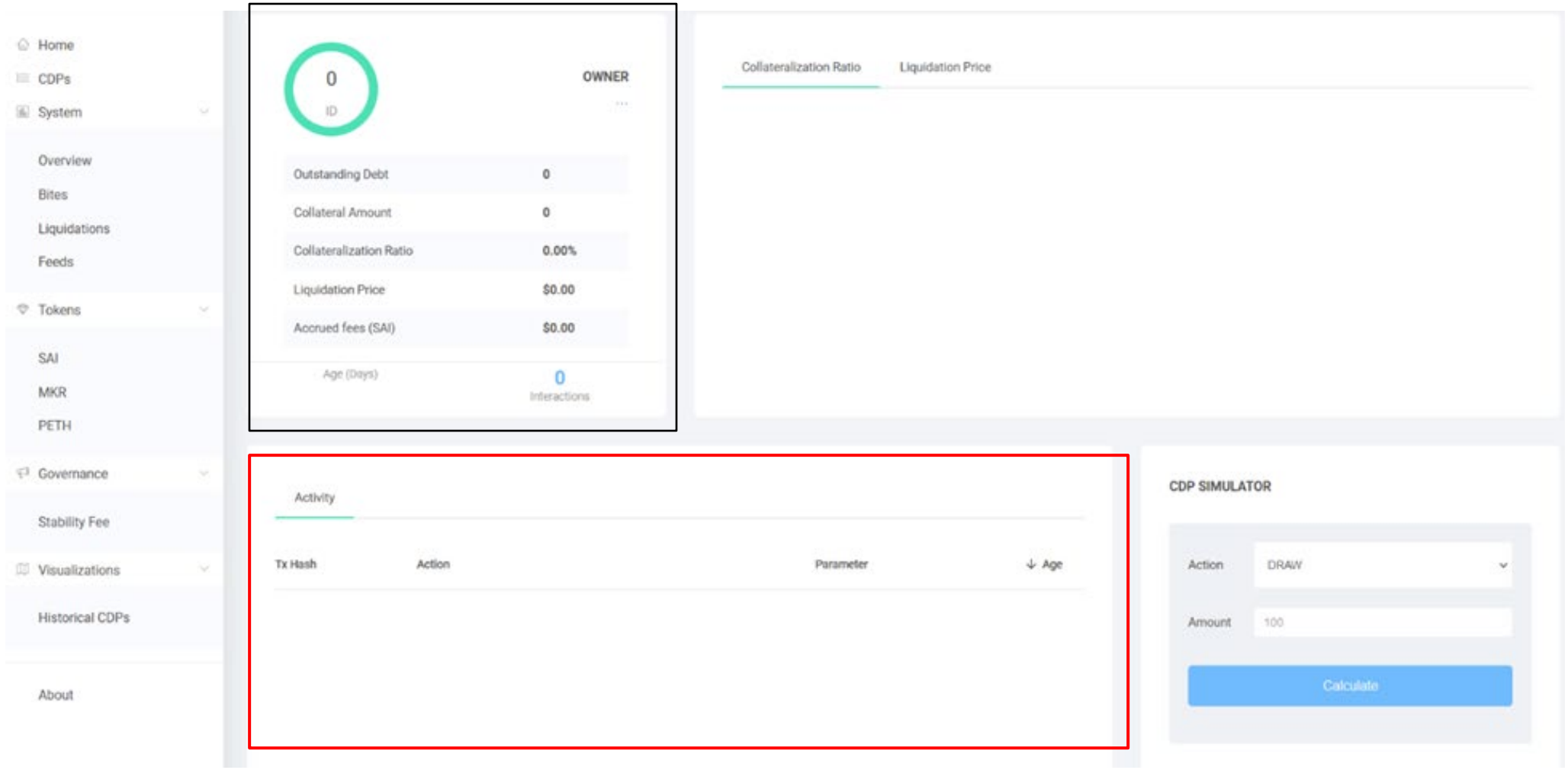
The following score is the number of followers of a loan.

The follower of this loan is someone who follows at least half of all borrowing and repaying transactions with in 15 minutes of the original transactions.

Do Investors Mimic Those with Superior Past Performance in Real Time?

Regressions	I		II	
	following	tstat	following	tstat
return(-1)	0.009	0.90		
liquidated(-1)			-0.020	-2.26
collateralization(-1)	0.002	0.34	0.001	0.27
leverage(-1)	-0.015	-1.99	-0.009	-1.15
principal(-1)	-0.004	-1.81	-0.004	-1.92
duration(-1)	0.000	1.41	0.000	1.79
volatility(-1)	0.510	2.51	0.531	2.59
volatility_missing(-1)	0.081	3.94	0.081	3.94
eth_return	-0.365	-1.32	-0.378	-1.36
age	-0.000	-1.26	-0.000	-1.27
NA_trading_hours	0.007	0.60	0.007	0.59
NA_regular_hours	-0.061	-1.64	-0.062	-1.66
num_txhash	0.003	2.60	0.002	2.53
Observations	5517		5517	
R-squared	0.034		0.034	
Month-year FE	Yes		Yes	
Clustering	Wallet		Wallet	

Costs to Process the Historical Performance Data



Costs to Process the Historical Performance Data

Regressions	I		II	
	following	tstat	following	tstat
post	0.040	0.78	0.044	0.85
return(-1)	0.000	0.01		
post*return(-1)	0.020	1.35		
liquidated(-1)			0.000	0.07
post*liquidated(-1)			-0.041	-3.05
Observations	5207		5207	
R-squared	0.034		0.035	
Fully Interacted Controls	Yes		Yes	
Month-year FE	Yes		Yes	
Clustering	Wallet		Wallet	

Costs to Follow in Real Time

Regressions	pc = duration I following	tstat	pc = number of smart contracts II following	tstat	pc = number of Makerdao transactions III following	tstat
processing cost	-0.0001	-2.81	-0.0243	-3.71	-0.0003	-4.41
return(-1)	0.0215	1.66	0.0416	1.71	0.0120	1.08
processing cost * return (-1)	-0.0002	-2.22	-0.0222	-1.96	-0.0002	-1.39
Observations	5517		5517		5517	
R-squared	0.034		0.035		0.034	
Controls	Yes		Yes		Yes	
Month-year FE	Yes		Yes		Yes	
Clustering	Wallet		Wallet		Wallet	

Regressions	pc = duration I following	tstat	pc = number of smart contracts II following	tstat	pc = number of Makerdao transactions III following	tstat
processing cost	-0.0002	-3.34	-0.0256	-3.10	-0.0005	-4.84
liquidated(-1)	-0.0340	-3.16	-0.0397	-2.12	-0.0256	-2.64
processing cost * liquid.(-1)	0.0002	3.74	0.0165	1.66	0.0004	3.45
Observations	5517		5517		5517	
R-squared	0.035		0.035		0.035	
Controls	Yes		Yes		Yes	
Month-year FE	Yes		Yes		Yes	
Clustering	Wallet		Wallet		Wallet	

Mimicking VS Herding/Coordination

- Alternative 1: Trading on correlated signals
  - Following in our setting is mostly in one direction and mutual following is really rare in our sample.
- Alternative 2: One holding multiple wallets
  - Our results are robust to excluding wallets that interact with each other.
- Alternative 3: Group Coordination to Manipulate Prices
  - Mutual following is rare, and the average number of followers per loan cycle for all wallets is low (<=3).
  - As Li, Shin, and Wang (2022, p2) note: "Different from the stock market where pumpers target the smallest stocks, cryptocurrency pumpers target a wide range of cryptocurrencies, including very large ones, **although not the largest ones such as Bitcoin or Ethereum**."

Additional Analyses

- Results are robust to
  - Using the average past returns than the most recent past returns
  - Excluding loans with a principle less than 100 USD
  - Excluding the significant ETH price drop period (first 3 or 6 months of the sample)

- Mimicking Strategy Returns
  - Before the website introduction, mimicking wallets with past performance in top deciles generates an average return of 12.8%, significantly different from zero.

Conclusion

- We find robust evidence of cross-sectional persistence in traders' performance.
- Despite the public availability of all traders' past and real-time activities, investors' efficient mimicking does not happen automatically and varies with the information processing costs associated with using the real-time publicly available information on the blockchain.
  - Transparency by itself is not enough
  - Information should be easy to collect and process
  - Policy makers should focus not only on transparency but also on reducing the investors' processing costs