Trading Frequency and Asset Pricing: Evidence from a New Price Impact Ratio

Chris Florackis, Andros Gregoriou and Alex Kostakis

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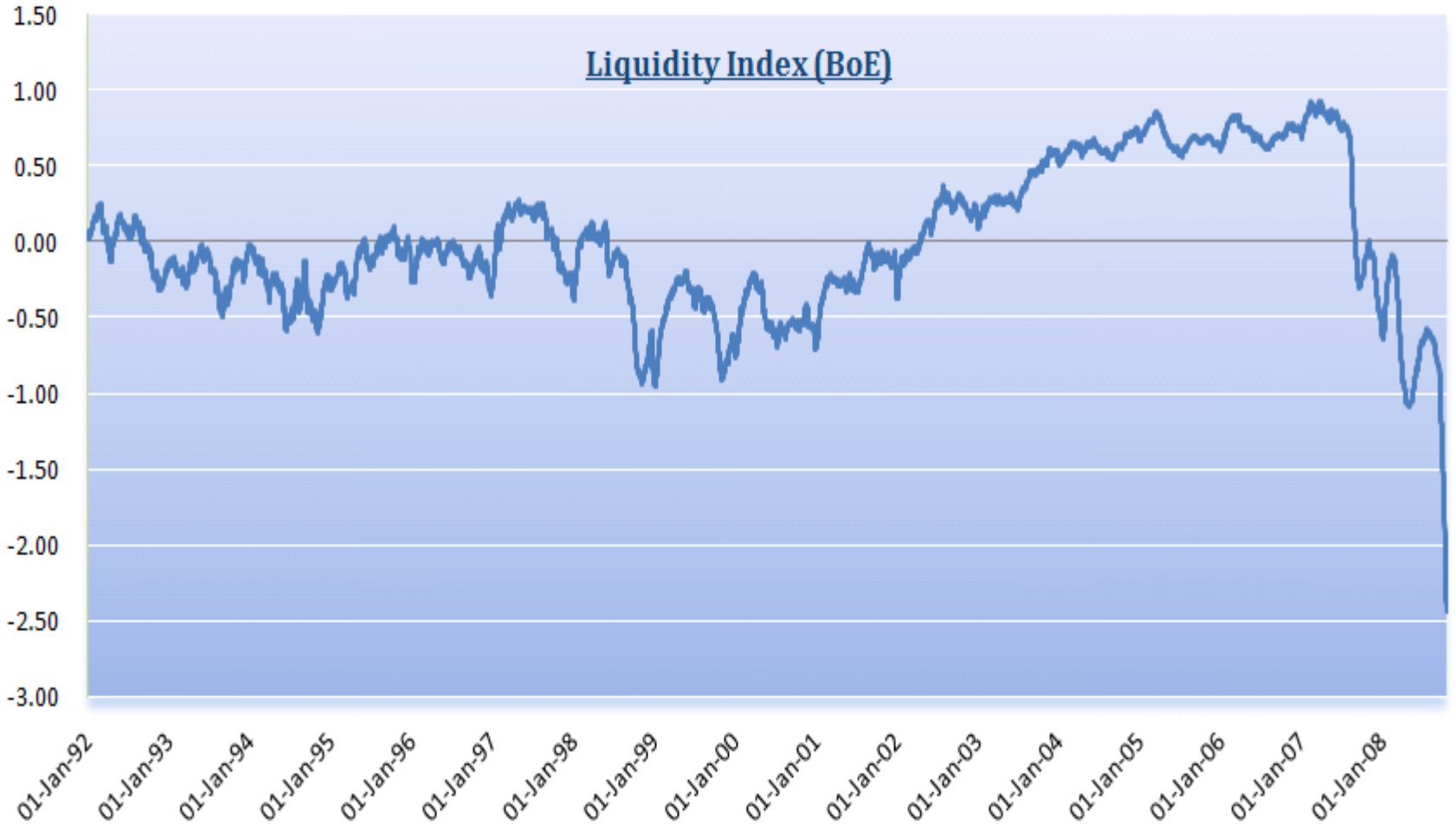
Presentation Outline

- Introduction: Liquidity and Existing measures
- Amihud's RtoV measure: Definition and shortcomings
- A New Price Impact Ratio
- Asset Pricing: Evidence from the UK market
- Conclusions and Future Research

Liquidity in Centre Stage

- The recent global financial crisis highlighted the importance of macro- and micro-liquidity in financial markets
- Market analysts, traders and the financial press have been focussing on liquidity as a main driver of asset prices
- Central banks and regulators have been also monitoring liquidity for the sake of financial stability

BoE Financial Stability Report (October 2008)



Liquidity in Centre Stage

- Liquidity has been long regarded as an important feature in market micro-structure studies
- But few asset pricing studies (and models) had explicitly recognized its role
- Notable exceptions are the studies of Yakov Amihud and Haim Mendelson (already from 1981)
- Now, liquidity has become a dominant issue in academic finance literature too

Measuring Liquidity

- This increasing interest leads to the necessity of measuring liquidity

- But this has been a difficult task, because:
  - *Liquidity is an elusive concept*
  - *Liquidity has several dimensions (trading quantity, trading speed, trading cost and price impact)*

- Result: Lots of measures proposed, each with attractive features and shortcomings

Plethora of Measures: Blessing or Curse?

- Bid-ask spread (Amihud and Mendelson, 1986a)
- Relative spread (Amihud and Mendelson, 1986b)
- Effective spread (Lee, 1993 and Heflin and Shaw, 2000)
- Amortized spread (Chalmers and Kadlec, 1998)
- Trading volume (Brennan et al., 1998)
- Turnover rate (Datar, Naik and Radcliffe, 1998)
- Number of zero-return days (Bekaert et al., 2005)
- Price sensitivity to order flow (Pastor and Stambaugh, 2003)

Plethora of Measures: Blessing or Curse?

- No measure can perfectly capture all dimensions of liquidity
- Some studies (and the Bank of England) try to combine them into one indicator (e.g. PCA)
- A relatively new measure has been the most popular among recent studies
- Amihud's (2002) price impact ratio (RtoV):

$$RtoV_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{| R_{itd} |}{V_{itd}}$$

Why Amihud's Price Impact Ratio

- Intuitive interpretation: It directly measures the impact of a pound of trading volume on stock's return
- Kerry (2008): Proxy for market depth and resiliency
- Interpreted as a measure of disagreement among investors
- "Price discovery" component: Trading activity motivated by information/expectations regarding future price movements
- Good empirical proxy for the theoretically fine concept of Kyle's (1985) lambda (Hasbrouck, 2005)
- Easy to calculate for long periods due to data availability

Shortcomings

- **Inherent size bias**: Trading volume in monetary terms is by no means comparable across stocks with different market values
  - Small size stocks are forced to exhibit high RtoV values
    → automatically characterized as "illiquid"
  - RtoV inappropriate for cross-sectional asset pricing studies
- Neglects **investors' stock holding horizons**
  - Uninformative for the frequency at which this cost is incurred
  - Implicitly assumes that trading frequency is similar across stocks
- Inherent **price level bias**
  - Trading volume in monetary terms exhibits an upward time trend
  - Unless deflated, RtoV exhibits a downward time trend
    → stocks become automatically more liquid through time
  - BoE and Kerry (2008) divide through aggregate MV to remove bias

Illustration of Size Bias (MV vs. Volume)

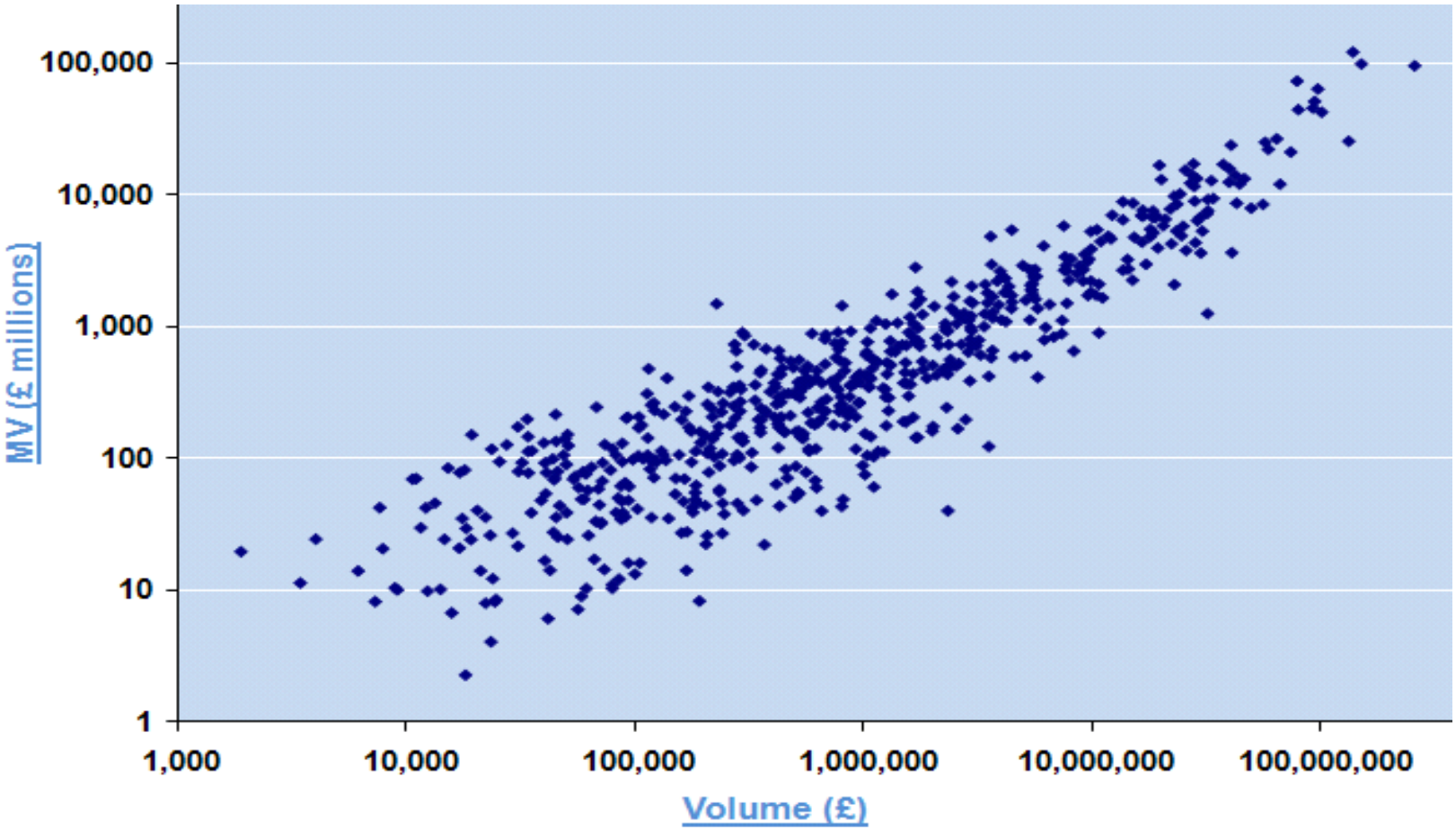


Illustration of Size Bias (Amihud's Ratio vs. MV)

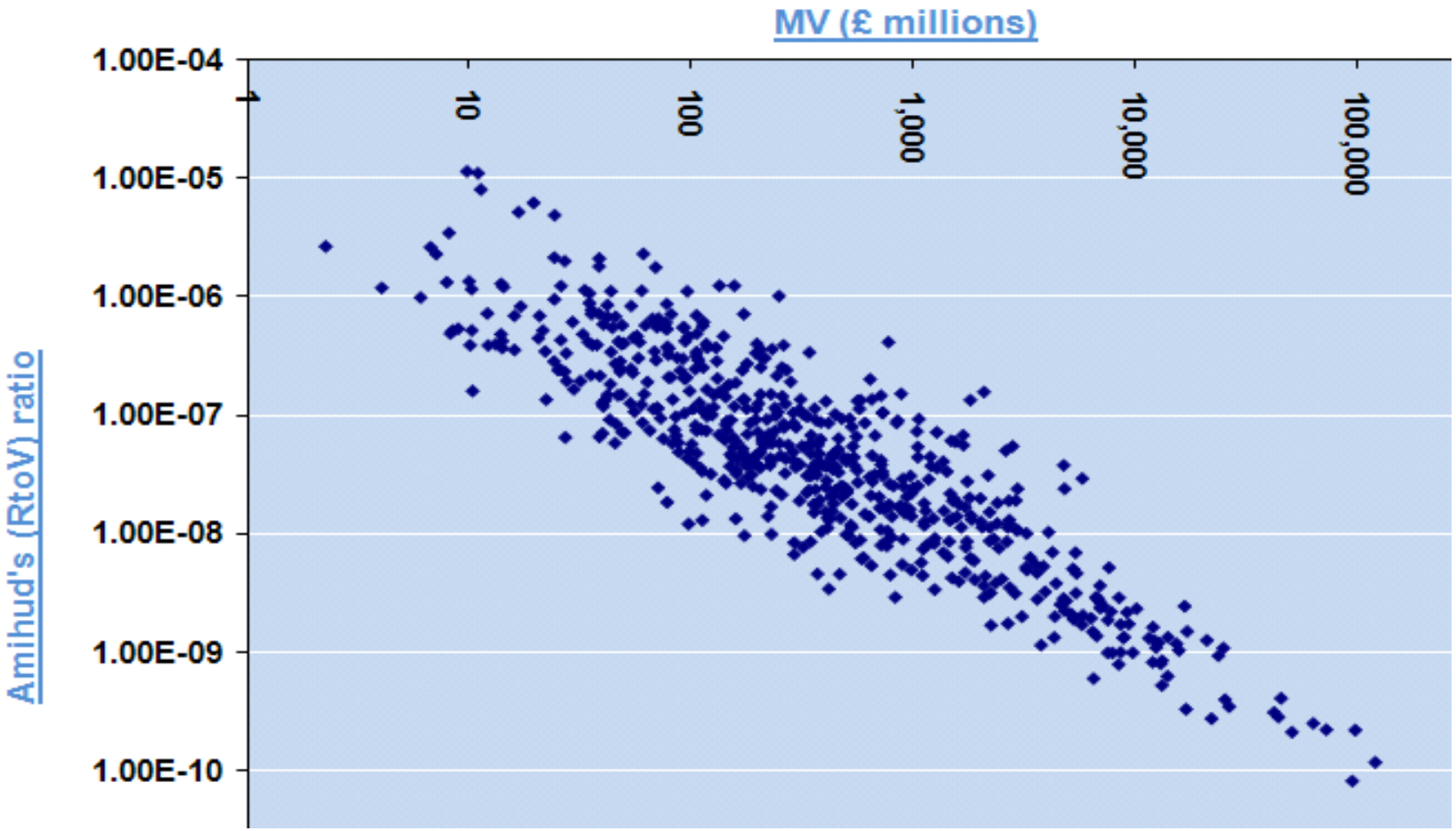
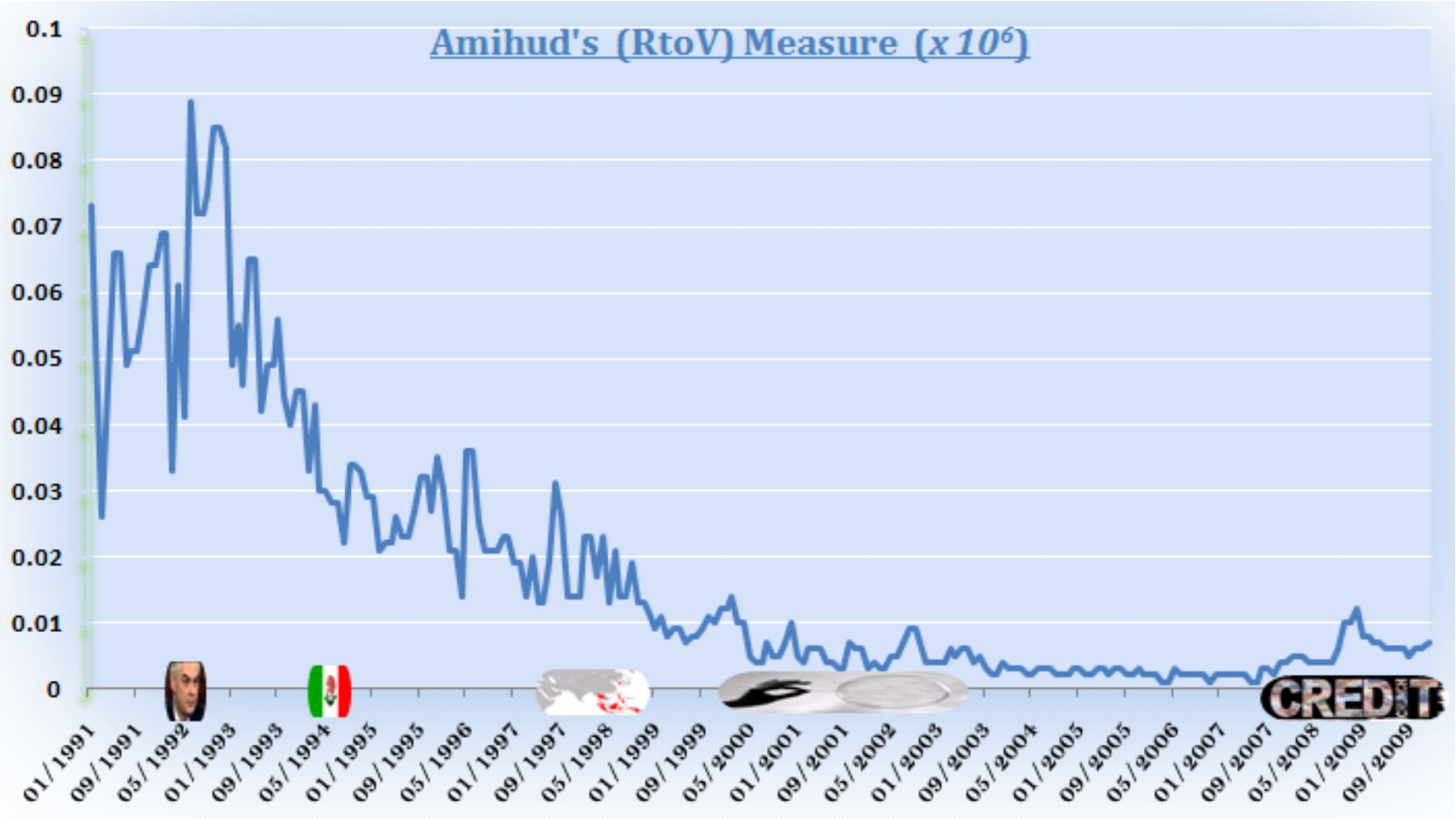


Illustration of Price Level Bias (BP plc.)



The Importance of Trading Frequency

- The fundamental theorem of liquidity asset pricing (Amihud and Mendelson, 1986a) states that for a risk-neutral investor with trading intensity μ, the required return on security i is given by:

$$E(r^i) = r^f + \mu \frac{C^i}{P^i}$$

C^i stands for the illiquidity cost of asset i and P^i for its price

- Excess expected returns depend not only on the transaction cost but also on the frequency according to which this cost is incurred

The Importance of Trading Frequency

- Trading costs have been dramatically reduced over the last 20 years (French, 2008, AFA Presidential Address)
- Transaction costs almost negligible due to improved micro-structure mechanisms and electronic platforms
- Turnover rate in LSE has increased from 40.5% in 1995 to 152.7% in 2008 (World Federation of Exchanges)
- Dramatic reduction in holding horizons by institutional investors

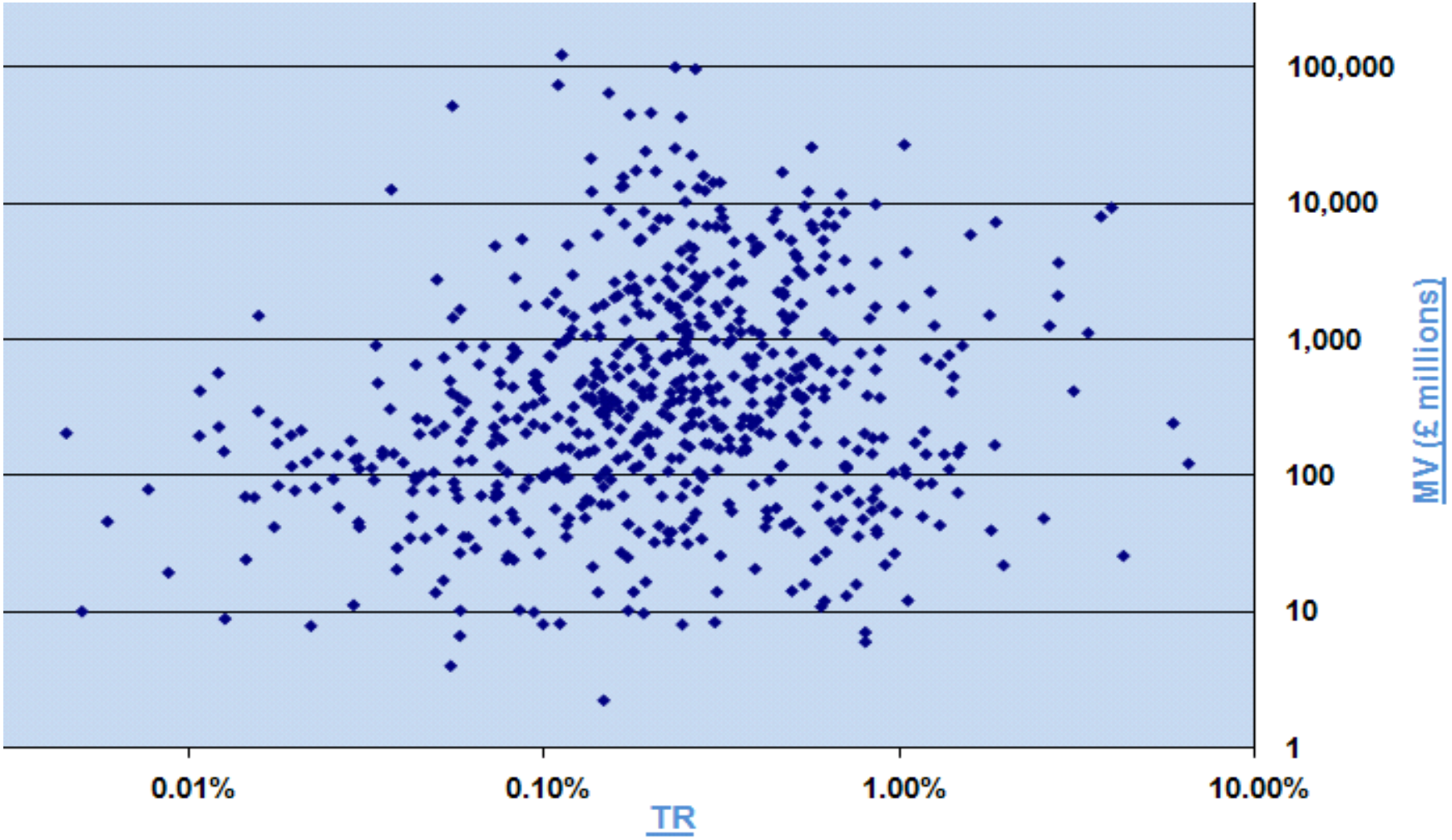
A New Price impact Ratio

- We propose a new price impact ratio, RtoTR, that replaces trading volume with turnover ratio in Amihud's ratio

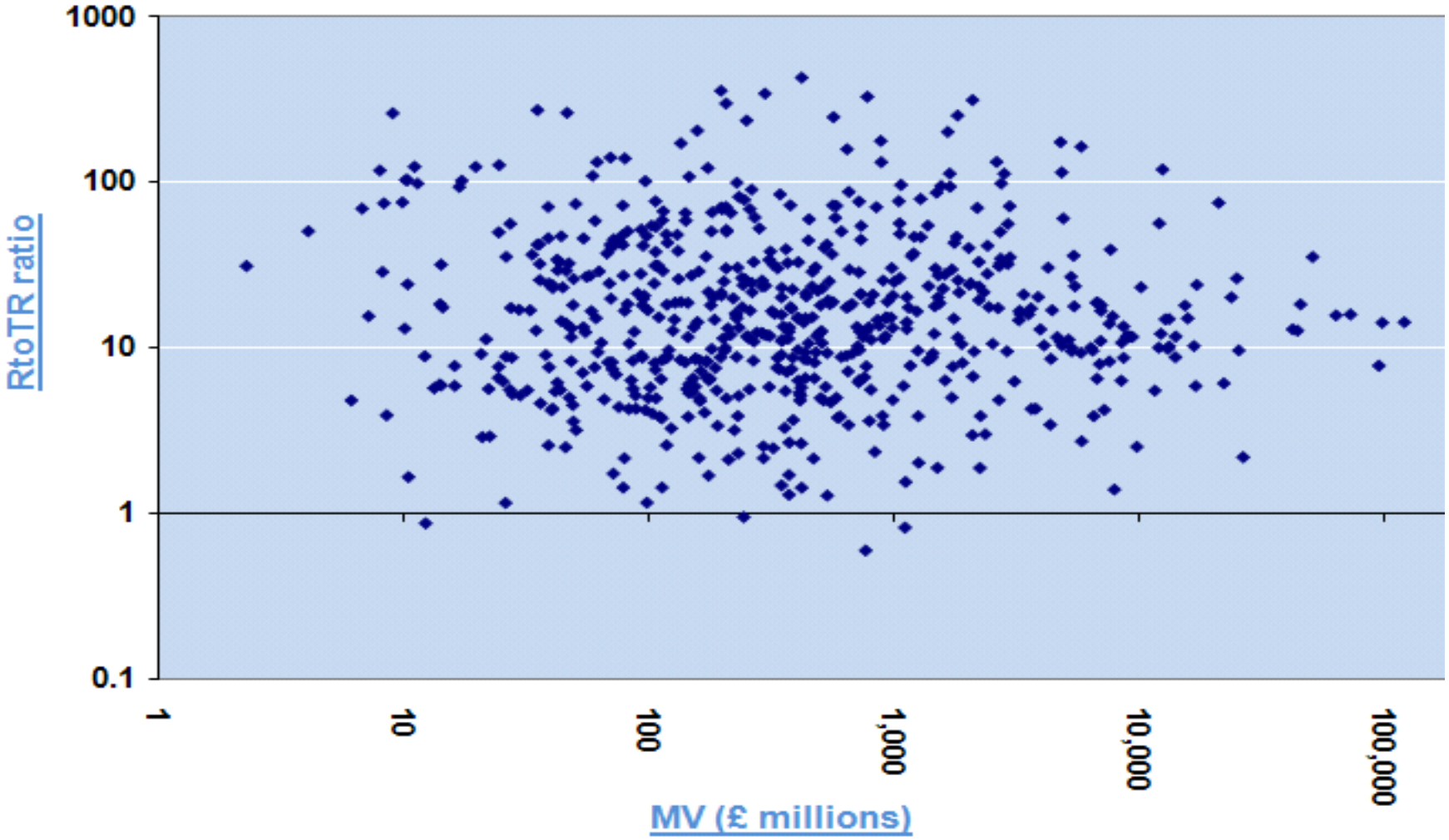
$$RtoTR_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{| R_{itd} |}{TR_{itd}}$$

- Inherits the **intuitive** price impact interpretation of RtoV
- **Free of size bias** → appropriate for cross-sectional asset pricing
- **Free of price level bias**, better than dividing by aggregate MV
- Captures **compound effect** of trading frequency + transaction costs
- **Easy to calculate** for long horizons and international stock markets

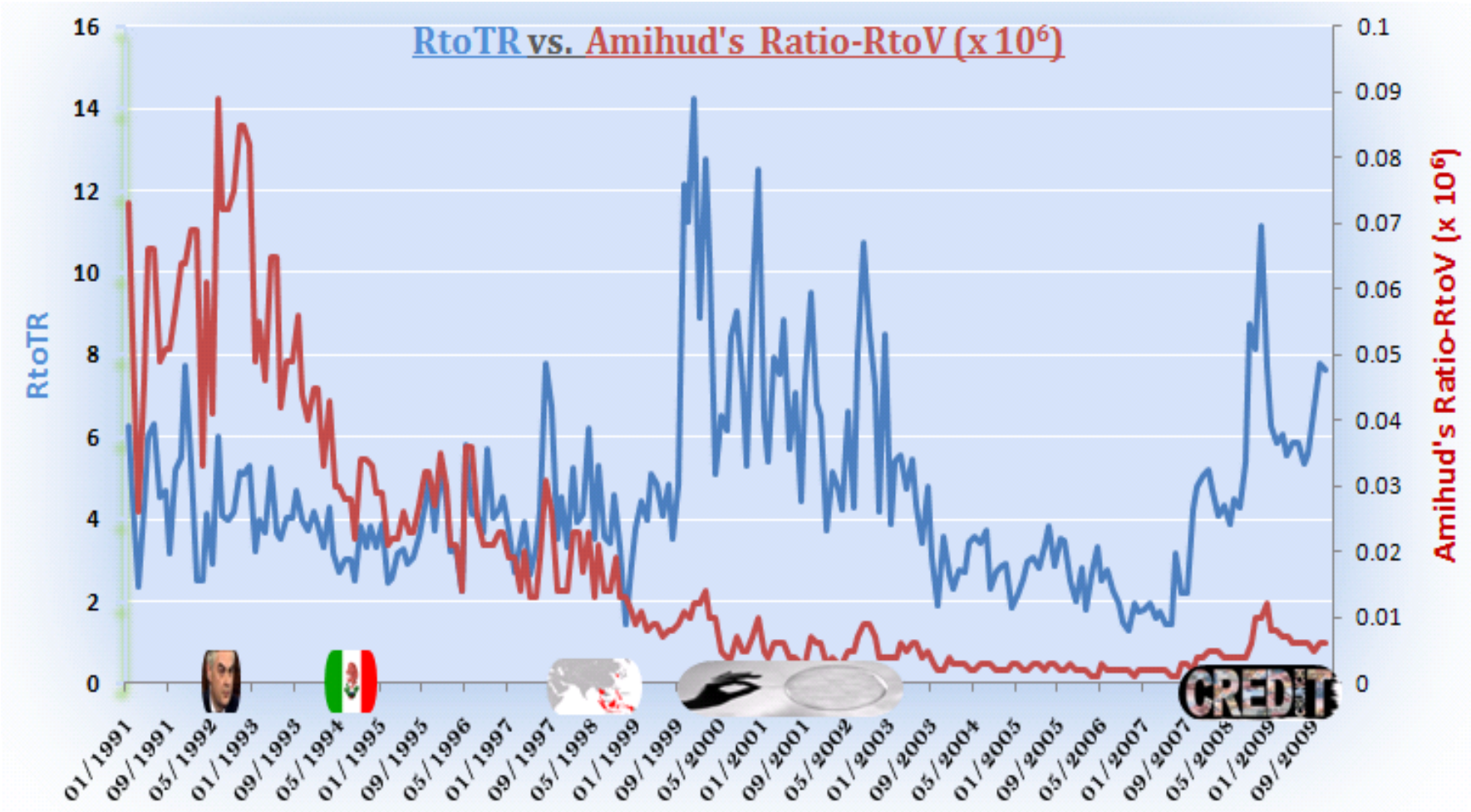
Free of Size Bias (MV vs. TR)



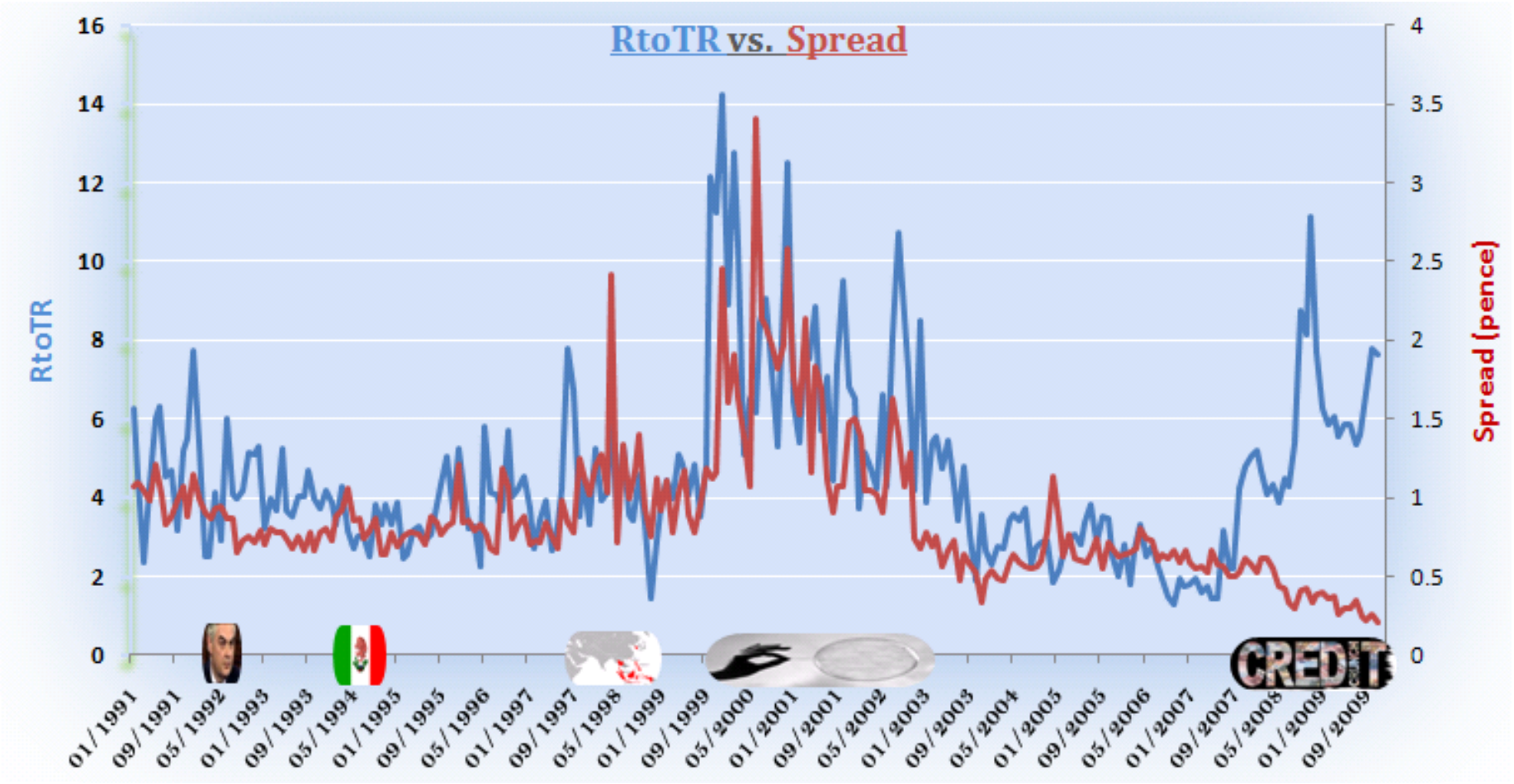
Free of Size Bias (RtoTR vs. MV)



Free of Price Level Bias (BP plc.)



Compound effect (BP plc.)



The Dataset

- Common stocks listed on LSE, no survivorship bias
- Excluding investment trusts and ADRs
- Period: January 1991- December 2008
- Daily data on bid-ask spread, turnover ratio, volume and returns
- Source: Thomson Datastream
- Sort stocks according to RtoV and RtoTR + construct decile portfolios
- Calculate post-ranking EW and VW portfolio returns, monthly rebalancing

Performance and Characteristics of RtoV-sorted portfolios

	RtoV Portfolios					
	P1	P2	P9	P10	P10-P1	*t*-test
EW returns (% p.a.)	0.852	0.260	7.344	14.242	13.390	3.093
VW returns (% p.a.)	-0.735	-0.564	0.665	5.479	6.215	1.517
RtoV ratio	5.97E-04	2.19E-03	5.09E-01	2.50	2.50	15.015
MV(£m)	12005.541	2216.778	101.645	64.412	-11941.13	-47.977
Price-to-Book	3.414	3.300	2.813	2.542	-0.872	-14.784
CAPM Beta	1.005	1.095	1.021	1.011	0.006	0.290

Performance and Characteristics of RtoTR-sorted portfolios

	RtoTR Portfolios					
	P1	P2	P9	P10	P1-P10	*t*-test
EW returns (% p.a.)	13.902	6.357	2.556	-1.493	15.395	5.156
VW returns (% p.a.)	6.551	1.842	-7.814	-5.918	12.469	3.896
RtoTR ratio	1.441	2.899	35.425	120.436	-118.996	-42.730
MV(£m)	2719.871	3499.827	386.894	253.512	2466.359	31.029
Price-to-Book	3.660	3.315	2.956	2.875	0.785	9.966
CAPM Beta	0.952	1.023	1.034	1.073	-0.122	-6.986

Findings

- Highest RtoV portfolios yield the highest post-ranking returns
- Confirm the size gradient in RtoV portfolios
- Reverse order for RtoTR-sorted portfolios:
  Lowest RtoTR portfolios yield the highest post-ranking returns
- Low RtoTR: Small price impact but very high Turnover ratio

→Conclusion:

- Trading frequency dominates the trading cost effect
- Even low transaction costs may lead to high premia if they are very frequently incurred

Alphas of RtoV-sorted Portfolios

	RtoV Portfolios					
	P1	P2	P9	P10	P10-P1	Chi-sq.
CAPM alpha (% p.a.)	0.90 (1.27)	1.37 (0.85)	2.60 (0.84)	7.49 (2.10)***	6.58 (1.64)	19.29 (0.037)
Fama-French alpha (% p.a.)	1.49 (3.19)***	0.18 (0.15)	0.58 (0.20)	5.33 (1.62)	3.83 (1.13)	20.12 (0.028)
Carhart alpha (% p.a.)	1.54 (3.19)***	0.05 (0.04)	1.99 (0.65)	5.38 (1.49)	3.84 (1.02)	17.82 (0.058)

Alphas of RtoTR-sorted Portfolios

	RtoTR Portfolios					
	P1	P2	P9	P10	P1-P10	Chi-sq.
CAPM alpha (% p.a.)	8.30 (4.46)***	3.48 (2.31)**	-5.60 (-1.44)	-3.89 (-1.32)	12.20 (3.65)***	42.23 (0.00)
Fama-French alpha (% p.a.)	7.79 (4.39)***	3.10 (2.03)*	-7.74 (-2.45)**	-5.78 (-2.25)**	13.58 (4.22)***	42.30 (0.00)
Carhart alpha (% p.a.)	6.53 (3.93)***	3.07 (1.91)*	-6.85 (-2.16)**	-6.85 (-2.26)**	13.38 (3.77)***	33.22 (0.00)

Findings

- RtoV alphas disappear once a size factor (a la Fama-French) is included in the asset pricing model →

  Confirms the Size-RtoV tautology

- RtoTR alphas persist in the presence of size, value and momentum factors →

  This characteristic is genuinely priced in the UK market

Cross-sectional asset pricing tests

- Augment common asset pricing models (CAPM, Fama-French and Carhart) with a Price Impact factor
- Price Impact factor= P1-P10 of RtoTR-sorted portfolios
- Examine if this factor is priced in the cross-section of RtoTR portfolios
- Fama-McBeth 2-step methodology
- Shanken-corrected standard errors

Cross Sectional Asset Pricing Tests

	λ_0	λ_{MKT}	λ_{SMB}	λ_{HML}	λ_{MOM}	λ_{PI}	Adj. R^2	ΔR^2
1. CAPM&PI	0.99 (1.15) [1.08]	-1.24 (-1.24) [-1.18]	-	-	-	0.81 (2.34)** [2.30]**	0.14	0.06
2. Fama-French&PI	2.02 (1.63) [1.33]	-2.41 (-1.70)* [-1.40]	0.21 (1.24) [1.06]	-0.32 (-0.44) [-0.36]	-	0.97 (2.96)*** [2.82]***	0.20	0.05
3. Carhart&PI	1.74 (1.19) [0.96]	-2.16 (-1.32) [-1.07]	0.29 (1.02) [0.84]	-0.59 (-0.76) [-0.62]	0.25 (0.68) [0.56]	0.94 (2.94)*** [2.82]***	0.25	0.05

Momentum and Size alphas

	Momentum (Winner-Loser Deciles)
1. CAPM alpha	22.78 (2.78)***
2. CAPM&PI alpha	16.71 (2.10)**
3. Fama-French alpha	25.12 (3.73)***
4. Fama-French&PI alpha	19.81 (2.96)***
5. Carhart alpha	9.44 (1.97)**
6. Carhart&PI alpha	4.67 (0.98)

Findings

- PI-augmented models do not capture the size "anomaly"
- Momentum alphas are considerably reduced in PI-augmented models (but do not disappear)
- Momentum may be related to the price impact effect
- Similar finding in Pastor and Stambaugh (2003) that use order flow sensitivity as liquidity proxy

Conclusions and Future Research

- The suggested price impact ratio is not only a methodological improvement to remove the size bias in RtoV
- It also captures the trading frequency effect that has become a dominant feature in financial markets
- Trading frequency dominates the transaction cost effect in determining the corresponding premium
- Utilize RtoTR for bond markets
- Examine the relationship between momentum and RtoTR