”High-Frequency Trading and Price Informativeness”

Jasmin Gider, Tilburg University

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High-Frequency Trading and Price Informativeness

J. Gider S. Schmickler C. Westheide

Tilburg University Princeton University University of Vienna & SAFE

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High-Frequency Trading

- Subset of algo trading
- Use technology to be extremely fast
- Small, short-lived positions, mostly intradaily
- Frequent order cancellation

Figure: From Menkveld 2016.

[I]f sophisticated market players can devise algorithms that extract information from the patterns of trades, it can be profitable. But their profits come at the expense of someone else. And among those at whose expense it may come can be those who have spent resources to obtain information about the real economy.

Joseph Stiglitz,
Atlanta Fed Financial Markets Conference April 2014

Related Literature

Acquiring new information: theory

- HFT can reduce rents to fundamental information acquisition

  (Draus 2018, Baldauf and Mollner 2018, Dugast and Foucault 2018, Yang and Zhu 2019)

Acquiring new information: evidence

- HFT able to detect institutional order flow and profit from this information (Van Kervel and Menkveld 2019, Korajcyk and Murphy 2019)
- More algorithmic trading associated with less anticipation of quarterly earnings announcements (Weller 2018)

Research Question and Motivation

How does the informativeness of prices change with HFT?

- For prices to reflect information about fundamental value:
  1. **Existing** information is quickly impounded into prices through the trading process
  2. Information is acquired by market participants **in the first place**
- Existing short-term studies not designed to detect adverse effects on information acquisition
- Challenge: information acquisition difficult to observe directly

Paper in a Nutshell

- Use staggered presence of HFT in international markets
- Informativeness measure: how well do prices in t predict future cash flows and investment in $t + k$ (Bai, Philippon and Savov 2016)?
- Key findings:
  - Market prices are poorer predictor of future cash flows and investment
  - Firm-level: while spreads decrease, idiosyncratic volatility also decreases
  - Funds deviate less from value-weighted portfolio
- Contribution:
  - Longer-term considerations, anchoring prices to fundamental value
  - **Indirect** test of information acquisition

Empirical Approach

- Use **staggered** start of HFT presence in panel of international stock markets

$$\mathrm{Y}_{m,t} = \beta_0 + \beta_1 \mathrm{HFT}_{m,t} + \delta X_{m,t} + \eta_t + \mu_m + \varepsilon_{m,t} \qquad (1)$$

- m indicates market, t time, Y indicates measure of price informativeness, X is vector of time-varying control variables. η_t are year fixed effects, η_m are market fixed effects.

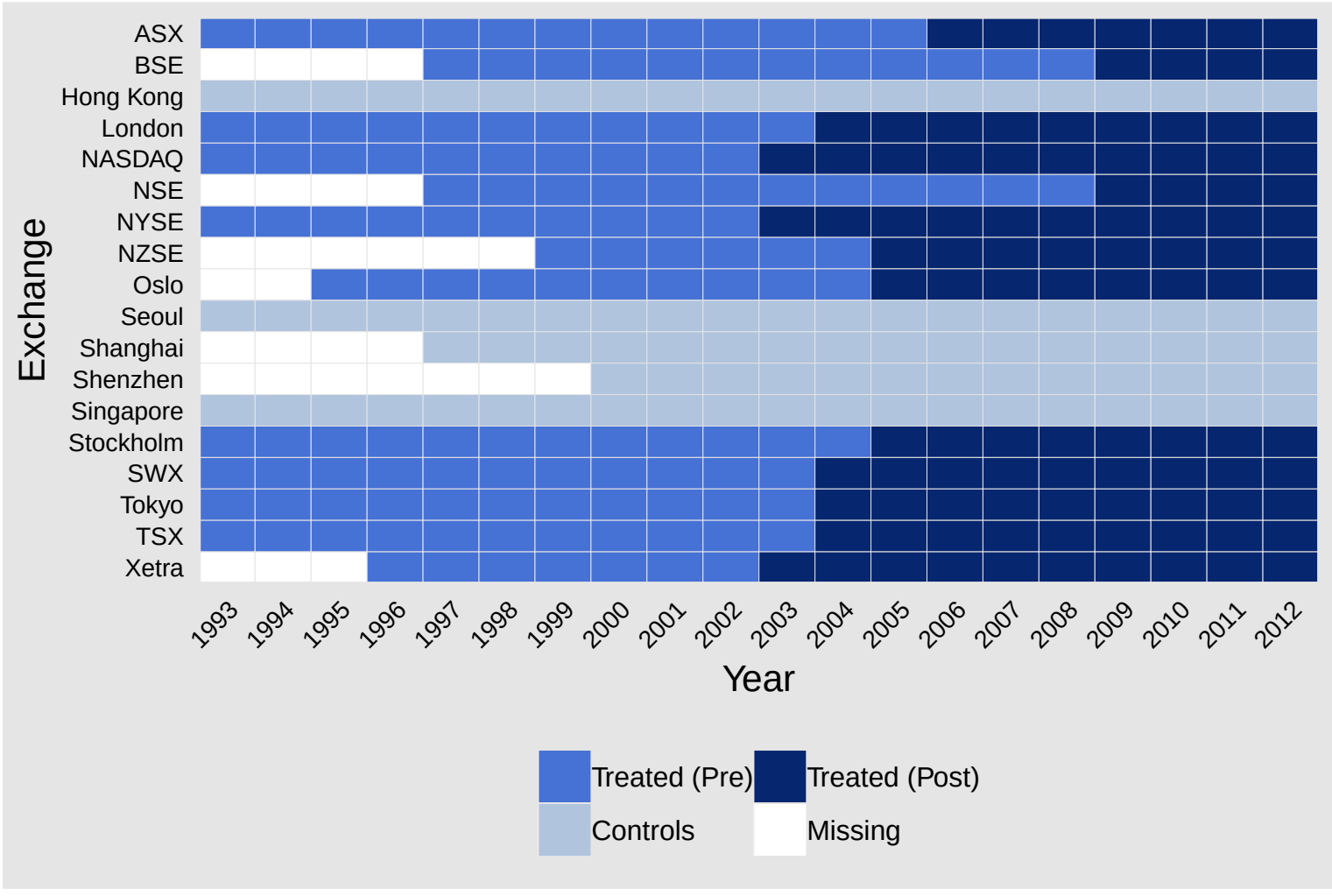
Estimation of HFT Presence

- No "official" start dates known
- Estimate presence based on the earlier of the indicators (see Aitken et al. 2015)
  - Large amount of order cancellations $\rightarrow$ increase in cancellation-to-trade ratios
  - High number of small orders with short holding period $\rightarrow$ drop in trade size
- Colocation as 'quasi-exogenous' shock?
  - HFT presence precedes colocation by on average 8 months
  - Colocation endogenous to demand by existing HFTs

Data

- International panel of 18 exchanges
- Compustat Global, Compustat NA, CRSP from 1995 to 2017
- HFT start dates and colocation offering: Aitken et al. 2015
- Thomson Reuters Global Ownership Data
- Federal Reserve Economic Data
- Exchange automation dates: Gorham and Singh 2009

Estimated Presence of HFT Participation



Discussion of Empirical Approach

- Source of variation: differential timing of HFT presence
- Reverse causality: self-selection into markets where they anticipate lower informativeness?
  - Presence starts in rather informative markets
  - HFT more active in large caps (Brogaard et al. 2014)
- Omitted variable: differentially-timed local factors prompting HFTs to start activities?
  - Analyze pre-trends
  - Investigate potential confounders

Informativeness Measure: Cash Flow Predictability

Bai, Philippon and Savov 2016: predicted variance of cash flows using market price as conditioning variable

$$\frac{E_{i,m,t+k}}{A_{i,m,t}} = a_{m,t,k} + b_{m,t,k} \log\left(\frac{M_{i,t}}{A_{i,t}}\right) + c_{m,t,k}\left(\frac{E_{i,t}}{A_{i,t}}\right) + d^{s}_{m,k} 1^{s}_{i,m,t} + \varepsilon_{i,m,t}$$

- where t denotes year, i firm, m is market, k is horizon with $k \in (1, ..., 5)$, E is EBITDA, M market value, A book value of assets, 1^s indicates first SIC digit.
- $\text{Priceinfo}^{CF}_{m,t,k} = \widehat{b}_{m,t,k} \times \sigma\left(log \frac{M_{m,t}}{A_{m,t}}\right)$

$\rightarrow$ Analogously for investment predictability: $\text{Priceinfo}^{I}_{m,t,k}$

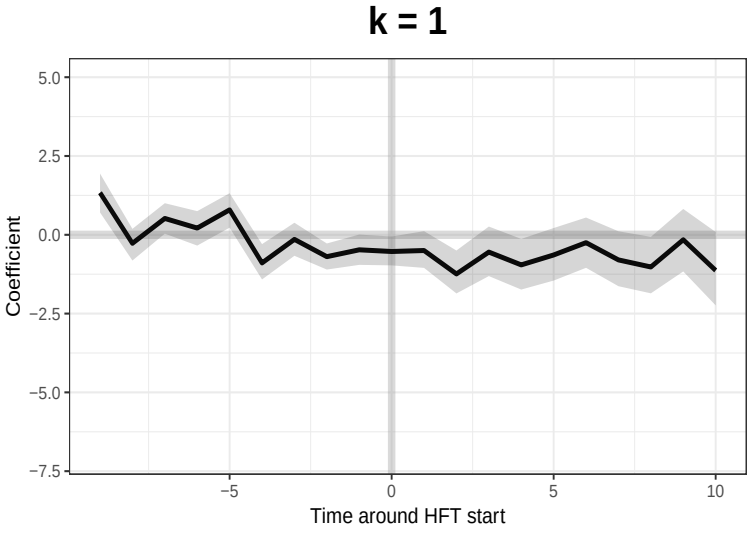
Summary Statistics: Informativeness Measures

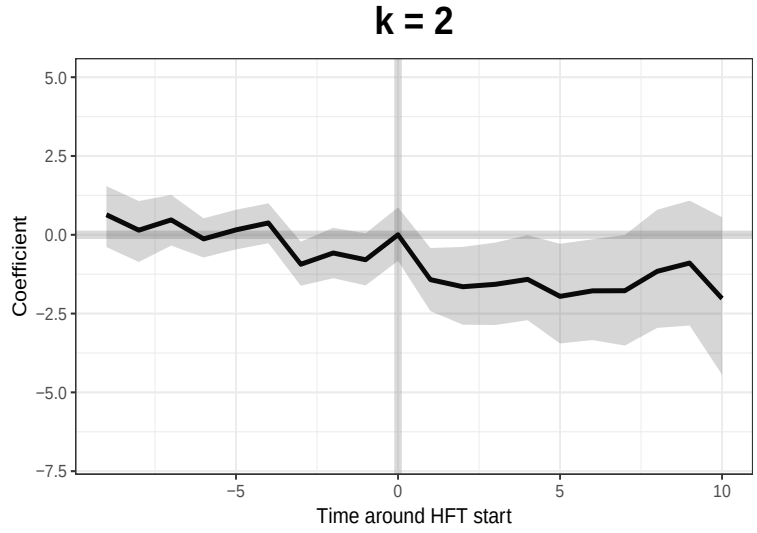
Variable	Lower 5%	Median	Mean	Upper 5%	S.D.
Priceinfo^{CF} (k=1)	-1.84	0.93	0.91	3.24	1.49
Priceinfo^{CF} (k=2)	-2.71	1.21	1.17	4.62	2.08
Priceinfo^{CF} (k=3)	-2.95	1.64	1.64	5.93	2.51
Priceinfo^{CF} (k=4)	-2.29	2.07	2.20	6.63	2.77
Priceinfo^{CF} (k=5)	-1.75	2.62	2.98	8.16	3.12
Priceinfo^{I} (k=1)	-0.12	0.83	0.99	3.05	1.01
Priceinfo^{I} (k=2)	-0.27	1.14	1.57	4.85	1.77
Priceinfo^{I} (k=3)	-0.67	1.41	1.71	5.45	1.90
Priceinfo^{I} (k=4)	-0.83	1.45	1.89	6.17	2.24
Priceinfo^{I} (k=5)	-0.70	1.77	2.12	6.84	2.40

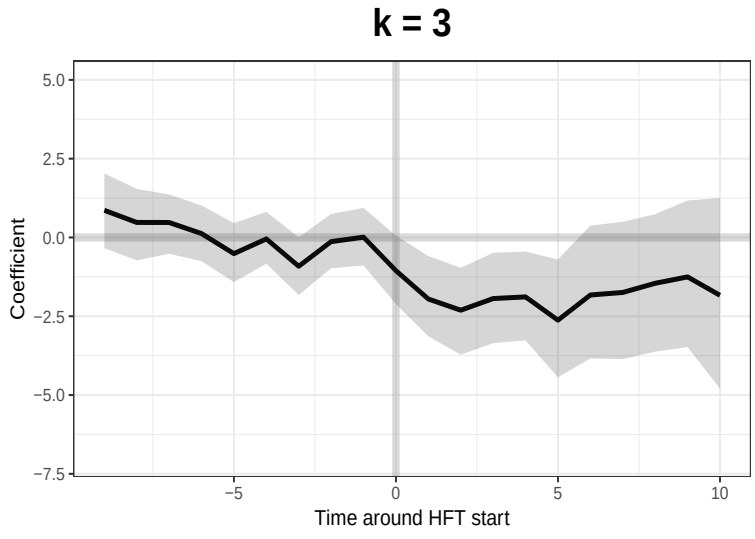
Predictability of Cash Flows I

Dep. var.: Priceinfo^{CF}	(1) k = 1	(2) k= 2	(3) k = 3	(4) k = 4	(5) k = 5
HFT	-0.348	-1.034***	-1.395**	-1.893***	-2.220***
	(0.306)	(0.341)	(0.543)	(0.425)	(0.595)
Electronic	0.478	1.178***	0.965*	-0.221	-0.058
	(0.309)	(0.383)	(0.532)	(0.516)	(0.729)
Log market size	-0.153	-0.348**	-0.551**	-0.572**	-0.529**
	(0.119)	(0.156)	(0.239)	(0.246)	(0.238)
Year FE	yes	yes	yes	yes	yes
Exchange FE	yes	yes	yes	yes	yes
Adjusted R2	0.273	0.456	0.406	0.411	0.339
Obs	330	325	324	322	304

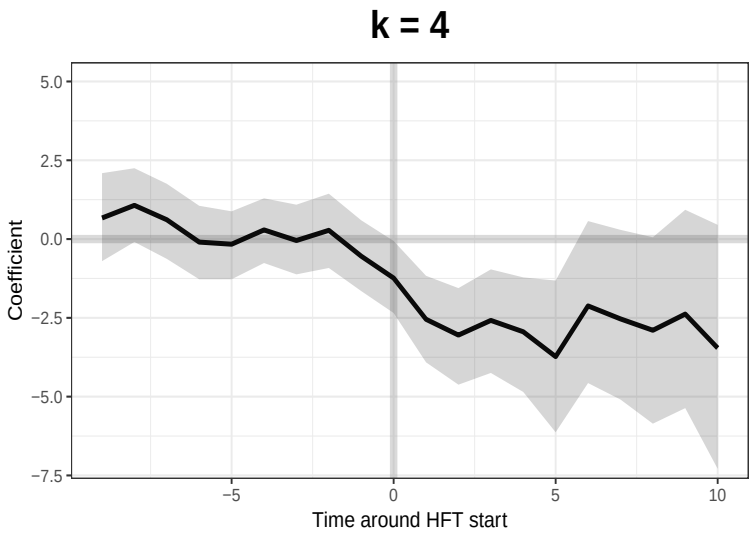
Predictability of Cash Flows II

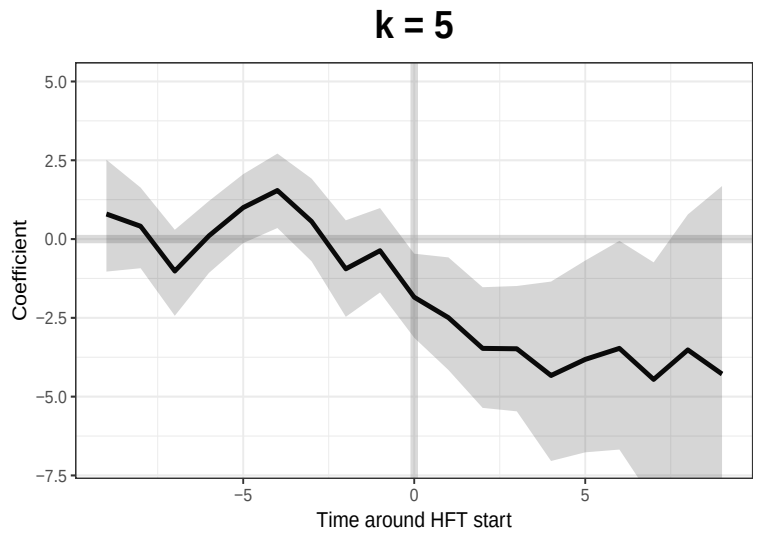






Predictability of Cash Flows III

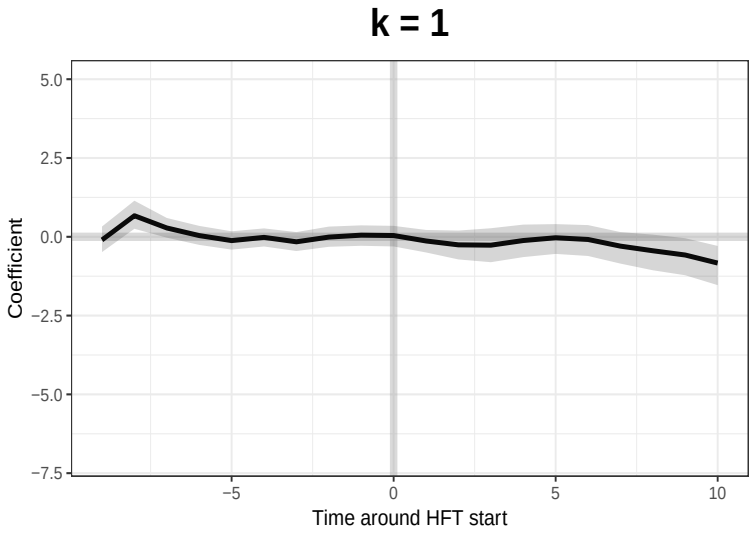


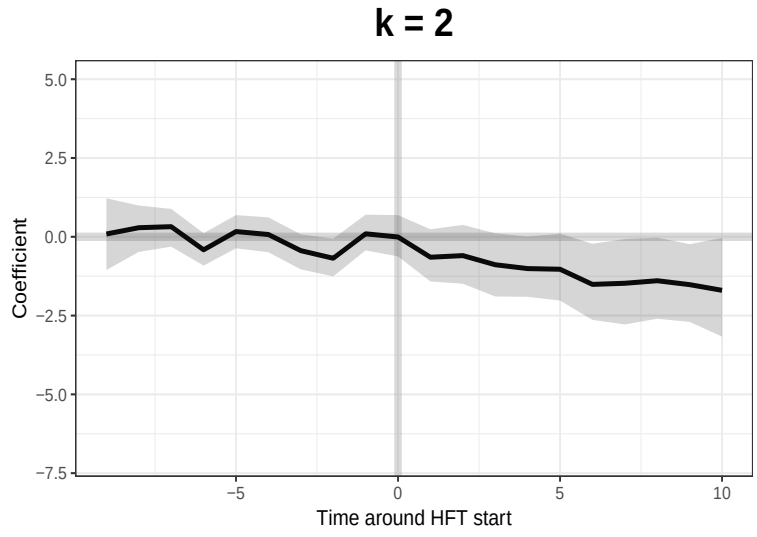


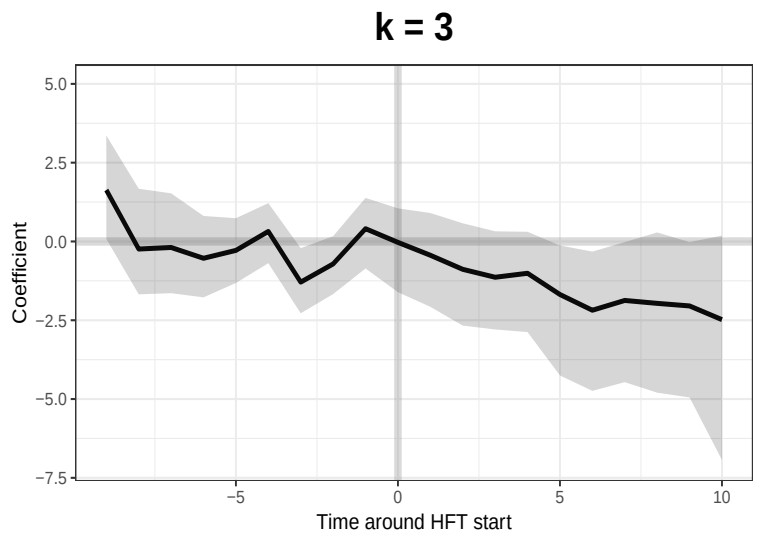
Predictability of Investment I

Dep. var.: Priceinfo^{I}	(1) k = 1	(2) k= 2	(3) k = 3	(4) k = 4	(5) k = 5
HFT	-0.277**	-0.754***	-0.887***	-1.143***	-1.475***
	(0.114)	(0.193)	(0.303)	(0.380)	(0.366)
Electronic	-0.223	0.521	0.227	0.351	0.469
	(0.256)	(0.576)	(0.549)	(0.663)	(0.748)
Log market size	0.222*	0.180	0.212	0.300	0.159
	(0.111)	(0.163)	(0.132)	(0.182)	(0.280)
Year FE	yes	yes	yes	yes	yes
Exchange FE	yes	yes	yes	yes	yes
Adjusted R2	0.492	0.527	0.410	0.337	0.381
Obs	326	321	320	319	301

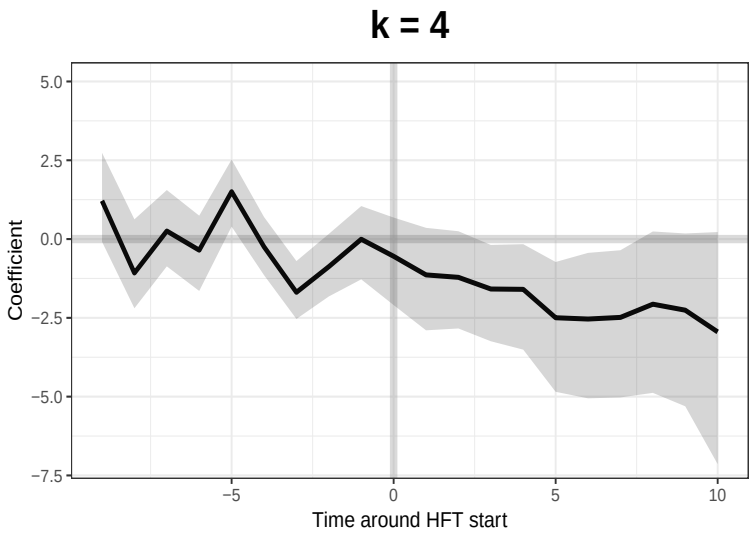
Predictability of Investment II

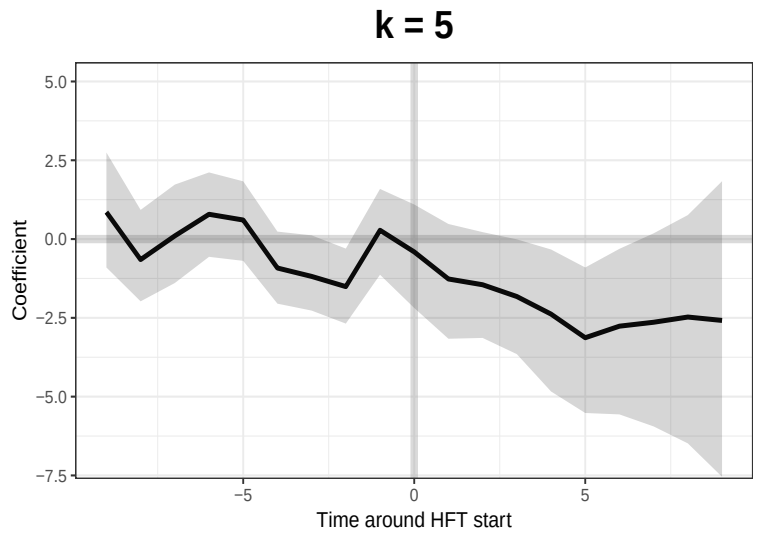






Predictability of Investment III





ETF Trading

- Large increase in ETF over the sample period
- Addressing potential confounder
  - ETF primarily US phenomenon. Do results hold if we exclude US?
  - Control for ETF trading volume in respective market

Excluding US Markets

	(1) k = 1	(2) k= 2	(3) k = 3	(4) k = 4	(5) k = 5
Panel A: Dep. var. Priceinfo^{CF}					
HFT	-0.283	-0.950**	-1.403**	-2.104***	-2.560***
	(0.362)	(0.406)	(0.635)	(0.488)	(0.609)
Panel B: Dep. var. Priceinfo^{I}					
HFT	-0.168	-0.613***	-0.532**	-0.812**	-1.153***
	(0.109)	(0.179)	(0.198)	(0.367)	(0.347)
Controls	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
Exchange FE	yes	yes	yes	yes	yes

Control for ETF Trading

	(1) k = 1	(2) k= 2	(3) k = 3	(4) k = 4	(5) k = 5
Panel A: Dep. var.	$Priceinfo^{CF}$				
HFT	-0.335	-0.948**	-1.280**	-1.674***	-1.796**
	(0.324)	(0.351)	(0.571)	(0.486)	(0.637)
Log ETF volume	-0.007	-0.043	-0.056	-0.106	-0.179*
	(0.031)	(0.030)	(0.045)	(0.071)	(0.100)
Panel B: Dep. var.	$Priceinfo^{I}$				
HFT	-0.309**	-0.776***	-0.906**	-1.067**	-1.374***
	(0.123)	(0.210)	(0.322)	(0.410)	(0.401)
Log ETF volume	0.016	0.011	0.009	-0.036	-0.042
	(0.012)	(0.026)	(0.037)	(0.051)	(0.053)
Controls	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
Exchange FE	yes	yes	yes	yes	yes

Changes in Market Composition

Dep. var.:	Log size	Age	SD earnings
HFT	-0.233	-0.057	0.005
	(0.136)	(0.054)	(0.006)
Electronic	0.377***	-0.006	-0.025***
	(0.080)	(0.042)	(0.005)
Log market size	0.254***	0.097***	-0.006***
	(0.033)	(0.016)	(0.002)
Year FE	yes	yes	yes
Exchange FE	yes	yes	yes
Adjusted R2	0.925	0.850	0.857
Obs	330	330	330

Cross-Sectional Tests I

Dep. var.: Priceinfo^{CF}	(1) k = 1	(2) k= 2	(3) k = 3	(4) k = 4	(5) k = 5
Panel A: firm size					
HFT × large	-0.865***	-1.674***	-2.230***	-2.461***	-2.663***
	(0.233)	(0.412)	(0.645)	(0.657)	(0.698)
HFT × small	-0.422	-0.999*	-0.842	-1.790**	-1.974*
	(0.435)	(0.504)	(0.733)	(0.774)	(1.023)
Difference	-0.411	-0.731	-1.321*	-0.872	-0.706
	(0.358)	(0.554)	(0.738)	(1.126)	(0.787)

Cross-Sectional Tests II

Dep. var.: Priceinfo^{CF}	(1) k = 1	(2) k= 2	(3) k = 3	(4) k = 4	(5) k = 5
Panel B: firm age					
HFT × old	-0.510*	-1.309***	-1.383***	-1.216**	-1.311
	(0.251)	(0.373)	(0.471)	(0.542)	(0.899)
HFT × young	-0.518	-1.127**	-1.676**	-2.650***	-2.969***
	(0.405)	(0.403)	(0.587)	(0.467)	(0.755)
Difference	0.063	-0.229	0.420	1.570***	1.915**
	(0.425)	(0.466)	(0.401)	(0.498)	(0.908)
Panel C: Tobin's Q					
HFT × high Q	-0.865***	-1.673***	-2.229***	-2.459***	-2.661***
	(0.233)	(0.412)	(0.645)	(0.658)	(0.698)
HFT × low Q	-0.422	-1.000*	-0.843	-1.792**	-1.976*
	(0.435)	(0.504)	(0.733)	(0.774)	(1.023)
Difference	-0.410	-0.729	-1.318*	-0.868	-0.702
	(0.358)	(0.554)	(0.739)	(1.127)	(0.787)

Further Robustness Checks

Test	Result
Colocation as alternative start	✓
Only order cancellation-based start	✓
Only trade size-based start	✓
Differential exposure to market crises	✓
Weighted by number of observations per market-year	✓
Exclude periods without electronic trading	✓
Betas as outcome variables	✓
(Log) linear time exchange-specific time trends	✓
Placebo test with random start dates	✓
Collapse pre and post periods	✓
Different SE clusters	✓
(...)	

Firm-Level Results

Dep. var.:	(1) Ivol	(2) Spread
HFT	-0.234***	-0.163***
	(0.018)	(0.026)
Controls	yes	yes
Year FE	yes	yes
Firm FE	yes	yes
Adjusted R2	0.739	0.670
Obs	157,469	157,469

Information Acquisition by Funds: Measures

Market-specific measures of mutual fund activeness (based on Doshi, Elkamhi and Simutin's 2015 fund-specific measure)

$$\text{Active weight}_{m,t} = \frac{1}{2}\sum_{j=1}^{J}|w_{i,t}^{j} - w_{i,t}^{m}|\frac{AUM_j}{AUM_m}, \tag{2}$$

$$\text{Active trade}_{m,t} = \frac{1}{2}\sum_{j=1}^{J}|(w_{i,t}^{j} - w_{i,t}^{m}) - (w_{i,t-1}^{j} - w_{i,t-1}^{m})|\frac{AUM_j}{AUM_m}, \tag{3}$$

where w is the individual security portfolio weight, i indicates the stock, and t the year, j refers to the fund, and m to the market.

Fund Holdings and Trades

Dep. var.:	(1) Active weight	(2) Active trade
HFT	-0.039*	-0.027***
	(0.019)	(0.007)
Electronic	0.047***	0.003
	(0.015)	(0.007)
Log market size	0.031***	0.018***
	(0.008)	(0.004)
Year FE	yes	yes
Exchange FE	yes	yes
Adjusted R2	0.526	0.524
Obs	287	269

Conclusion

- Market prices are a poorer predictor of future cash flows and investment in the presence of HFT
  $\rightarrow$ Suggests detrimental effect on information acquisition
- Empirical support for tension between incorporation of *existing* information and incentives to acquire *new* information
- Aggregate effects of HFT on welfare require weighing
  - detrimental effects on information acquisition
  - beneficial effects for liquidity/risk sharing

Thanks for your attention!