Variation in Liquidity and Costly Arbitrage

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Variation in Liquidity and Costly Arbitrage

- Model arbitrageur behavior under time-varying liquidity

- Predictions: In stocks with high variation in liquidity

  - Arbitrage activity is lower

  - Mispricing is severe

- Empirical results consistent with the model

- Arbitrage based explanation

  - -ve relationship between variation in liquidity and returns

Model

- 2 assets: 1 risky asset and risk free asset

- 3 Participants: Arbitrageur, Noise Traders, Index funds

- Demand for risky asset

  - X - Arbitrageurs

  - Z - Noise Traders

  - k - Fraction of asset supply S held by index funds

Modelling Variation in Liquidity

- Stochastic Price Impact
  - Purchase(sale) of X results in price increase (decrease) of ψX
  - $\psi \sim N(\mu_\psi, \sigma_\psi^2)$

- Profits: $P = X\tilde{r} - q(\psi_1 X + \psi_0 X)$
  - Where q=1 for buy and q=-1 for sell

- Arbitrageur has to initiate a trade and exit to profit.

- Profits: $P = X\tilde{r} - q(\psi_1 X + \psi_0 X)$

- Execution cost at exit ψ_1 is unknown at initiation

Why does uncertain ψ_1 matter?

- Arbitrageurs might be unable to time liquidity

  ▶ Subject to outflow from investors - Shleifer and Vishny (1997)

- Arbitrageurs might have to sell when liquidity is low

  ▶ Price Pressure in stocks held by extreme outflows MFs - Coval and Stafford (2007)

Arbitrageur Demand

- Arbitrageur demand is given by

$$X = \frac{\mu_r - q(\mu_\psi + \psi_0)}{\gamma(\sigma_r^2 + \sigma_\psi^2)} \qquad (1)$$

- Investment in risky asset
  - Decreases with variation in liquidity

Equilibrium

- Equilibrium returns

$$\mu_r = \gamma(\sigma_r^2 + \sigma_\psi^2)Y + q(\mu_\psi + \psi_0) \tag{2}$$

- $Y = (1 - k)S - Z$

  - +ve for underpriced stocks

  - -ve for overpriced stocks

- Relationship between μ_r and σ_ψ^2 depends on sign on Y

Hypothesis

- Mispricing severe when variation in liquidity is high

  ▸ Arbitragers take less position

  ▸ Prices deviate and mispricing is severe

- Among overpriced stocks

  ▸ High variation in liquidity most overpriced

- Among underpriced stocks

  ▸ High variation in liquidity most underpriced

Measures of variation in liquidity

- Primary measure
  - ▸ TURNVOL: Std Dev of monthly TURNOVER

- Other Measures
  - ▸ DTURNVOL: Std Dev of daily TURNOVER
  - ▸ AMIHUDVOL: Std Dev of Amihud Illiquidity
  - ▸ CVTURN: TURNVOL/TURN

Mispricing Measure: Mispricing Scores

- Stambaugh, Yu, and Yuan (2015) mispricing score
  - Net stock issues
  - Composite equity issues
  - Accruals
  - Net Operating Assets
  - Asset Growth
  - Investment-to-Assets
  - Distress
  - O-score
  - Momentum
  - Gross Profitability Premium
  - Return on Assets

Methodology

- Each month, sort stocks independently into quintiles
  - ▸ MISPRICING
  - ▸ TURNVOL

- Use Fama and French 5 factors for risk adjustment

- Standard errors corrected for heteroskedasticity

Main Results: Mispricing and TURNVOL

- Mispricing increases with TURNVOL

| Mispricing | TURNVOL | | | | | |
	Low	2	3	4	High	High - Low
Low	-0.04%	-0.01%	0.43%	0.39%	0.50%	0.53%
	(-0.49)	(-0.15)	(4.98)	(3.37)	(2.96)	(2.87)
2	-0.12%	-0.09%	-0.02%	0.30%	0.53%	0.65%
	(-1.43)	(-1.29)	(-0.26)	(2.87)	(3.02)	(3.41)
3	-0.19%	-0.02%	-0.12%	0.04%	0.36%	0.55%
	(-1.80)	(-0.22)	(-1.45)	(0.38)	(2.57)	(2.80)
4	-0.17%	-0.28%	-0.10%	-0.21%	0.02%	0.19%
	(-1.51)	(-2.82)	(-0.99)	(-1.88)	(0.14)	(0.99)
High	-0.21%	-0.21%	-0.42%	-0.58%	-1.00%	-0.79%
	(-1.63)	(-1.52)	(-3.56)	(-4.98)	(-7.36)	(-4.20)
Low - High	0.17%	0.19%	0.85%	0.97%	1.49%	1.32%
	(1.20)	(1.11)	(5.53)	(5.37)	(6.82)	(5.15)

Sentiment and Mispricing

- Degree of overpricing varies with sentiment
    - Stambaugh, Yu, and Yuan (2012)

- When arbitrage is hindered, sentiment drives mispricing

- Following High Sentiment Months
    - Mispricing more severe compared to Low Sentiment Months

- Use Baker and Wrugler (2006) investor sentiment measure

Specification

- High sentiment months ($d_H = 1$)

  - Months with sentiment higher than median

- Split the sample based on sentiment previous month.

- Specification

$$R_{it} = a_L \ d_{Lt} + a_H \ d_{Ht} + b \ MKT_t$$
$$+ \ c \ SMB_t + d \ HML_t + e \ CMA_t + f \ RMW_t + \epsilon_{it}$$

(3)

Sentiment and Mispricing

- During High Sentiment months

  - No change in underpriced returns

  - Overpriced High TURNVOL stocks earn even lower returns

Mispricing	Low Sentiment Months			High - Low Sentiment Months		
	TURNVOL			TURNVOL		
	Low	High	High - Low	Low	High	High - Low
Low	-0.08%	0.40%	0.48%	0.07%	0.23%	0.17%
	(-0.91)	(1.92)	(2.08)	(0.46)	(0.78)	(0.48)
High	-0.39%	-0.79%	-0.40%	0.39%	-0.38%	-0.76%
	(-2.25)	(-4.31)	(-1.54)	(1.58)	(-1.51)	(-2.10)
Low - High	0.31%	1.19%	0.88%	-0.32%	0.61%	0.93%
	(1.53)	(4.44)	(2.73)	(-1.16)	(1.53)	(1.95)

Variation in Liquidity and Average Returns

- Stocks with higher variation in liquidity earn lower returns

  - Chordia, Subrahmanyam, and Anshuman (2001)

  - If liquidity varies, risk averse investors should require compensation (Amihud, Mendelson, and Pedersen 2005)

- Potential Explanations

  - Weak evidence of heterogeneity in investors - Chordia, Subrahmanyam, and Anshuman (2001)

  - Valuable option if investors can time trades with liquidity - Pereira and Zhang (2010)

  - Costly Arbitrage ?

Individual stock regression

- Follow Brennan, Chordia, and Subrahmanyam (1998)

- First compute risk adjusted return of individual stocks

- Control for characteristics in Fama-Macbeth
  - SIZE, BM, 1/PRICE, RET23, RET46, RET712

- No relationship between TURNVOL and returns after controlling for mispricing.

Variables	Excess Returns	Excess Returns
ln(SIZE)	-0.151***	-0.141***
	(0.018)	(0.018)
1/PRICE	0.299***	0.351***
	(0.055)	(0.055)
RET23	0.655***	0.485*
	(0.248)	(0.249)
ln(TURNVOL)	-0.300***	-0.098
	(0.039)	(0.072)
MISPRICING		-0.030***
		(0.006)
MISPRICING × ln(TURNVOL)		-0.004**
		(0.001)

- Other Controls: Ln(BM), RET46, RET712, IVOL, Ln(TURN)

Arbitrage Asymmetry

- Overpricing on average when arbitrage is hindered

    - Stambaugh, Yu, and Yuan (2015)

    - Difficult to short stocks due to short sale constraints

    - This creates asymmetry in arbitrage

    - Arbitrageurs allocate more capital to correct underpricing

    - Results in overpricing on average

Controlling for IVOL

- Control for IVOL by 3x3x3 sort

- Mispricing still severe in High TURNVOL Stocks

Mispricing	Low IVOL			High IVOL		
	TURNVOL			TURNVOL		
	Low	High	High - Low	Low	High	High - Low
Low	-0.08%	0.36%	0.44%	0.08%	0.20%	0.12%
	(-1.28)	(3.49)	(3.56)	(0.67)	(1.15)	(0.64)
High	-0.09%	-0.29%	-0.20%	-0.53%	-1.12%	-0.59%
	(-0.80)	(-2.99)	(-1.36)	(-3.51)	(-6.19)	(-2.90)
Low - High	0.01%	0.65%	0.64%	0.61%	1.32%	0.71%
	(0.06)	(4.44)	(3.64)	(3.07)	(5.68)	(2.91)

Conclusion

- Arbitragers worry about uncertainty in liquidity

- Reduce their exposure to stocks with high variation in liquidity

- Mispricing severe in stocks with high variation in liquidity

- Limited arbitrage explains -ve return between variation in liquidity and returns