The Impact of HFT and Market Structures on liquidity, price efficiency/discovery, and transaction costs: Some Updates

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The Future of Computer Trading in Financial Markets
(FMG/SRC)

Outline

1. Our project's conclusion
2. Updates on
    1. Market structure and regulation
    2. Performance
3. Update for US and UK stock markets on
    1. Liquidity,
    2. Volatility
    3. Market Efficiency

Our Project's Conclusions

1. A lot of negative articles and comments about HFT. Despite this, the best evidence we have today suggests that CBT in general and HFT in particular have several beneficial effects on average market quality
    1. They have contributed to improvements in the Liquidity of markets as measured by spreads and other metrics
    2. They have contributed to improvements in Transaction costs both for retail investors and for institutional investors mostly due to changes in market structure which are related to the developments of HFT
    3. They have contributed to improvements in Market efficiency by impacting new information into prices faster and by linking fragmented market places together thereby enabling competition

1. However, while liquidity has improved overall, there appears to be the potential for increased periodic illiquidity or liquidity crises such as the US flash crash of May 6th 2010 and various other events since then
2. This can arise through feedback loops generated within the computerized trading process itself that once started can amplify over time even within well intention management and control processes

Updates on Market Structure and Regulation

- MiFID1 (2007) encouraged competition. Our report (2012) emphasized the benefits of competition by speed for liquidity providers.
- Michael Lewis's 2014 Flash boys. IEX exchange (nixed price/time priority) and speed bumps. Budish, Cramton and Shim (QJE, 2015) and recent FCA paper. Dynamic batch auctions and latency arbitrage.
- Oxera (2020) report on European equity markets found an increase in trading at closing auction and new periodic auctions.
- MiFID2 (2018) emphasized transparency and tick size regimes.
- Bitcoin and Blockchain (T+ϵ clearing).

Updates on Performance

This was the ranking of world stock exchanges presented in 2012

Rank	Exchange 1999	tr $	Exchange 2010	tr $
1	NYSE	11.44	NYSE Euronext (US)	13.39
2	Nasdaq	5.20	NASDAQ OMX	3.89
3	Tokyo	4.46	Tokyo SE Group	3.83
4	London	2.86	London SE Group	3.61
5	Paris	1.50	NYSE Euronext (Europe)	2.93
6	Deutsche Börse	1.43	Shanghai SE	2.72
7	Toronto	0.79	Hong Kong SE	2.71
8	Italy	0.73	TSX Group	2.17
9	Amsterdam	0.70	Bombay SE	1.63
10	Switzerland	0.69	National SE India	1.60
10=			BM&FBOVESPA	1.55

Rank	Exchange 2022	tr $
1	NYSE	22.1
2	NASDAQ	17.2
3	Shanghai SE	5.98
4	Euronext	5.52
5	Japan Exchange Group	4.91
6	Shenzhen SE	4.23
7	Bombay SE	3.5
8	Hong Kong SE	3.36
9	National SE India	3.34
10	Tawadil (Saudi Arabia)	2.86
10=	London SE	2.82

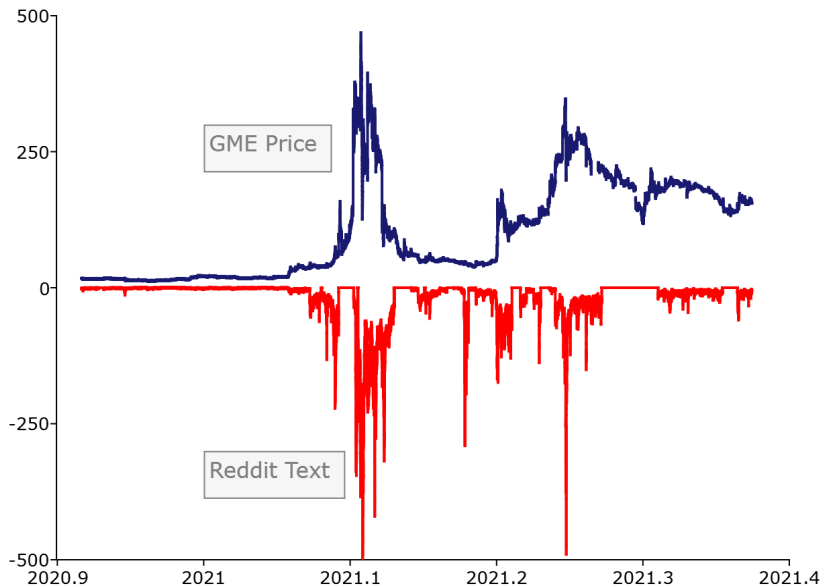
Cui Bono

One question we addressed was about the (claimed excess) profitability of HFT

Virtu (NASDAQ Listed HFT active worldwide) and LSE/LSEG stock price.

- Normalization of Deviance. Flash crash was caused by what?
  - SEC/CFTC version of events.
  - Nanex version of events
  - Hound of Hounslow version of events
- Other flash crashes: in Treasury's, in FX, commodities, Hash crash (2013). Order imbalances and man?pulat?ons.
- Gamestop/Reddit/Robinhood texting (January 2021). Man bites dog story.

Game Stop corporation price level



Price and Reddit Texts one minute data

Stock Market Liquidity

- "Liquidity is a fundamental property of a well-functioning market, and lack of liquidity is generally at the heart of many financial crises and disasters". The ability to buy and sell quickly at a good price. Kyle (1985), O'Hara (1995), Hasbrouck (2006). On limit order book (LOB) markets, this is about: trading costs, price impact, depth, resiliency.
- Common ways of measuring financial market liquidity using high frequency trade and LOB quote data include:
  - quoted bid-ask spreads, effective spreads, realized spreads,
  - quoted depth and weighted depth,
  - transaction volume

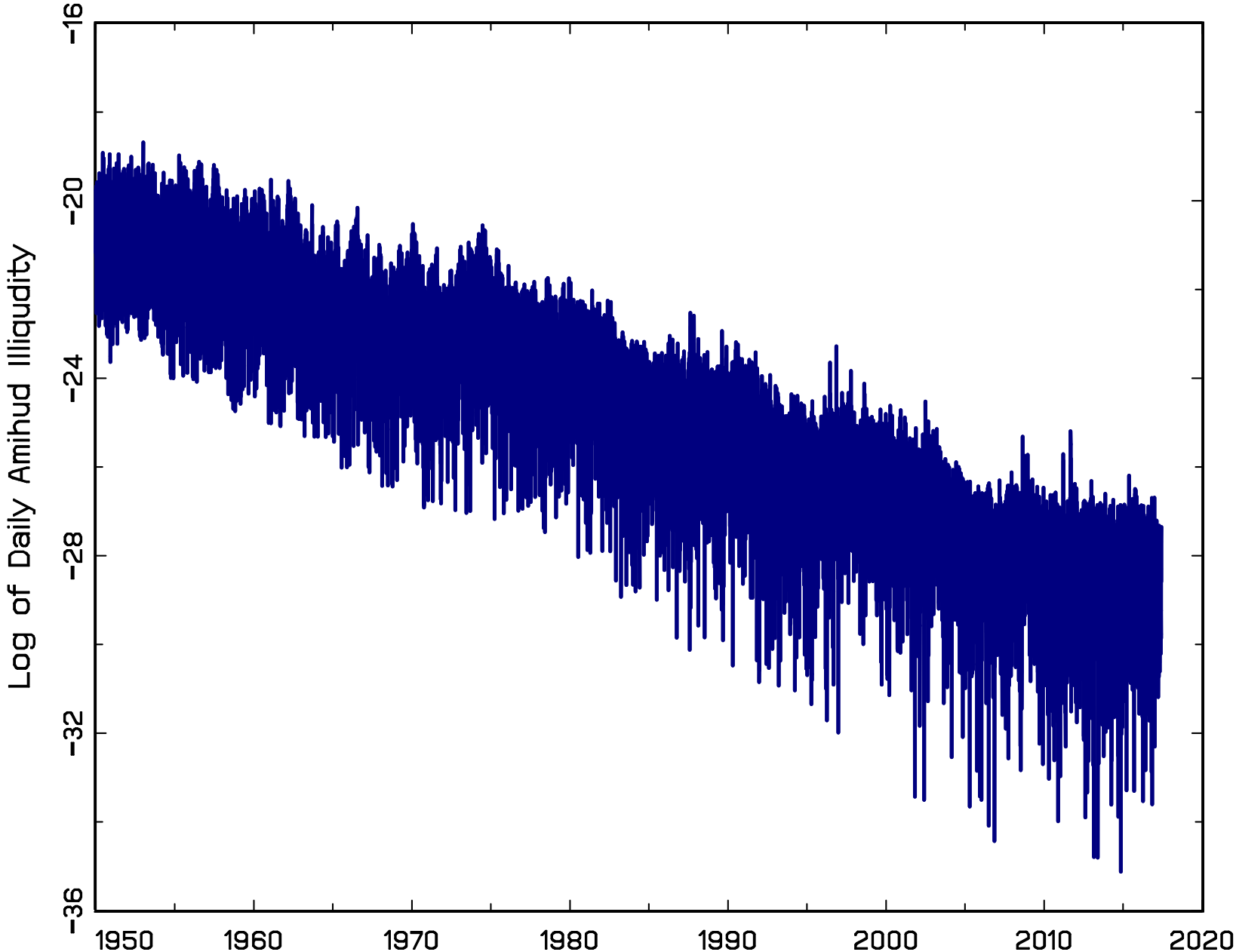
- There is a big literature that uses such measures to compare market quality metrics across markets, across time, and before and after interventions of various sorts using panel regression with liquidity as a dependent variable
  - For example, it has been a big part of the debate around **High Frequency Trading**, i.e., whether such trading activity has improved or degraded market liquidity in **normal times** and in **stressed times** (flash crash): Brogaard (2010), Hendershott, Jones, and Menkveld (2011), O'Hara and Ye (2011), see Foresight (2012), Linton, O'Hara, and Zigrand (2014), Linton and Mahmoodzadeh (2018) for surveys.
  - For example, the effect of UK corporate bond QE on market quality. Boneva, Elliott, Kaminska, Linton, Morley, and McLaren (2019), *Economics Journal* forthcoming

Low Frequency Behavior of Liquidity

- Angel, Harris and Spatt (2010), Jones (2010) argued that the costs of trading and other dimensions of stock market liquidity have improved consistently since 1900 by a factor of five.
- Oxera 2020 report on European equity markets.
  - Brokers fees fell between 2009 and 2019
  - Bid ask spreads fell across EU from 23.3bp to 7.1bp over 2009-2019
  - Implementation shortfall, likewise improved
- Is this rosie trend continuing? We present the Amihud (2002) daily illiquidity measure

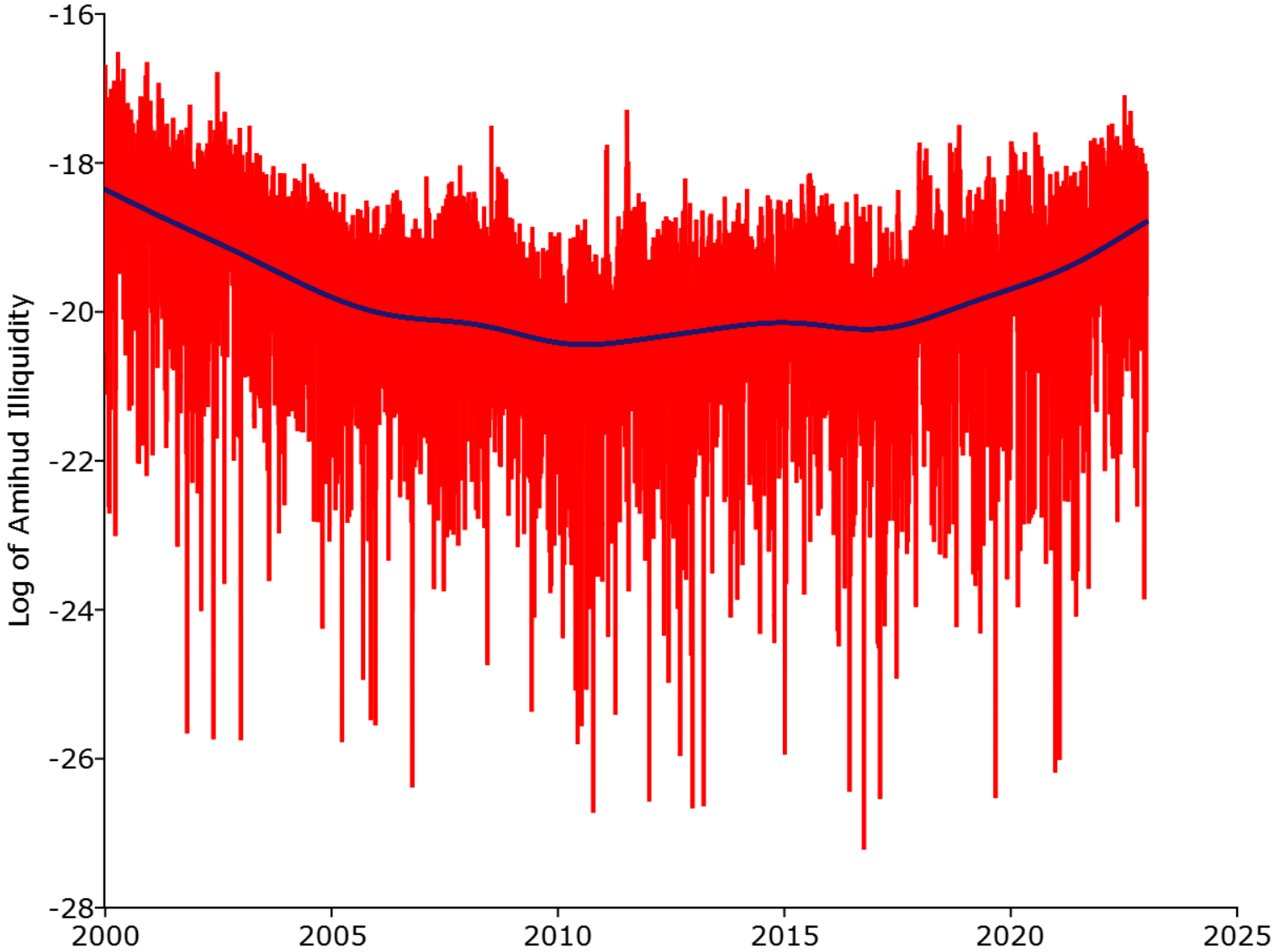
$$\ell_t = \frac{|R_t|}{V_t} \text{ or } \ell_t = \frac{HLvol_t}{V_t} \quad := \frac{\partial Price}{\partial Quantity}$$

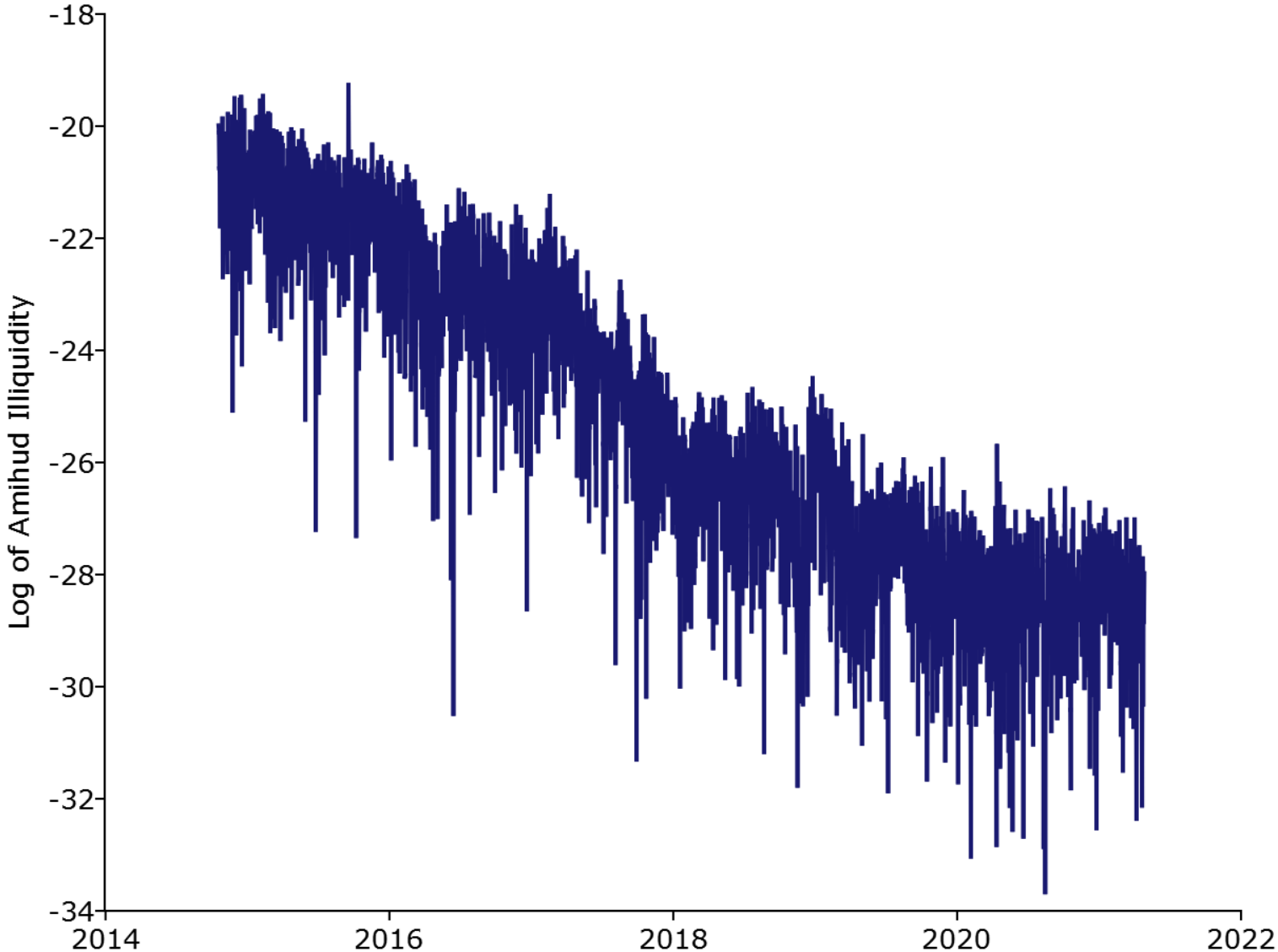
Amihud found that the monthly average of this is a "priced factor" in cross section of stocks



Daily Amihud illiquidity on S&P500

Updated log of S&P500 liquidity with trend




-18
-20
-22
-24
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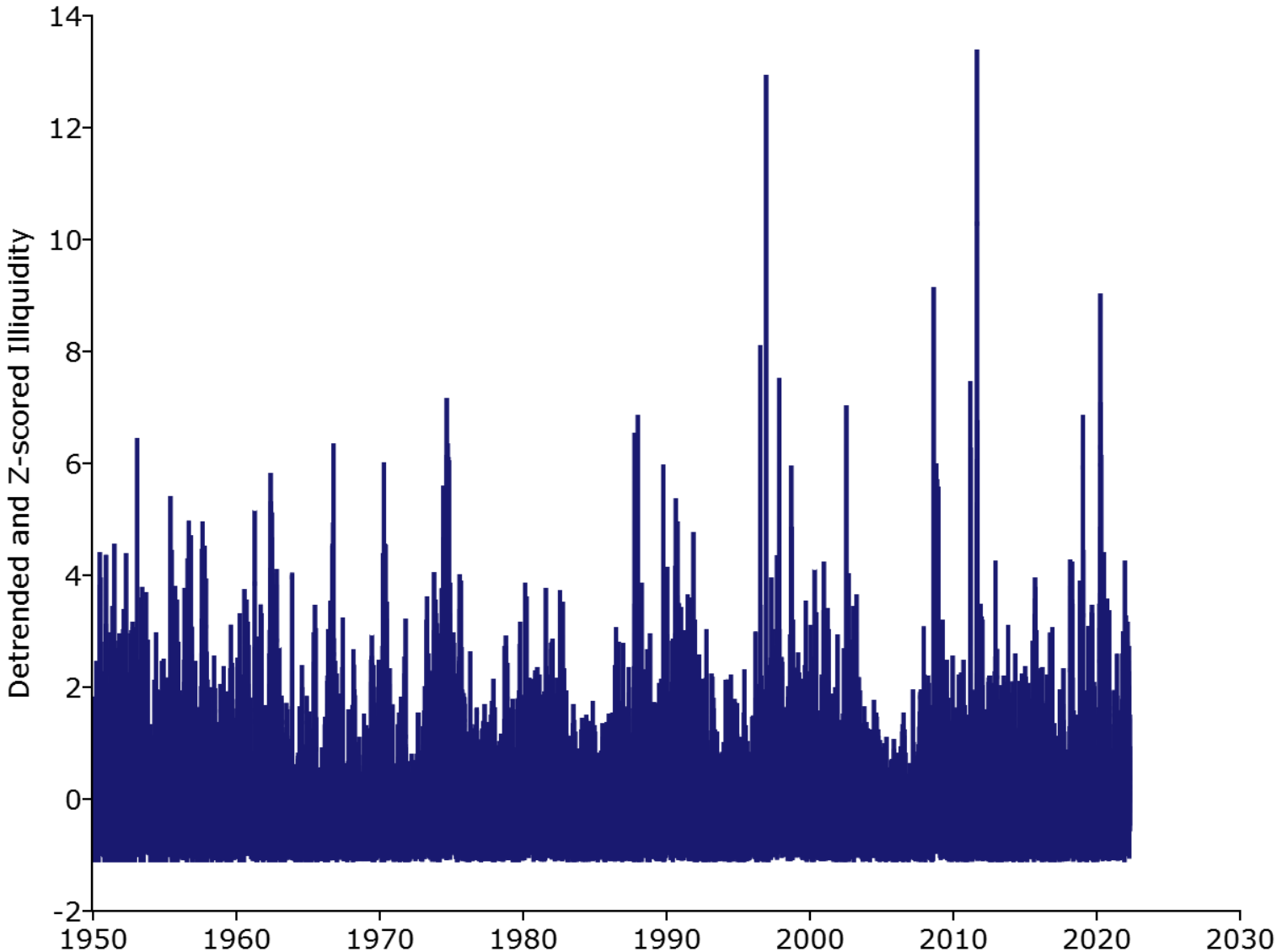
-34
Log of Amihud Illiquidity
2014
2016
2018
2020
2022

Bitcoin

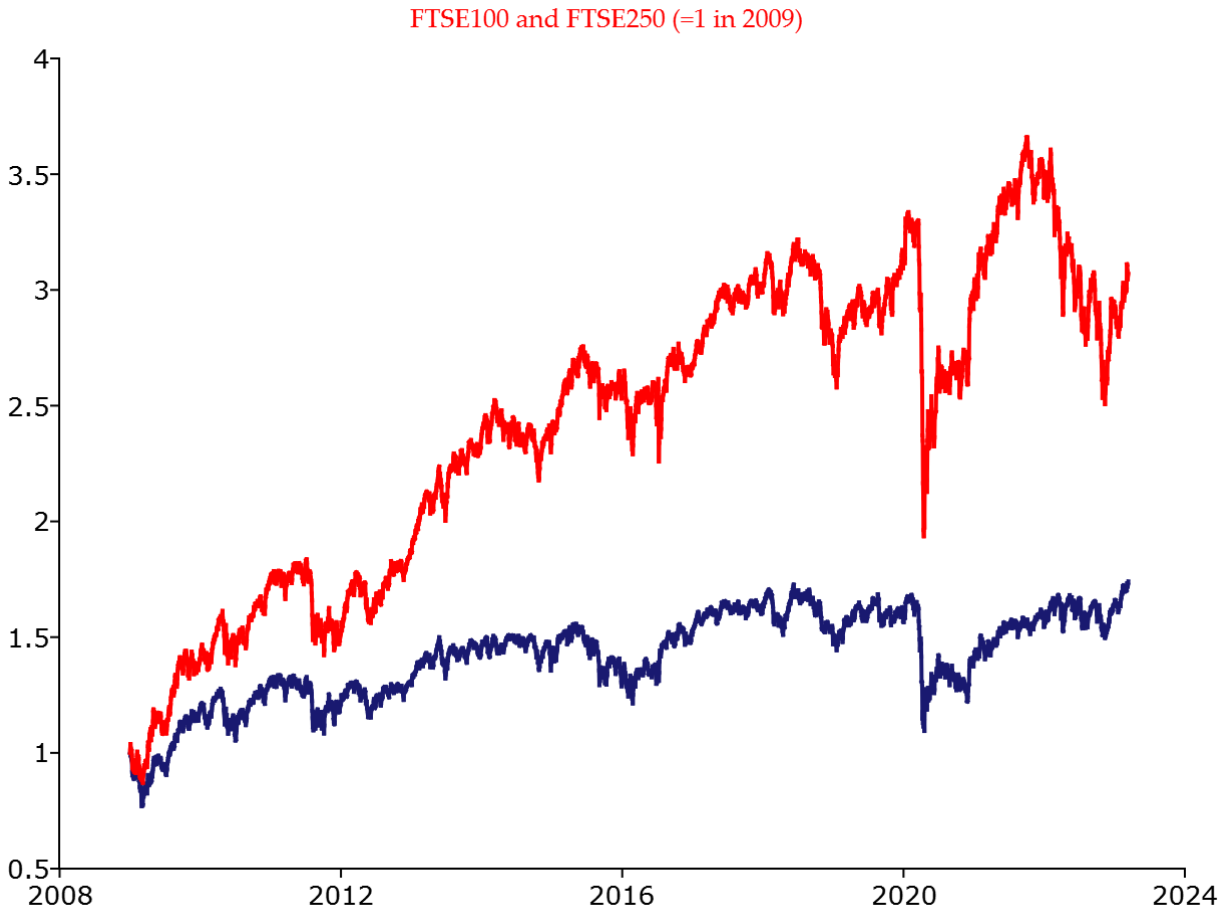
What about large illiquidity events?



Detrended S&P500 Liquidity

Comparison of FTSE100 and FTSE250 over 2009-2023

I assumed FTSE250 had low HFT penetration in 2010 and used as a control group. Not perhaps accurate now.



Predictability aka Market Efficiency

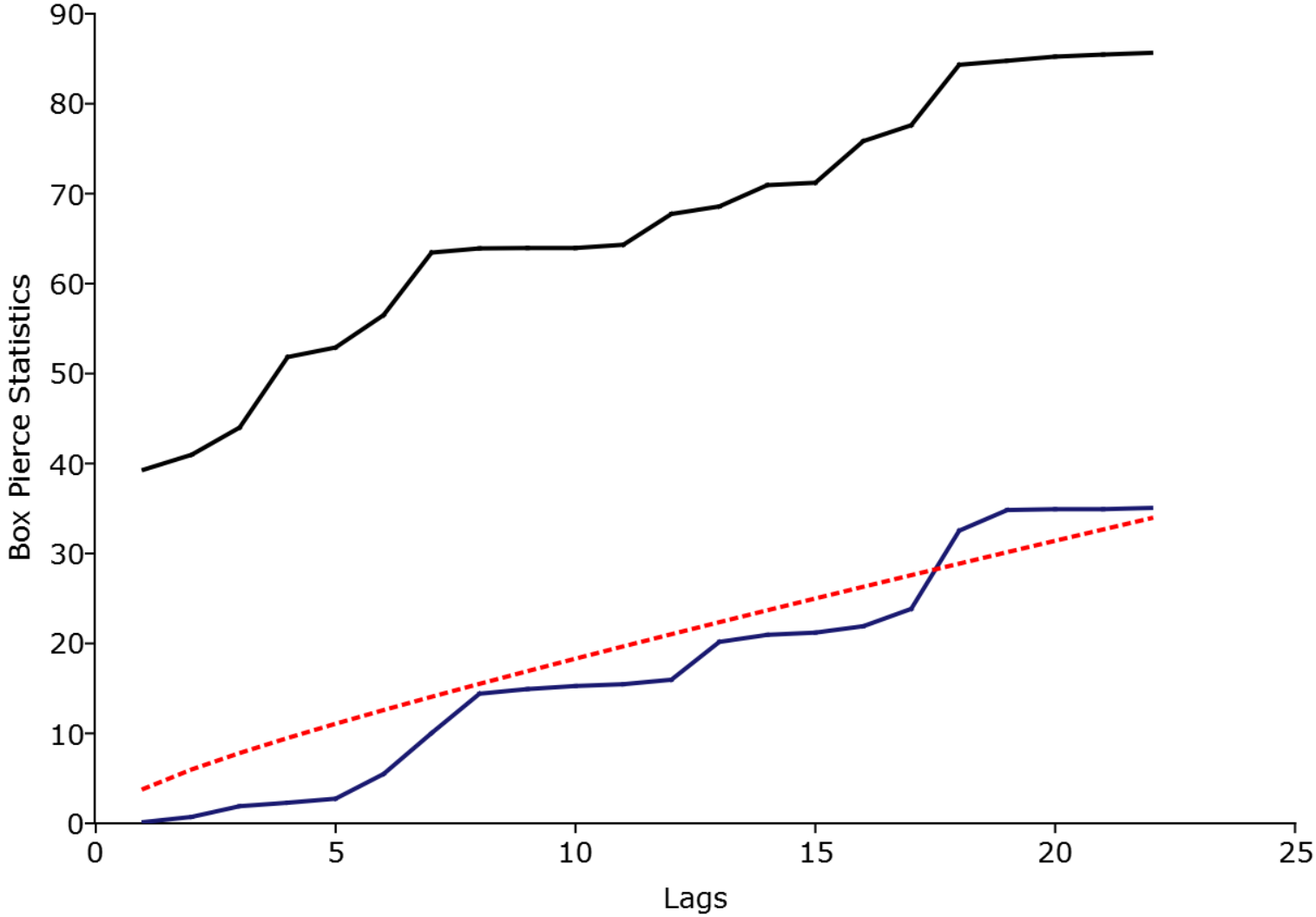
Global Measure $\widehat{\rho}_j$ sample autocorrelations with all daily returns data

$$BP_k = T \sum_{j=1}^{k} \widehat{\rho}_j^2, \quad k = 1, \ldots, 22$$

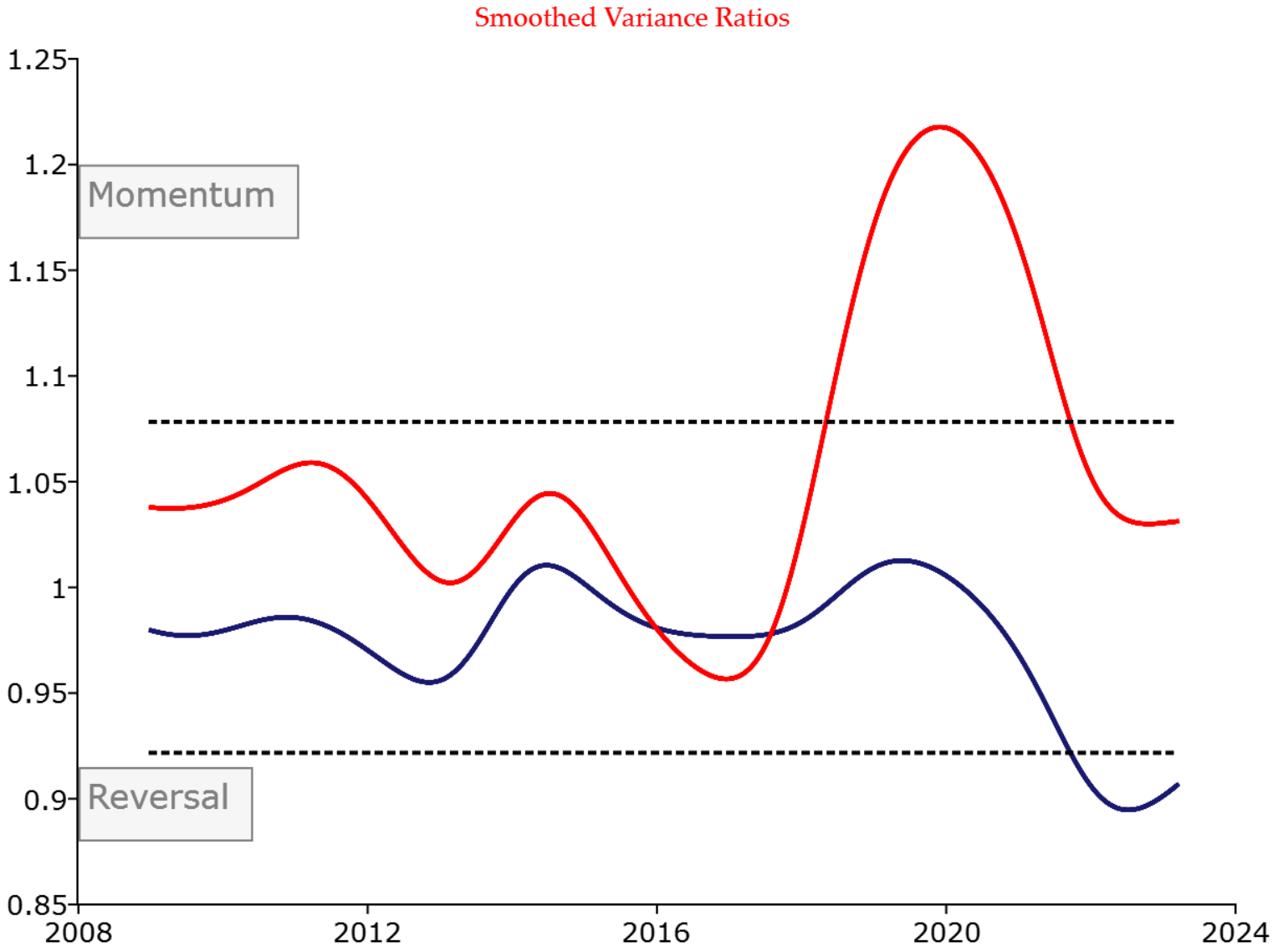
Local (in time) Measure

$$VR_5(u) = 1 + \sum_{j=1}^{5} \left(1 - \frac{j}{5}\right) \widehat{\rho}_j(u), \quad 2009 \leq u \leq 2023$$

Kernel smoothing in time to get local autocorrelations $\widehat{\rho}_j(u)$. Under market efficiency $\rho = 0$ and $VR = 1$.



Predictability of daily Stock Returns by global Box-Pierce statistic: Blue is FTSE100 and Black is FTSE250, red is critical value line



Time varying predictability measured by trend of time varying 5day:1day variance ratios: blue is FTSE100 and red is FTSE250; compare with Castura et al. (2010) paper we cited

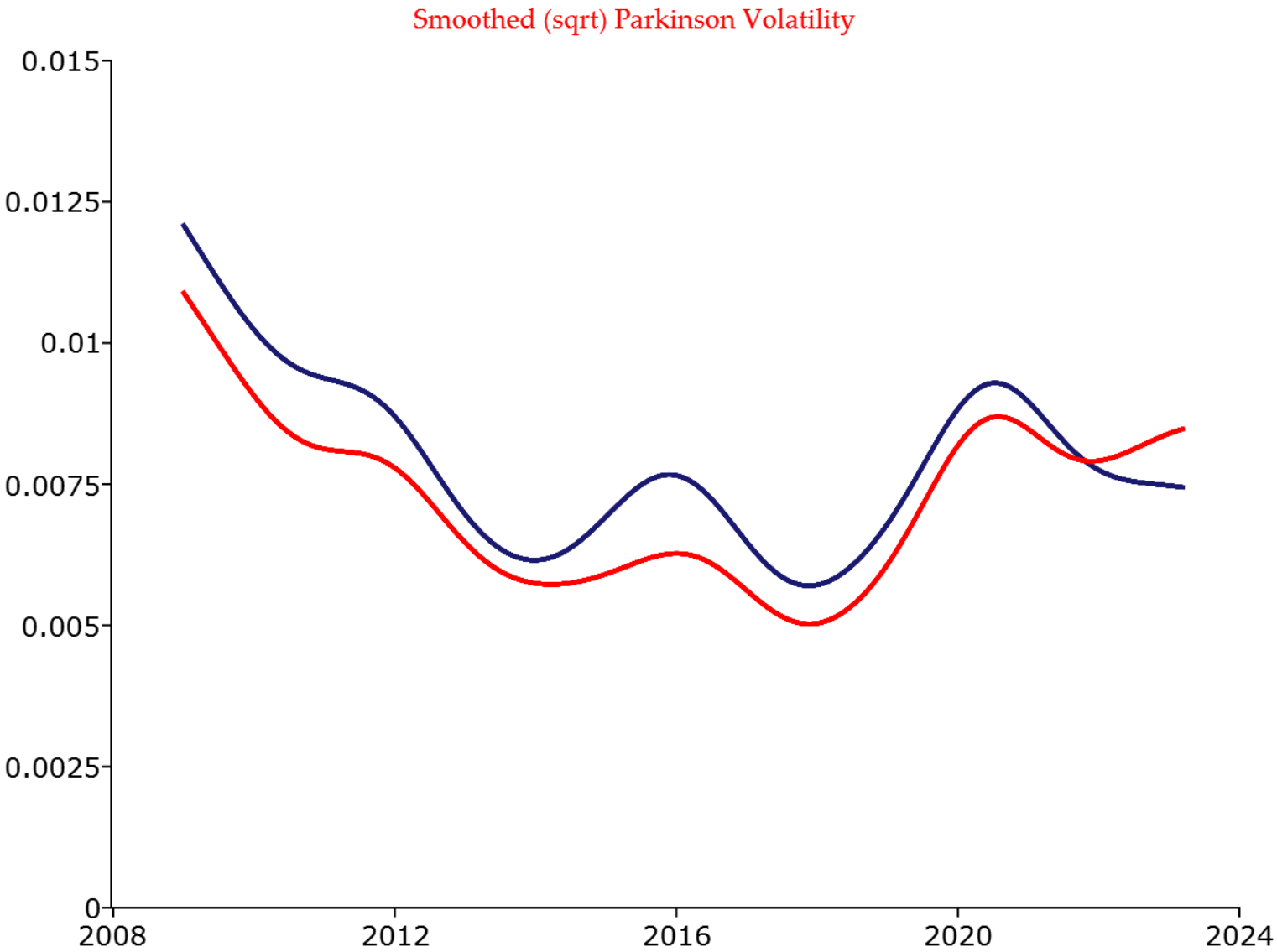
Volatility

- Overnight/Intraday volatility. Linton and Wu (2020) compared overnight and intraday volatility for the Dow stocks from 1990-2017 through a time series model.
  - If (HF) trading increases volatility should expect intraday vol to increase relatively (provides a diff in diff type natural experiment)
    - ⋆ Found that ratio increased rather than decreased, perhaps because of globalization of Dow stocks earnings over that period.
- We show daily intraday volatility measure on UK stock indexes from 2009-2023 (square root of Parkinson)

$$\mathcal{P}_t = \frac{\ln P_H(t) - \ln P_L(t)}{\sqrt{4 \ln 2}}.$$

Smoothed against time to show the trend

Volatility has recovered from the highs of 2008



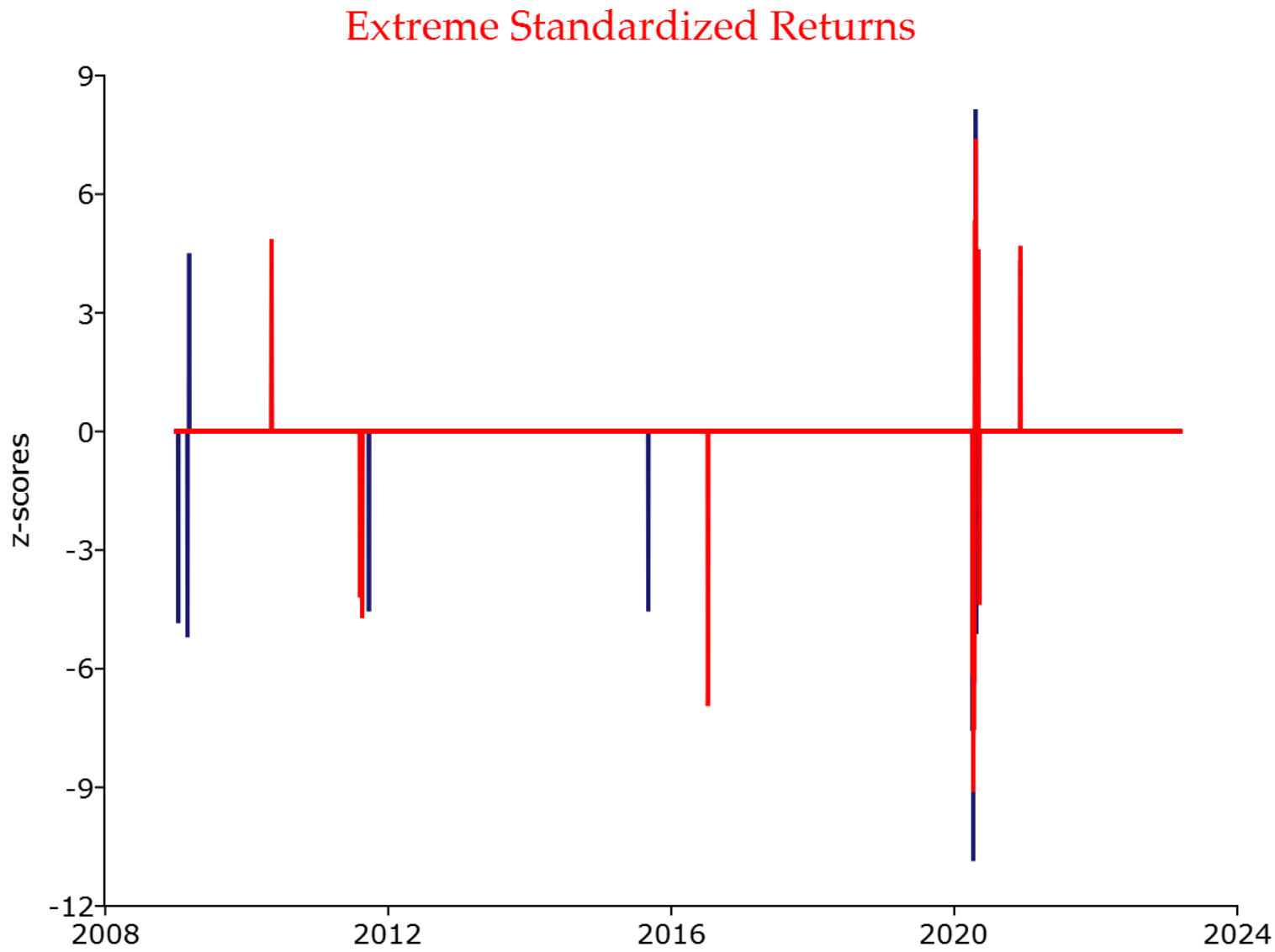
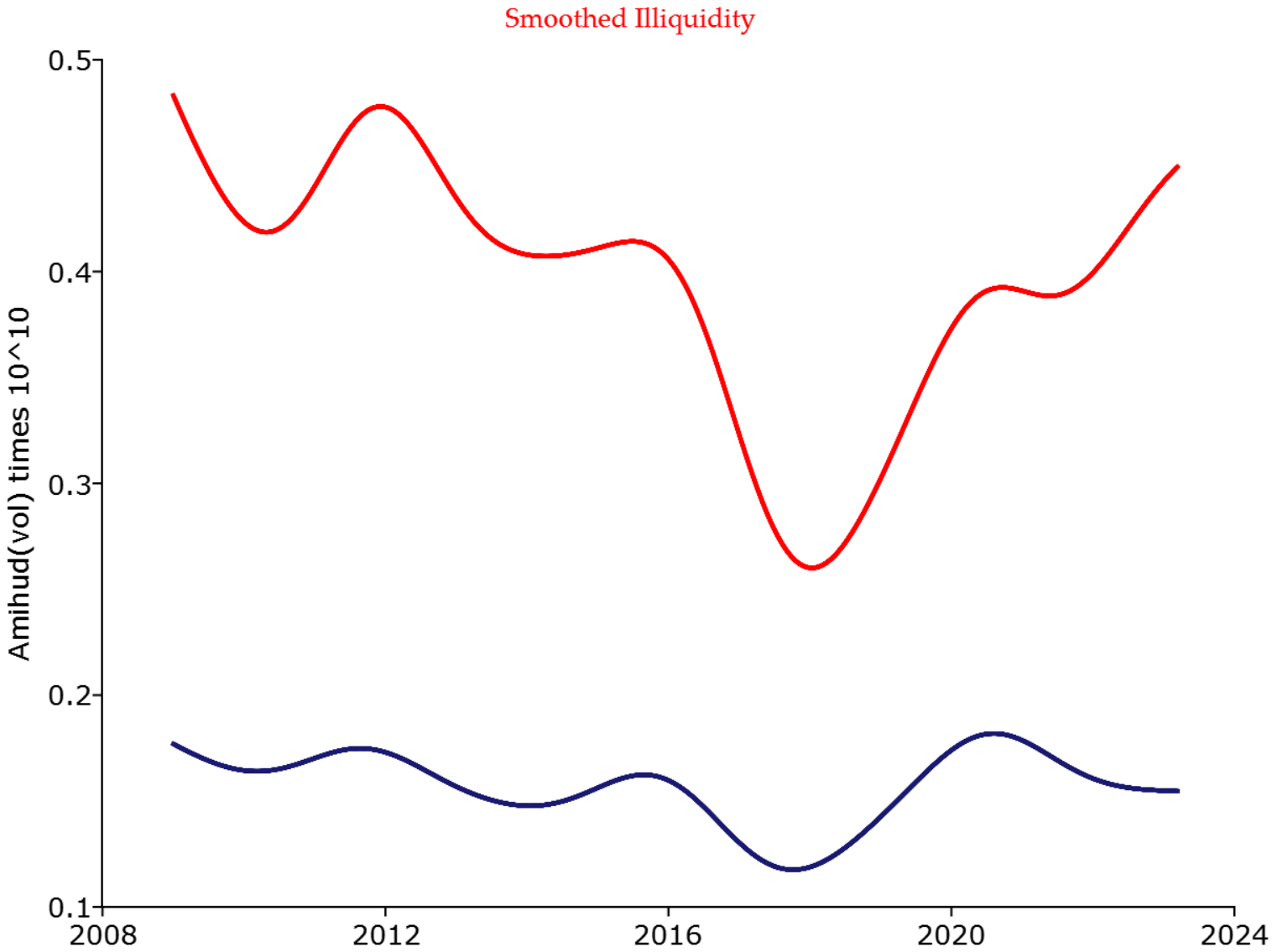


Figure: Extreme movements on FTSE100 and FTSE250, >4sigma

Liquidity

The long run trends in Amihud illiquidity for FTSE's



- Clearly the FTSE100 is more liquid according to this metric.
- The variability of the trend of FTSE250 is also greater than that of FTSE100
- They do seem to move together in the same direction until 2020 when they part company
- We estimate some short run dynamics reative to trend. The F-tests for Granger causality are $F100 = 7.8493029$ and $F250 = 104.86149.$ Both are strongly significant indicating that there is two directional feedback between FTSE100 and FTSE250 liquidity. There appears to be stronger feedback from FTSE100 to FTSE250 rather than the other direction.
- We next show the largest illiquidity days (relative to trend) for the two indices

	FTSE100				FTSE250		
Rank	Date	Day of Week	z-score	Rank	Date	Day of Week	z-score
1	20090105	M	7.4884	1	20090105	M	9.1511
2	20101229	W	6.4329	2	20101222	W	8.6601
3	20181224	M	5.2473	3	20200320	F	5.5392
4	20200320	F	5.2078	4	20181220	Th	5.4722
5	20200310	T	4.9079	5	20181224	M	5.4240
6	20111221	W	4.8918	6	20160623	Th	5.2854
7	20110901	Th	4.4308	7	20110816	T	5.1010
8	20151221	M	4.4114	8	20111221	W	4.9758
9	20201229	T	4.3648	9	20160622	W	4.7755
10	20190930	M	4.2791	10	20200310	T	4.7656
11	20130702	T	4.0661	11	20160616	Th	4.6799
12	20200514	Th	4.0447	12	20200402	Th	4.6249
13	20171227	W	3.9281	13	20160707	Th	4.5350
14	20141224	W	3.8910	14	20150820	Th	4.2919
15	20200903	Th	3.8740	15	20200409	Th	4.2329

- News-Implied Linkages and Local Dependency in the Equity Market (with S. Ge and S. Li) *Journal of Econometrics.* https://doi.org/10.1016/j.jeconom.2022.07.004
- The Impact of Corporate QE on Liquidity: Evidence from the UK (with L. Boneva, D. Elliott, I. Kaminska, B. Morley, and N. McLaren) *The Economic Journal*, Volume 132, Issue 648, 2022, pp 2615–2643,
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- A Coupled Component DCS GARCH model for intraday and overnight volatility (with J. Wu) *Journal of Econometrics* Journal of Econometrics Volume 217, Issue 1, July 2020, pp 176-201
- An Empirical Analysis of Circuit Breakers on the London Stock Exchange. (with James Brugler, Lucas Pedace and J. Noss) *Market Microstructure and Liquidity* Vol. 4, Nos. 3&4 (2018)

- The behaviour of betting and currency markets on the night of the EU referendum (with T. Auld) *International Journal of Forecasting* 35, 371-389
- Implications of High-Frequency Trading for Security Markets (with Soheil Mahmoodzadeh) *Annual Review of Economics* 10:237–59. https://doi.org/10.1146/annurev-economics-063016-104407
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