The Impact of Spoofing on Bitcoin Market Microstructure

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- Understanding spoofing is critical for market integrity and policy design.

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2. How can we quantitatively detect and measure spoofing activity?
3. What are the economic incentives (profits) of spoofers?
4. How does spoofing affect market quality (liquidity, spreads, VPIN)?

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  - Deterioration of liquidity and market quality.

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  - Spoofing intensity and volume
  - Market quality: VPIN (Easley, López de Prado, and O'Hara (2012)), spreads

Order Imbalance and Returns

	R_t			
	[1-min]		[Hourly]	
Order book Bid-Ask imbalance,	0.0173	0.0209	0.2963	0.4079
$Max[0, OBIB_t \times 10^{-2}]$	(9.53) $***$	(11.45) $***$	(1.99) $**$	(2.76) $***$
Order book Ask-Bid imbalance,	0.0127	0.0143	0.5987	0.5420
$-\|Min[0, OBIB_t \times 10^{-2}]\|$	(4.92) $***$	(5.76) $***$	(2.42) $**$	(2.39) $**$
Lagged order book Ask-Bid imbalance,	-0.0081	-0.0056	-0.1188	-0.2031
$Max[0, OBIB_{t-1} \times 10^{-2}]$	(-5.37) $***$	(-3.82) $***$	(-0.72)	(-1.37)
Lagged order book Bid-Ask imbalance,	-0.0038	-0.0023	-0.5082	-0.5252
$-\|Min[0, OBIB_t \times 10^{-2}]\|$	$(-1.70)*$	(-1.07)	(-2.28) $**$	(-2.20) $**$
Order imbalance,		0.0270		0.0118
$OIB_t \times 10^{-2}$		(13.85) $***$		(6.35) $***$
Lagged return,		-0.0255		-0.0163
R_{t-1}		(-2.57) $***$		(-0.689)
Intercept	2.97×10^{-7}	-6.54×10^{-6}	1×10^{-4}	7.01×10^{-5}
	(0.05)	(-1.31)	(0.46)	(0.266)
R^2	0.003	0.063	0.008	0.079
# of Observations	113937	113937	2173	2173

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- Consistent with NYSE equity results by Chordia et al. (2002).
- Positive OIB $\Rightarrow$ upward price pressure; negative OIB $\Rightarrow$ price decline.
- Evidence consistent across 1-minute and hourly horizons.

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  2. Median cancellation time < 1 second — high-frequency manipulation.

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- **Validation:**
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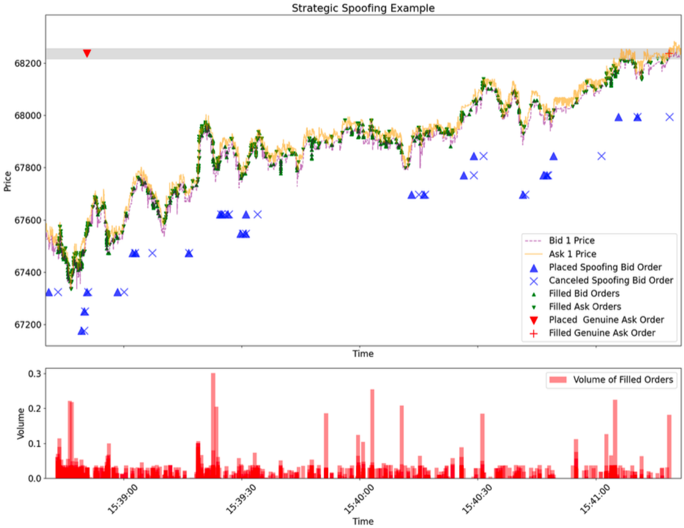
  - Produces realistic spoofing distributions aligned with Lee et al. (2013) and Do and Putniņš (2023).

Spoofing Detection Illustration

T_0	Genuine Ask Order Submitted
T_1	Submission [Side: Bid, Price: $40000, Size: 0.038]
T_2	Cancellation [Side: Bid, Price: $40000, Size: 0.038]
T_3	Submission [Side: Bid, Price: $40020, Size: 0.038]
T_4	Cancellation [Side: Bid, Price: $40020, Size: 0.038]
T_5	Submission [Side: Bid, Price: $40015, Size: 0.038]
T_6	Cancellation [Side: Bid, Price: $40015, Size: 0.038]
...	...
T_{n-1}	Submission [Side: Bid, Price: $40010, Size: 0.038]
	Genuine Ask order filled
T_n	Cancellation [Side: Bid, Price: $40010, Size: 0.038]

Example of Spoofing Event



Bid spoofing on March 8, 2024 (15:39–15:42).
Price pumped from $67,500 to $68,200 before spoof cancellation.

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- Effects persist even after controlling for order imbalance and lagged returns.

Spoofing Intensity and Returns-Continuted

	R_t			
Bid spoofing intensity,	7.33×10^{-4}	6.05×10^{-4}		
BSI_t	(13.71)***	(12.29)***		
Ask spoofing intensity,	-9.56×10^{-4}	-8.08×10^{-4}		
ASI_t	(-7.46)***	(-6.27)***		
Bid spoofing volume,			6.53×10^{-4}	5.28×10^{-4}
BSV_t			(3.32)***	(2.97)***
Ask spoofing volume,			-2.69×10^{-3}	-2.50×10^{-3}
ASV_t			(-5.29)***	(-4.69)***
Order book imbalance,		1.40×10^{-2}		1.42×10^{-2}
$OBIB_t \times 10^{-2}$		(10.41)***		(10.53)***
Order imbalance,		2.63×10^{-2}		2.68×10^{-2}
$OIB_t \times 10^{-2}$		(13.88)***		(14.01)***
Lagged return,		-2.35×10^{-2}		-2.19×10^{-2}
R_{t-1}		(-2.89)***		(-2.72)***
Constant	2.25×10^{-6}	-4.15×10^{-6}	5.58×10^{-6}	-1.39×10^{-6}
	(0.91)	(-1.60)	(2.15)**	(-0.52)

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  - Liquidity providers respond defensively, demanding greater compensation for adverse-selection risk.

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Impact on Market Quality-Continued (1)

	Without spoofing activity	With spoofing activity	Difference
$VPIN$	0.55	0.78	0.23
$SPREAD$	12.01	12.22	0.21
PQS	0.021%	0.022%	0.001%

Impact on Market Quality-Continued (2)

Panel A:			
	VPIN	**Spread**	**PQS**
Const	0.58	9.72	1.79×10^{-4}
	(92.72)***	(72.92)***	(83.06)***
During Spoofing × Spoofing Size	0.26	0.98	2.4×10^{-5}
	(10.54)***	(1.88)*	(2.88)***
After Spoofing × Genuine Size	-0.45	-2.79	-2.9×10^{-5}
	(-9.48)***	(-2.73)***	(-1.77)*
Order imbalance	0.16	-0.88	-5×10^{-6}
$\lvert OIB_t \rvert$	(40.26)***	(-10.4)***	(-3.54)***
Order book imbalance	0.05	0.72	8×10^{-6}
$\lvert OBIB_t \rvert$	(3.02)***	(2.2)**	(1.52)
Trading Volume	-1×10^{-6}	1.4×10^{-5}	1×10^{-6}
VOL_t	(-36.0)***	(20.39)***	(15.6)***
Return	-35.53	2147.35	0.037372
$\lvert R_t \rvert$	(-9.0)***	(25.46)***	(27.44)***

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- Spoofing yields high *risk-adjusted* profits — low exposure to adverse moves.
- Asymmetric effects suggest stronger price response to ask-side spoofing.

Profitability of Spoofing-Continued

	Bid spoofing profit, BSP		Ask spoofing profit, ASP	
Bid spoofing volume, $\overline{BSV_t}$	0.0026	0.0027		
	(2.16)**	(2.43)**		
Ask spoofing volume, $\overline{ASV_t}$			0.0095	0.0055
			(4.73)***	(2.89)***
Order book imbalance, $\overline{OBIB_t} \times 10^{-2}$		-0.026		-0.02
		(-2.62)***		(-1.28)
Order imbalance, $\overline{OIB_t} \times 10^{-2}$		0.0048		-0.0083
		(0.93)		(-1.23)
Volatility, σ_t		5.70×10^{-6}		1.21×10^{-5}
		(2.60)***		(3.84)***
Bid-ask spread, $\overline{SPREAD_t}$		2.60×10^{-5}		1.01×10^{-5}
		(4.69)***		(1.26)
Spoofing length, $\overline{SL_i}$		7.07×10^{-6}		1.61×10^{-5}
		(6.98)***		(9.86)***
Constant	0.0005	5.47×10^{-5}	0.0007	5.28×10^{-5}
	(37.28)***	(1.19)	(32.25)***	(0.74)
R^2	0.004	0.178	0.024	0.181

Robustness Tests

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- These tests demonstrate that our spoofing measures capture genuine manipulative behavior rather than mechanical order-book noise.

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Thank you