JACOBS LEVY EQUITY MANAGEMENT CENTER
FOR QUANTITATIVE FINANCIAL RESEARCH

Asset Pricing in the Dark: The Cross Section of OTC Stocks

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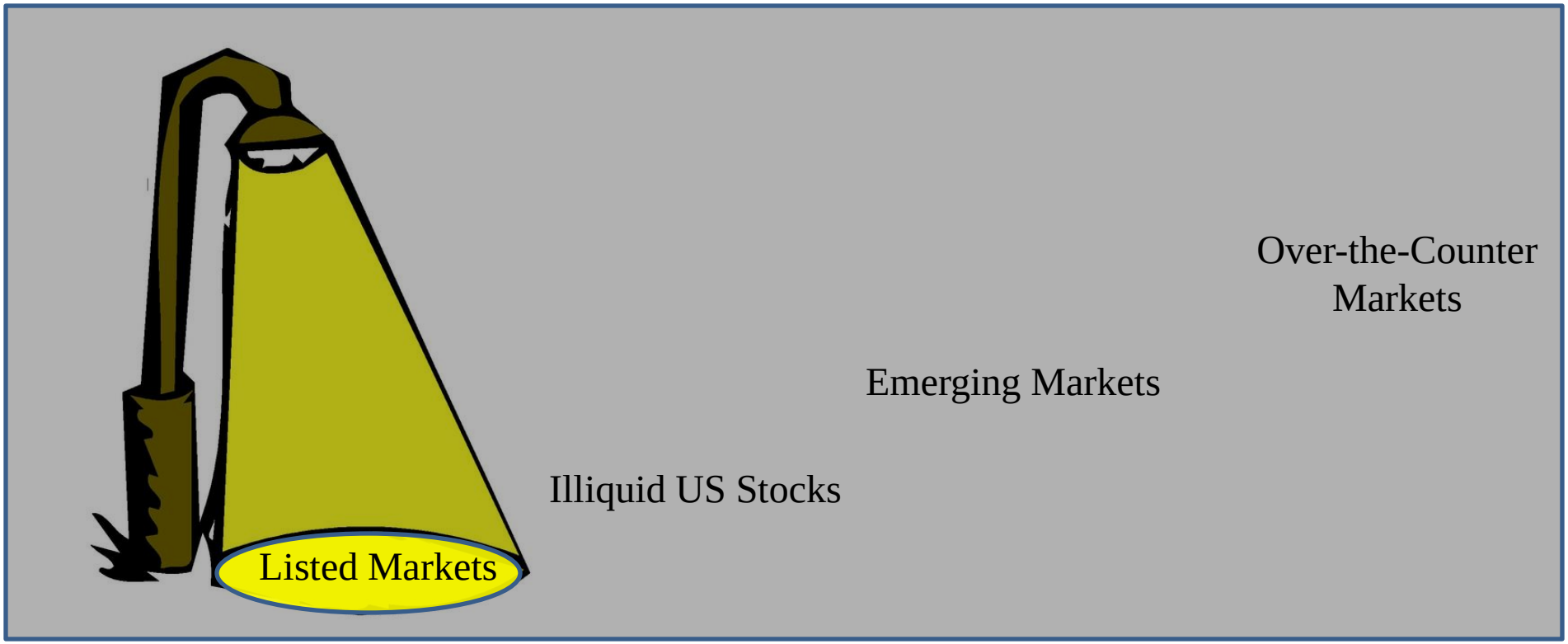
Motivation

- Most asset pricing studies look at "listed" stocks
  - Partly because these are the largest and most liquid
  - Partly because of the "streetlight" effect (good data)



Over-the-Counter (OTC) Markets

- We examine stock returns in OTC markets
  - 6,668 OTC firms from 1977 through 2008
  - Largest US dataset since Nasdaq was introduced in 1984
  - OTC Bulletin Board (OTCBB) or Pink OTC Markets (formerly Pink Sheets, or PS)

- The “wild, wild west” of securities markets (Bollen and Christie, 2009)

Over-the-Counter (OTC) Markets

From the SEC:

"Pink Quote does not require companies whose securities are quoted on its system to meet any eligibility requirements. With the exception of some foreign issuers, the companies quoted on Pink Quote tend to be closely held, very small and/or thinly traded. Most issuers do not meet the minimum listing requirements for trading on a national exchange. Many of these companies do not file periodic reports or audited financial statements with the SEC. As such, it may be difficult for the public to find current, reliable information about companies quoted through Pink Quote."

www.sec.gov/divisions/marketreg/mrotc.shtml

OTC versus Listed Markets

- Similarities
  - Similar or same firms (80% overlap pre- or post-listing)
  - Similar market makers and a lot of overlap in investors
  - United States stocks: same economic shocks, currency, claims to cashflows

- Differences (beyond firm size)
  - OTC requires little or no firm disclosure (*e.g.*, book equity)
  - OTC markets are less liquid (using *PNT*, Spread, or Amihud)
  - OTC markets have fewer “traditional” institutions

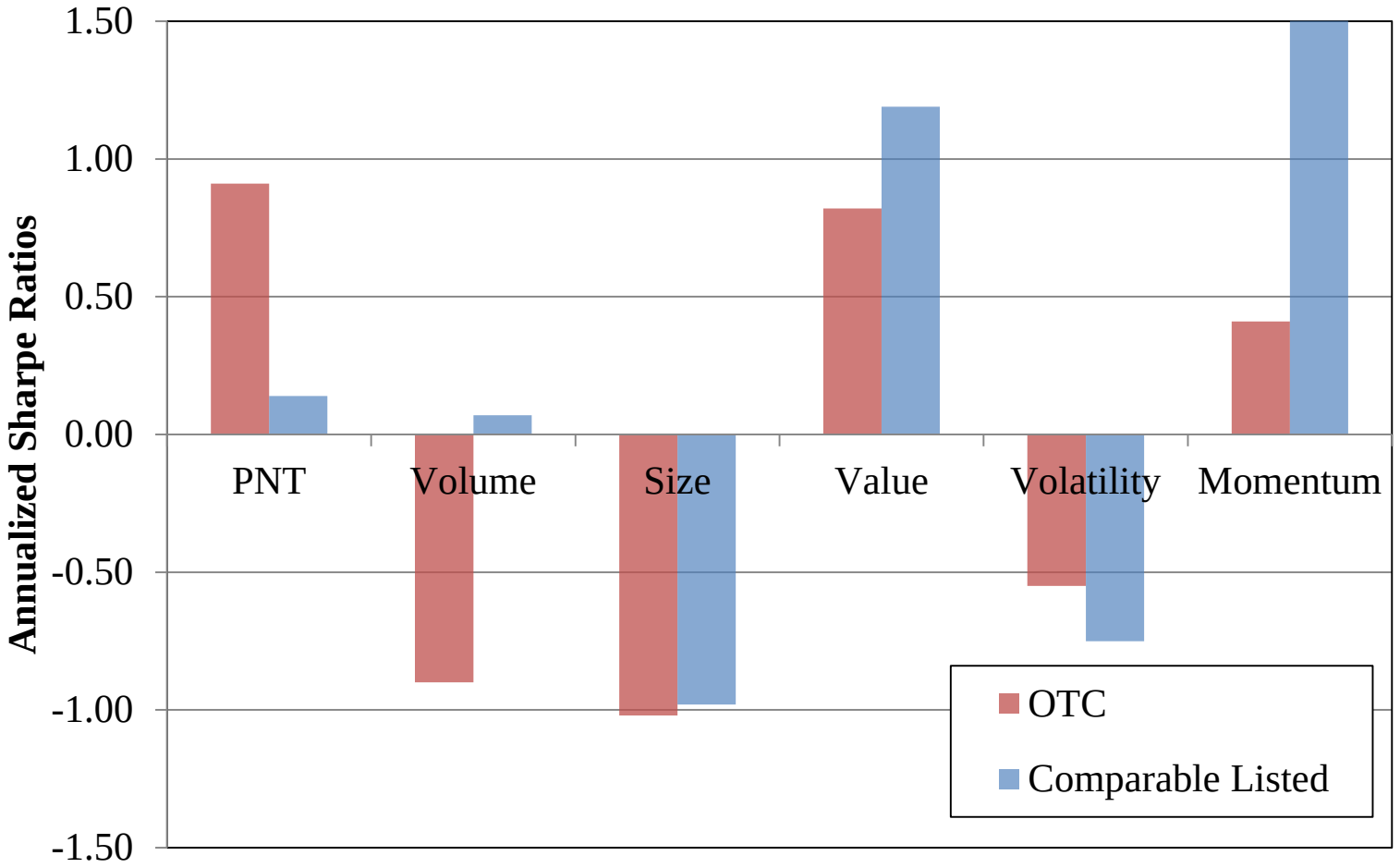
OTC Markets in Asset Pricing

- We exploit these features to distinguish among theories of return premiums
  - Rational versus behavioral theories
  - Specific behavioral theories
    - Differences in opinion + short sales constraints (e.g., Miller (1977))
    - Theories of over- and underreaction (e.g., Hong and Stein (1999))

- Our strategy is to estimate return premiums within and across OTC and listed markets
  - We sort by characteristics that distinguish the markets

Preview of Some Key Results

- We estimate return premiums by forming long-short portfolios using quintile sorts on stocks' characteristics



Summary of Results

- Illiquidity premiums are huge in OTC markets
- Size, value, and volatility premiums are similar in OTC markets, but the momentum premium is smaller
- Exposures to the listed factors do not explain the OTC factor premiums
  - The factor loadings often have the wrong sign
- Cross-market differences shed light on the origins of return premiums
  - Miller's (1977) theory can explain many key facts, including within-market and cross-market variation in premiums
  - Momentum results are most consistent with Hong and Stein (1999)

Brief Background on OTC Markets

- Definition: OTC = Pink Sheets + OTCBB
  - 1+ FINRA member is willing to be market maker
    - 211 market makers who must trade at their public quotes
- Return and other data come from MarketQA
- Regulated by FINRA (once NASD) and SEC
- *Minimal* financial disclosure requirements
  - After 2000, OTCBB (but not PS) requires annual reports, etc.
- *Heterogeneous* size, liquidity, and transparency
- Mainly *individual* investors trade OTC stocks

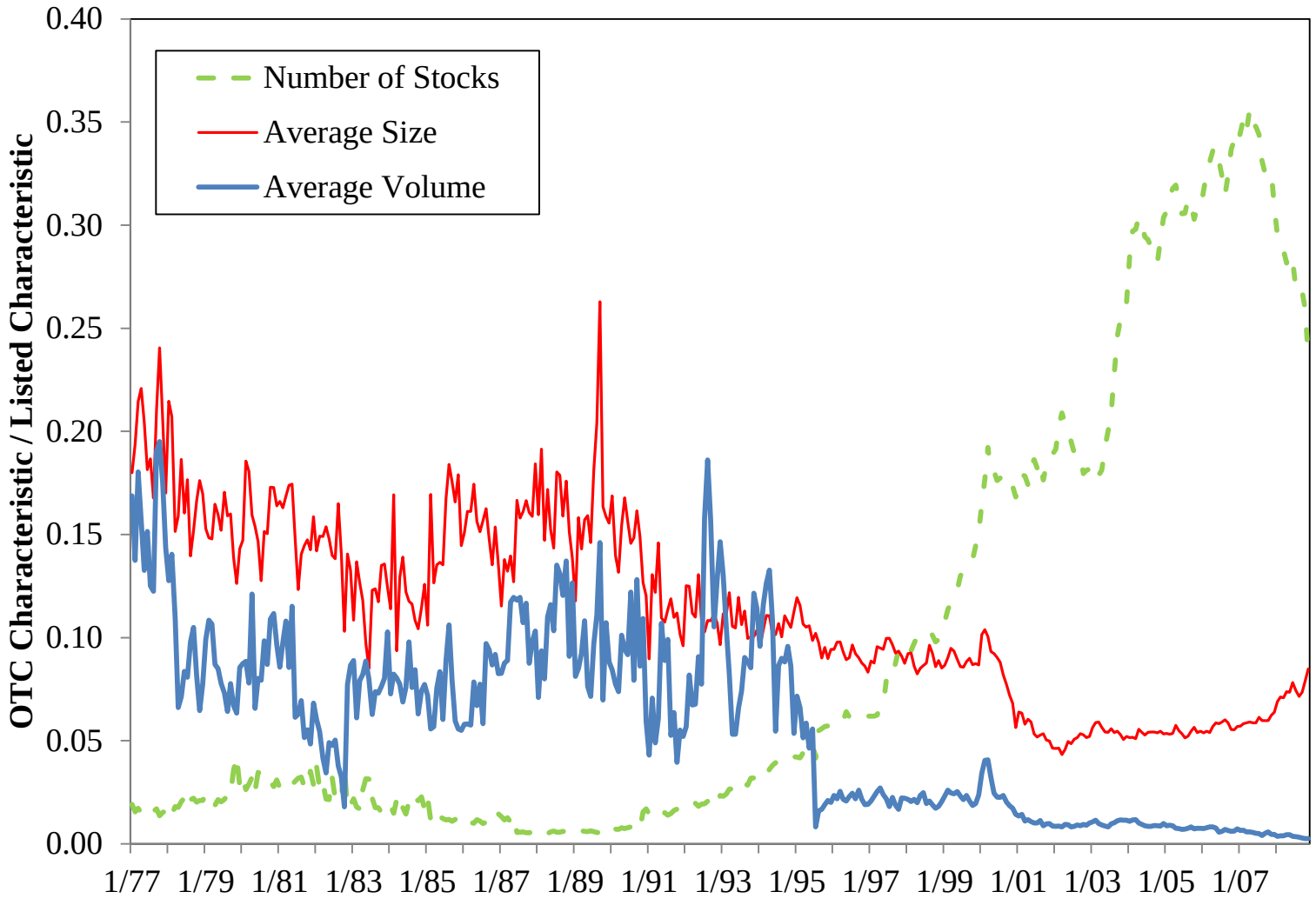
OTC Sample Restrictions

- Exclude joint listings on NYSE/Nasdaq/AMEX
  - E.g., drop Nasdaq firms with joint OTCBB listings
- For data quality, we require in previous month:
  - Non-missing price, market cap, and return data
  - Market cap exceeds $1 million in 2008 dollars
  - Stock price exceeds $1
  - At least one non-zero daily return
  - Positive trading volume, only after 1995
- Each individual filter would exclude 16-30% of firms
- Results in an average of 486 firms per month

Comparing OTC and Listed Firms

- Idea: Gauge size and relevance of OTC stocks
- Use two OTC / listed samples in comparisons
  - Eligible: Meet all data restrictions on previous slide
    - OTC (listed) firms drop from 3357 to 486 (5708 to 5228)
  - Comparable: Eligible listed firms with median OTC size
    - 1018 firms remain in listed sample (bottom size quintile)
- Example: Median firm sizes in July 1997 (typical mo)
  - Eligible OTC and Comparable Listed Samples: $12.9M
  - Eligible Listed Sample: $36M

Comparison to Eligible Listed Sample



Peak Sizes of the Largest 5 OTC Firms

Company Name	Peak Month	Trading Venue	Peak Size in Billions	Size Rank in Among Listed	Size Percentile Among Listed
PUBLIX SUPER MKTS INC	Dec-08	OTCBB	88.5	18th	99.5%
DELPHI CORP	Mar-08	Pink Sheets	13.0	225th	94.8%
MCI INC	Jan-04	Pink Sheets	7.7	292th	93.9%
MAXIM INTEGRATED INC	May-08	Pink Sheets	7.1	381st	91.2%
LEVEL 3 COMMUNIC INC	Feb-98	OTCBB	6.6	297th	95.8%

Summary of Firm Characteristics

	Means		Standard Deviations	
Variable	Eligible OTC	Comparable Listed	Eligible OTC	Comparable Listed
Return (%)	-0.04	0.66	28.08	19.46
Disclose	0.60	0.83	0.46	0.33
Size	2.35	2.21	1.30	0.53
B/M	1.09	1.29	2.17	1.64
Volatility	6.56	4.29	5.52	2.13
PNT	0.55	0.20	0.34	0.21
InstHold	0.26	0.71	0.41	0.39

Selected Data Issues and Remedies

- Bid-ask bounce bias in expected returns
  - Use gross return weights in portfolio returns
    - Follow Asparouhova, Bessembinder, and Kalcheva (2011)
  - Also use value weights, though these are often extreme
- Factor loadings biased by non-synchronous trading
  - Extend Lo and MacKinlay (1990) method to multiple factors
- Spurious extreme return reversals can occur
  - Use standard filter to exclude highly unlikely reversals

Estimating OTC Factor Returns

- Sort OTC firms into quintiles in each month based on a firm characteristic, such as size
  - Apply GRW weights to stocks' returns in each quintile
- Alpha: Intercept in regression on return factors
- Beta: Sum across lags 0 to 6 of the return factor
- Sharpe and Information Ratios
  - They automatically adjust for high OTC volatility
  - We annualize these ratios for ease of interpretation

Sharpe and Information Ratios

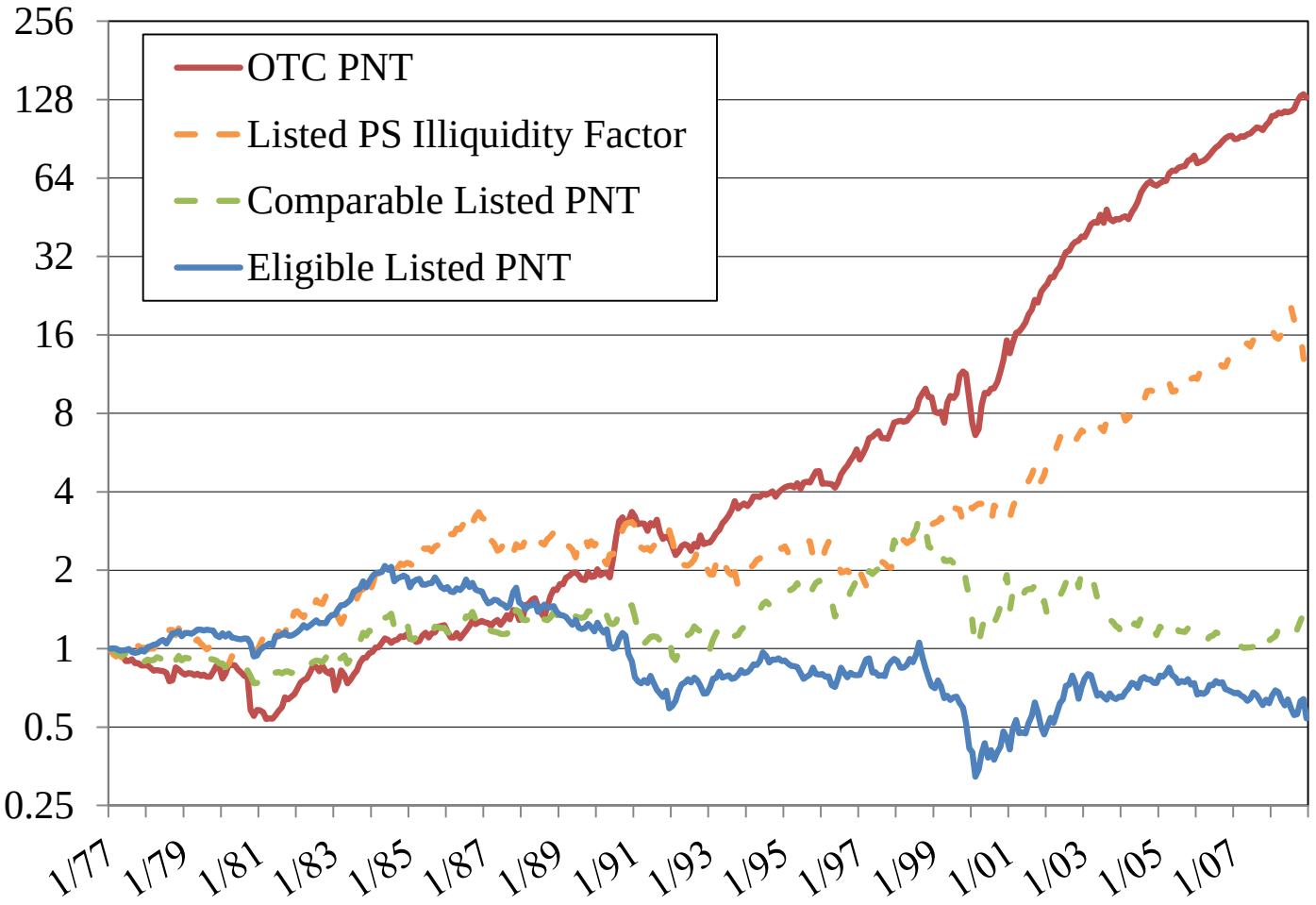
Return Model	None	Listed CAPM			5-Factor
Factor	OTC	OTC	Comp. Listed	Eligible Listed	OTC
PNT	0.91**	1.24**	0.29	0.08	1.34**
	(0.20)	(0.19)	(0.19)	(0.24)	(0.32)
PNT_{VW}	0.66**	1.00**	0.21	0.32	1.06**
	(0.21)	(0.23)	(0.19)	(0.27)	(0.32)
Volume	-0.90**	-1.14**	0.16	0.30	-1.23**
	(0.20)	(0.20)	(0.19)	(0.24)	(0.35)
Size	-1.02**	-0.98**	-0.81**	0.20	-0.93**
	(0.21)	(0.19)	(0.19)	(0.21)	(0.28)
Value	0.82**	1.19**	1.22**	0.68**	1.00**
	(0.24)	(0.22)	(0.218)	(0.25)	(0.33)
Momentum	0.41**	0.54**	1.71**	1.35**	0.09
	(0.16)	(0.14)	(0.15)	(0.17)	(0.20)
Volatility	-0.55**	-0.79**	-1.09**	-1.01**	-0.50
	(0.21)	(0.19)	(0.19)	(0.20)	(0.28)
$OTCMkt_{VW}$	-0.52*	-1.21**			-1.52**
	(0.23)	(0.19)			(0.26)

Systematic Variation in OTC Factors

	Factor Loadings						R^2 by Model		
OTC Factor	β_{OMKT}	β_{MKT_CAPM}	β_{SMB}	β_{HML}	β_{UMD}	β_{ILQ}	OTC CAPM	Listed CAPM	Listed 5-Factor
PNT	-1.05**	-1.41**	-1.02*	0.89	-0.17	0.13	24.3%	15.3%	34.1%
	(0.25)	(0.36)	(0.43)	(0.57)	(0.42)	(0.39)			
PNT_{VW}	-0.90**	-1.06**	-0.91*	0.70	-0.03	-0.14	36.1%	27.1%	40.1%
	(0.20)	(0.25)	(0.40)	(0.41)	(0.31)	(0.37)			
Volume	0.86**	1.04**	0.82	-0.75	0.16	-0.01	17.7%	11.5%	26.5%
	(0.25)	(0.36)	(0.48)	(0.66)	(0.45)	(0.41)			
Size	0.015	-0.36	-1.01	0.16	-0.39	0.33	2.4%	2.6%	8.1%
	(0.31)	(0.40)	(0.61)	(0.67)	(0.56)	(0.51)			
Value	-0.71**	-1.19**	0.15	0.67	-0.55	1.00*	11.3%	9.6%	25.3%
	(0.22)	(0.28)	(0.39)	(0.41)	(0.43)	(0.48)			
Momentum	-0.35	-0.62	-0.72	0.75	1.09**	0.47	3.0%	2.2%	12.0%
	(0.26)	(0.40)	(0.51)	(0.47)	(0.41)	(0.44)			
Volatility	1.07**	1.63**	1.06*	-1.11	0.31	-1.38*	15.5%	8.6%	21.8%
	(0.27)	(0.40)	(0.42)	(0.65)	(0.50)	(0.56)			
$OTCMkt_{VW}$	1.00	1.17**	0.59**	-0.01	-0.02	0.11	100%	43.5%	57.3%
	-	(0.11)	(0.17)	(0.17)	(0.14)	(0.18)			

Comparing Illiquidity Factor Returns

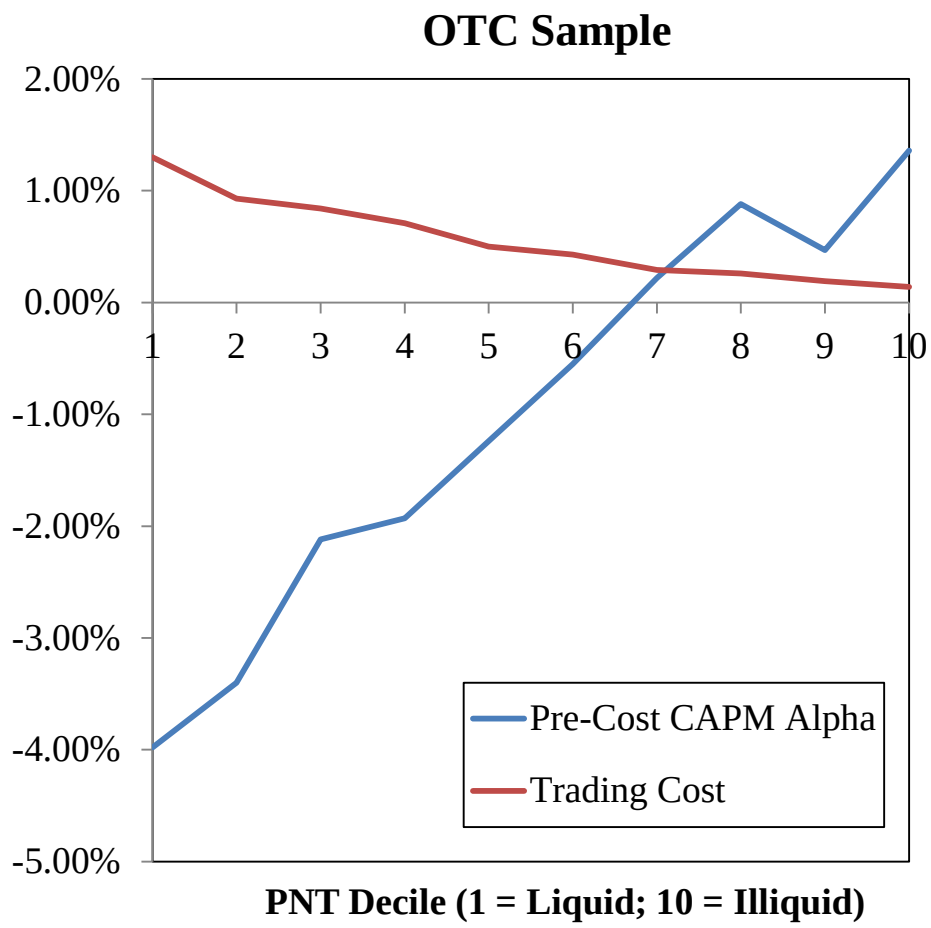
- Value of $1 invested in PNT (non-trading) factors

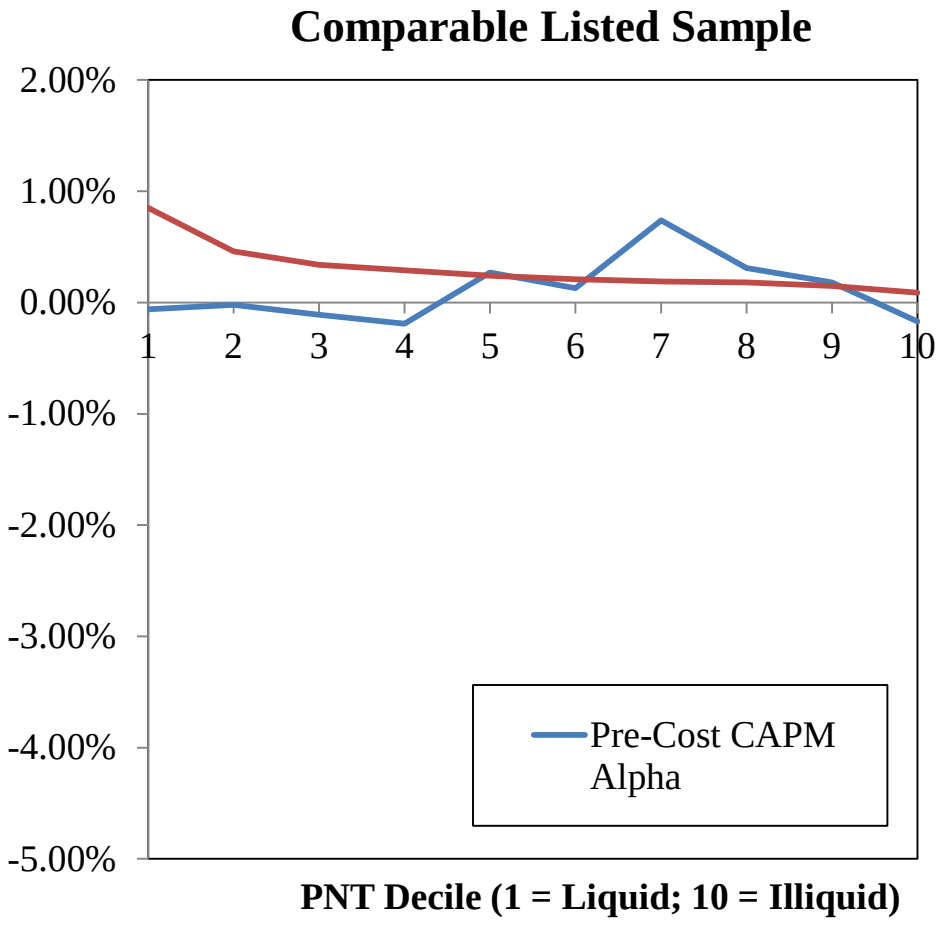


OTC Liquidity Premium

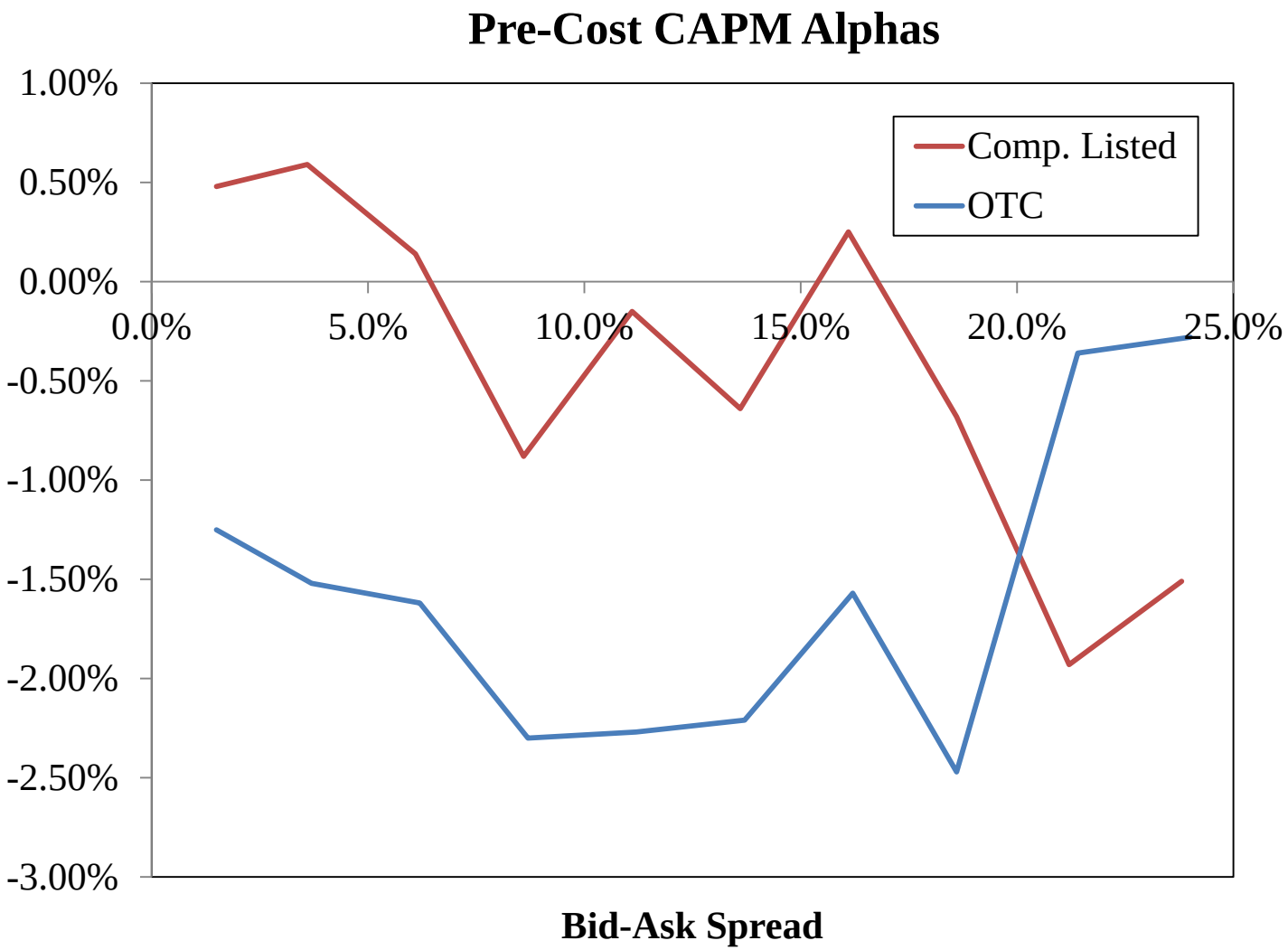
- Transaction cost (TC) theories predict that pre-cost alphas equal the typical investor's trading cost, as measured by bid-ask spread times turnover
  - Amihud and Mendelson (1986), Constantinides (1986)
- Results are largely inconsistent with TC theories
  - TC theories predict that OTC stocks should have higher returns than listed stocks, and risk-adjusted returns should always be positive
  - TC are small relative to the pre-cost premiums
  - Returns sorted by bid-ask spreads should be increasing and weakly concave; they are not

Alphas and Trading Costs by PNT Decile





Alpha Sorted by Spread Quantile



Cross-Sectional Regressions

- Dependent Variable: Monthly trading returns
- Independent Variables:
  - Firm Characteristics
    - Size, B/M, Volatility, Past Returns, Illiquidity, and Disclose
  - Factor Loadings
    - 3 Fama-French factors and UMD
- Separate FM regressions for three subsamples
  - Eligible OTC, Comparable Listed, Eligible Listed
- Apply Ferson and Harvey (1999) weightings

Monthly Predictive Regression Coefficients

	OTC	OTC	Comp. Listed	Comp. Listed	All Listed	All Listed
β_{MKT}		-0.140*		-0.057		-0.069
		(0.054)		(0.059)		(0.059)
β_{SMB}		-0.063*		-0.014		-0.047
		(0.031)		(0.032)		(0.031)
β_{HML}		0.091*		0.012		0.054
		(0.042)		(0.028)		(0.034)
β_{UMD}		-0.060		-0.005		0.028
		(0.041)		(0.026)		(0.023)
Size	-0.692**	-0.688**	-0.607**	-0.625**	-0.134**	-0.142**
	(0.141)	(0.124)	(0.097)	(0.095)	(0.038)	(0.038)
Book-to-Mkt	0.380**	0.316**	0.659**	0.631**	0.522**	0.475**
	(0.119)	(0.117)	(0.104)	(0.102)	(0.083)	(0.074)
Volatility	-0.247**	-0.245**	-0.356**	-0.347**	-0.436**	-0.414**
	(0.034)	(0.033)	(0.043)	(0.038)	(0.060)	(0.046)
Ret[-12,-2]	0.008**	0.008**	0.018**	0.019**	0.013**	0.014**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PNT	4.302**	4.053**	-0.364	-0.475	0.050	-0.086
	-0.642	(0.639)	-0.334	(0.301)	-0.373	(0.306)
Average R^2	0.106	0.150	0.037	0.047	0.048	0.058
Avg Stocks	441	439	905	905	4,762	4,762

Evaluating Theories

- Differences in opinion + short sales constraints could explain
  - Low / negative OTC market returns (on average overpricing)
  - Low returns for liquid stocks, volatile stocks, growth stocks (high differences in opinion)
  - Low returns for large stocks (high attention and large investor base)

- OTC stocks have different disclosure practices
  - Disclosure helps to resolve investor disagreement, and disclosing firms should be less overpriced and earn higher returns
  - Lack of disclosure exacerbates impacts of differences in opinion

OTC Short Sales Are Constrained

- Low available supply: 74% of OTC stocks have no institutional ownership (compared to 29% for listed)
- Retail investors also face restrictions from their brokers
  - Fidelity evidence: 50 OTC and 50 listed stocks in June 2012
    - Stocks are chosen to be similar in size

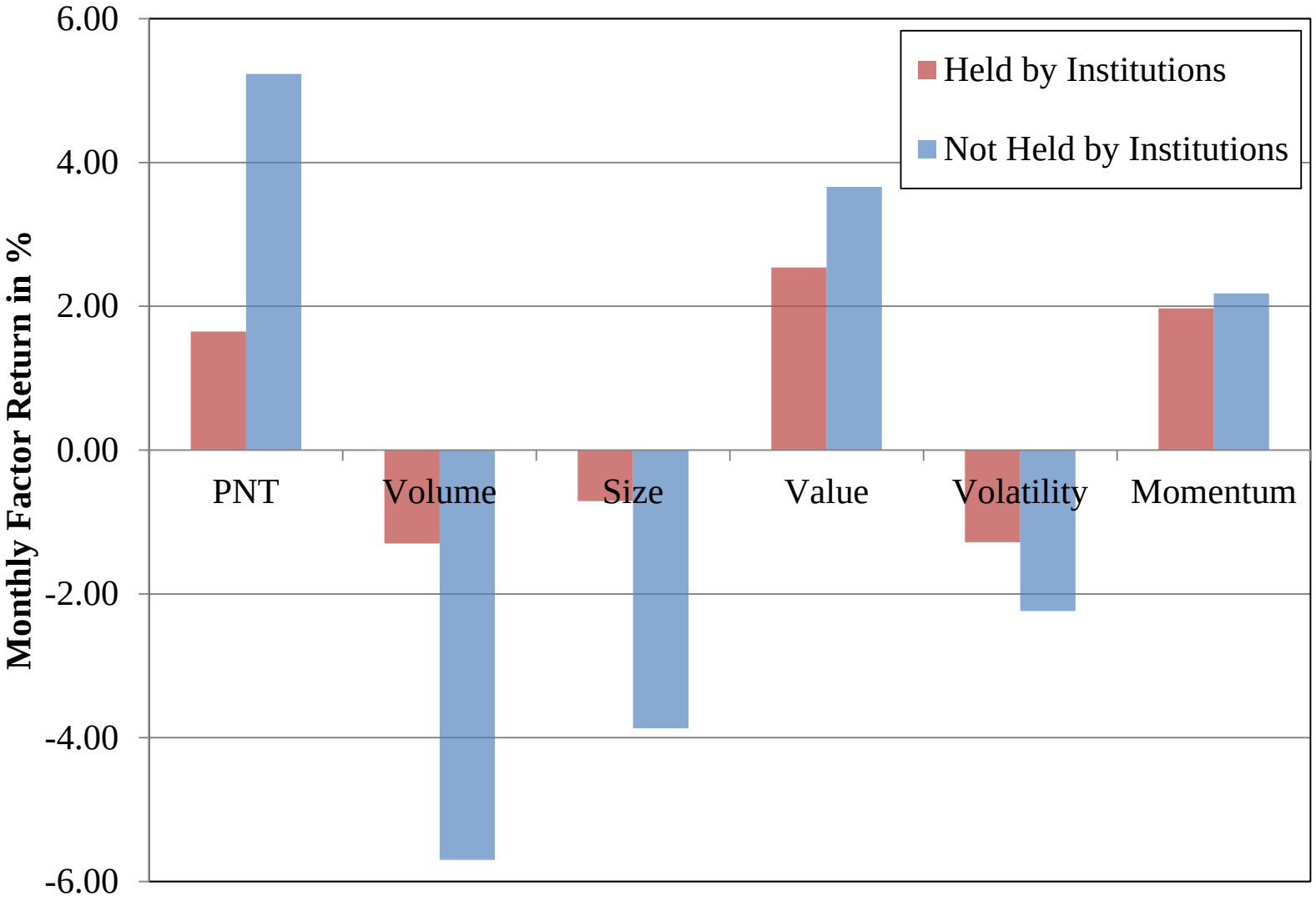
Samples of 50 Stocks	**Average Short Interest**	**Short Interest > 0.1%**	**Short Interest > 0**	**Fidelity Allows Shorting**	**Fidelity Allows Buying**
Listed	4.1%	50	50	8	50
OTC	0.5%	22	43	1	50

Differences in Opinion in OTC Stocks

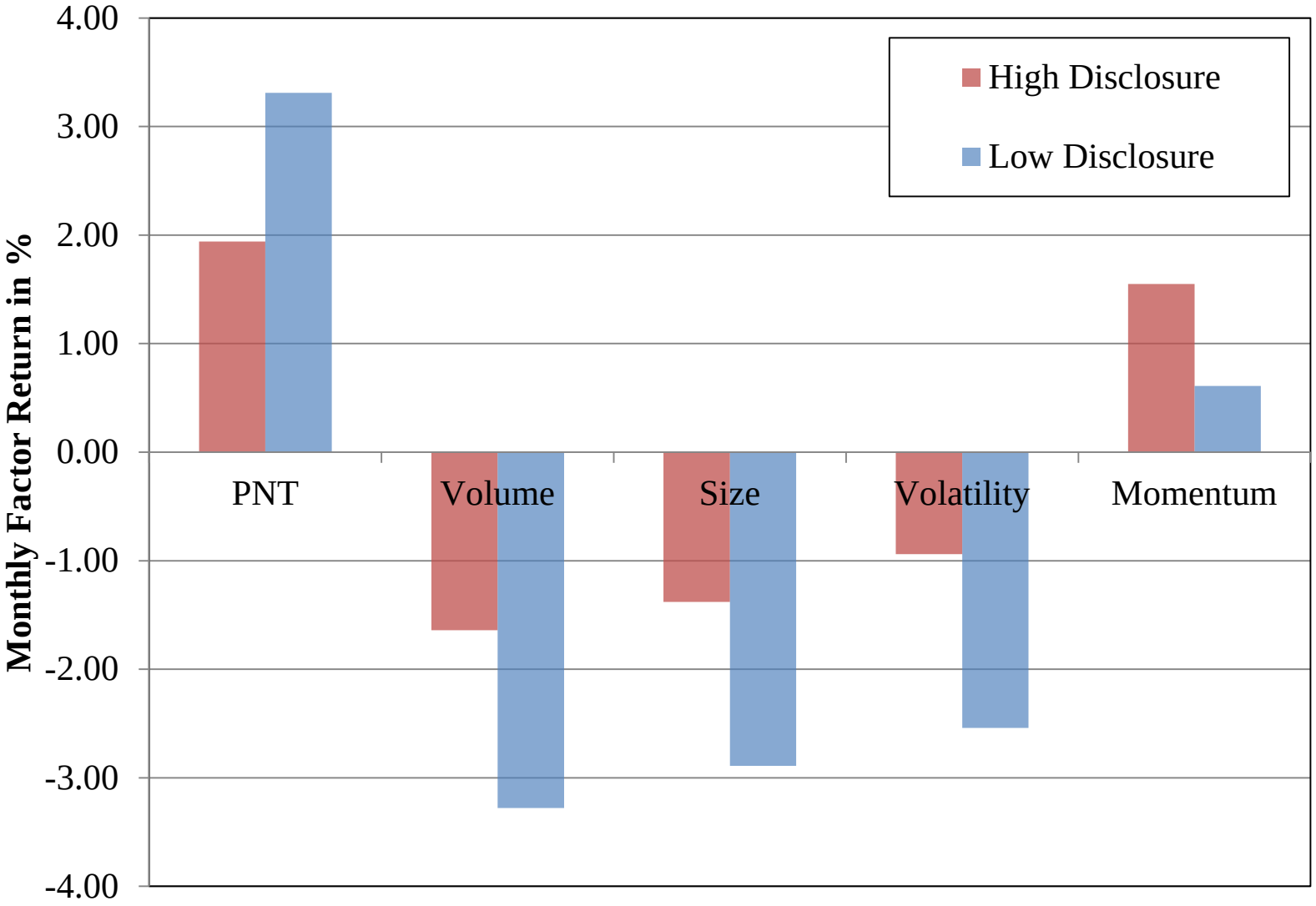
- Low transparency, as shown by the "Disclose" variable
  - Investors must form opinions in an informational vacuum
- Retail investors also may be overconfident
  - Endogenously generates differences in opinion

- To test these conjectures, we compare return premiums in portfolios initially sorted by *Disclose* and *InstHold*

Premiums Initially Sorted by *InstHeld*



Premiums Initially Sorted by *Disclose*



Theories of Momentum

- Two main theories of momentum:
  - Underreaction to news, see Barberis, Shleifer and Vishny (1998) and Hong and Stein (1999), with persistent momentum
  - Overreaction to news, see Daniel, Hirshleifer and Subrahmanyam (1998), with momentum eventually reversing
- OTC stocks trade in a “low information” environment
  - Few investors can observe firms’ fundamentals, especially for stocks that do not disclose
  - News travels very slowly – if it travels at all
  - Information disclosed by OTC firms is viewed as less credible than information from listed firms (see Greenstone, Oyer and Vissing-Jorgensen, 2006)

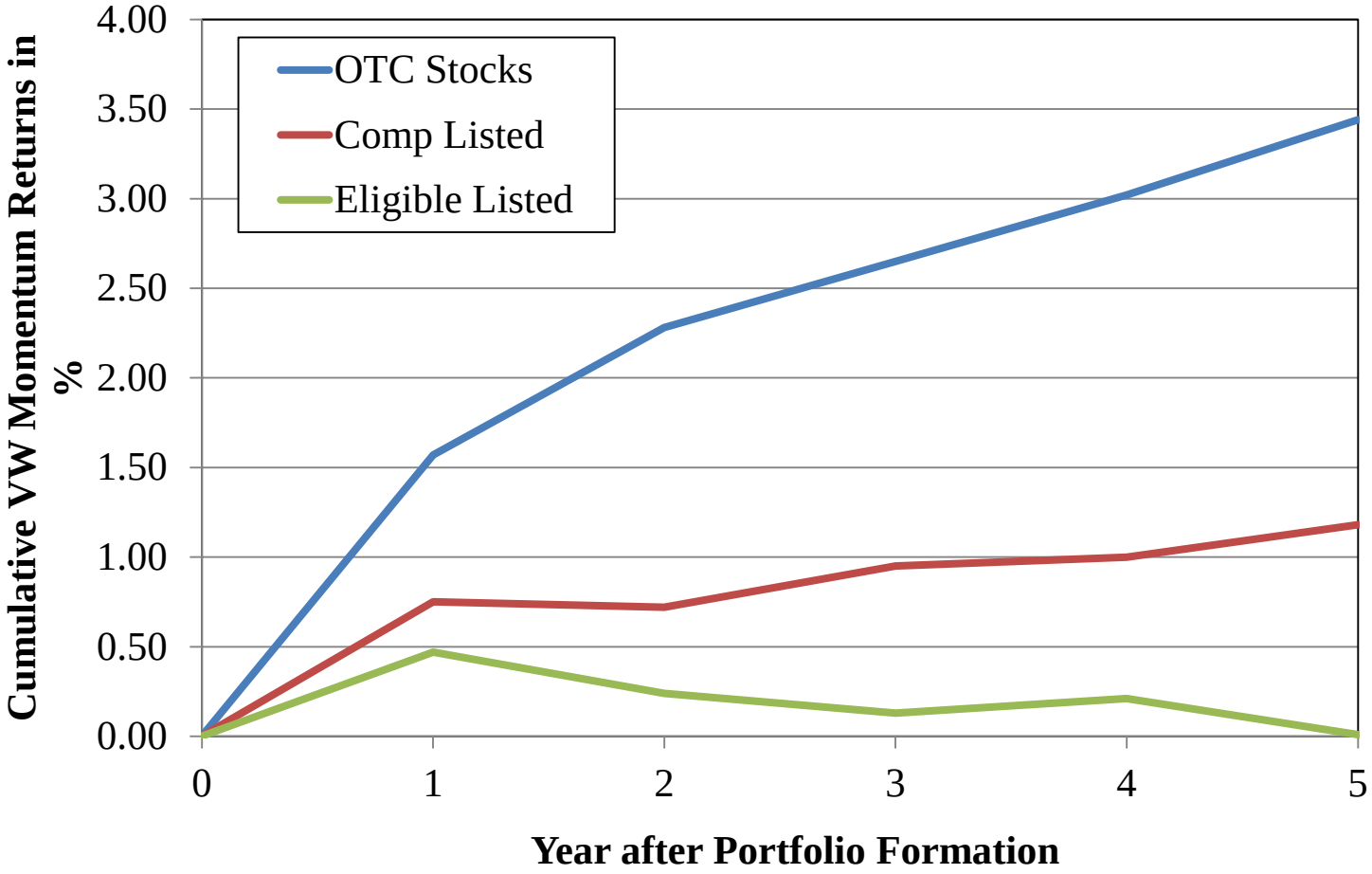
Theories of Momentum

- Hong and Stein (1999) assume that some investors watch firms' fundamentals and ignore stock prices
  - Momentum occurs as information diffuses across investors
- If there is less credible information about OTC stocks, this effect may be weak, leading to two predictions:
  - 1) Listed momentum > OTC momentum
  - 2) Momentum is higher in among those OTC stocks that newswatchers might follow (e.g., large and high disclosure)
- Also, in low information environments, momentum should be long-lasting and it may not reverse

Theories of Momentum

- OTC momentum, on average, is weaker than listed momentum
- We can test for long-term reversal or continuation by examining the OTC stocks that exhibit momentum, so we value weight
- Construct long-horizon momentum portfolios following Jegadeesh and Titman (1993)

Momentum Does not Reverse in 5 Years



- *Note: Comparison above uses VW returns because short-run GRW momentum returns are small in OTC stocks*

Alternative Momentum Theories

- Caused by overconfidence and self-attribution bias in Daniel, Hirshleifer, and Subrahmanyam (1998)
  - Inconsistent with positive long-term momentum returns
- Caused by institutions who use momentum trading strategies in Vayanos and Woolley (2012)
  - Inconsistent with double sort of momentum and *InstHold*

Conclusion

- We provide tests of theories of expected returns based on fresh out-of-sample US evidence
  - OTC liquidity premiums are far larger than in listed markets [Look for liquidity premiums in markets where assets are actually illiquid]
  - Miller (1977) and Hong and Stein (1999) explain the patterns in return premiums well
- Key takeaway
  - In the presence of limits to arbitrage, investor clientele and firm disclosure can have a substantial impact on stock pricing