

Liquidity Risk

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Liquidity Risk data provided by Orissa Group, Inc.

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Few opening claims

- Liquidity risk is well-studied but still an “elusive concept”
- Liquidity risk drives security prices away from fundamentals
- Markets are not efficient in pricing liquidity risk and hence it presents trading opportunities if exploited properly



Understanding Liquidity and Liquidity Risk

- Definition
 - **Liquidity** is the ease of trading a security
 - **Liquidity Risk** is the uncertainty associated with liquidity

- Other Definitions
 - Ease of availability of financing for very short term maturities

How to measure Liquidity?

- First Step: Estimate the cost of liquidating positions
 - Measured as the magnitude of price movements resulting from order size – Amihud (2002)
 - Modeled using **intraday trading data**

$$ILLIQ_t = \frac{|r_t|}{V_t}$$

- Measure is computed on a weekly basis and normalized to allow comparisons across time
- Second Step: Estimate the uncertainty in the cost
 - Formulate a time-series model of illiquidity
 - Estimate liquidity risk as the illiquidity shock – Amihud (2002)

$$ILLIQ_t = a + b * ILLIQ_{t-1} + \varepsilon_t$$

Some Associated Liquidity Jargon

□ Illiquidity Level

- Stock Illiquidity Level (SIL): Normalized $ILLIQ_t$
- Market Illiquidity Level (MIL): Median SIL

□ Liquidity Risk

- Stock Liquidity Rating (SLR): ε_t , i.e. the **illiquidity** shock

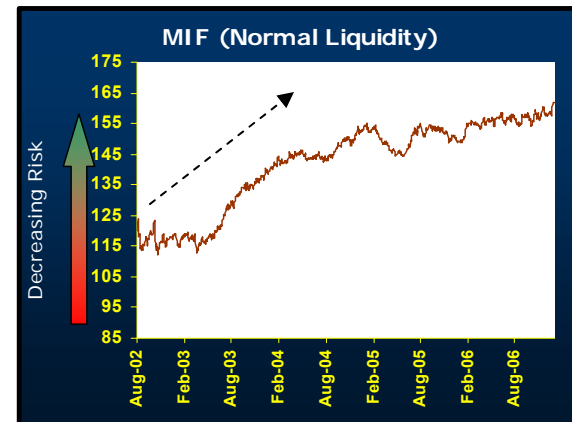
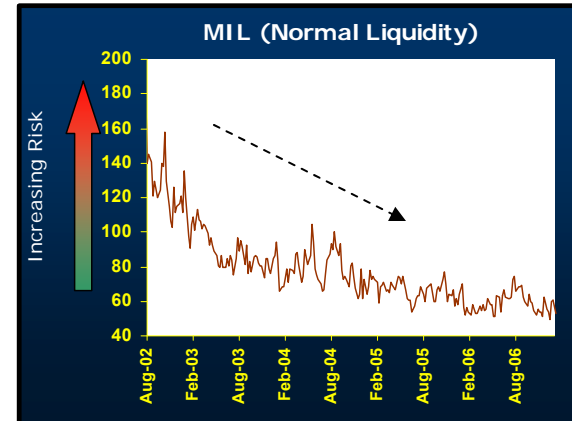
□ Returns to Liquidity Risk

- Market Illiquidity Factor (MIF): Illiquids ***minus*** Liquids

(See Appendix at the end for full definitions)

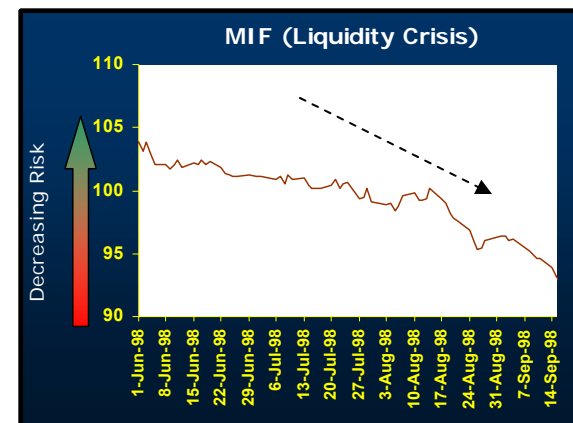
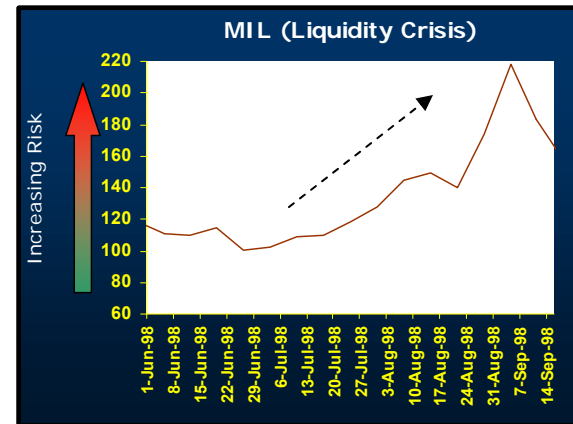
Liquidity Regimes – Normal Markets

- Benign Liquidity Regime
 - Illiquid securities out-perform accompanied with improvement in liquidity fundamentals
 - See Amihud and Mendelson (1986)



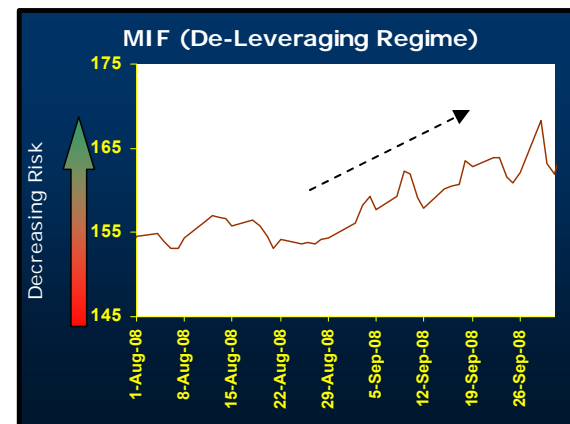
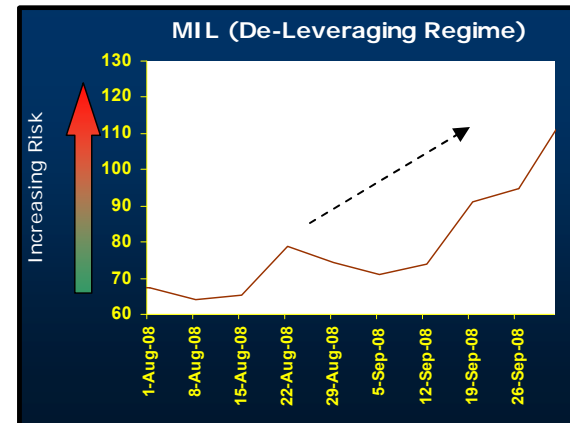
Liquidity Regimes – Flight-to-liquidity

- Liquidity Crisis Regime (“Flight-to-liquidity”)
 - Illiquid securities underperform accompanied with deterioration in liquidity fundamentals
 - August 98 (LTCM crisis)



Liquidity Regimes – Fight-for-liquidity

- De-leveraging Regime (“Fight-for-liquidity”)
 - Illiquid securities out-perform despite deterioration in liquidity fundamentals
 - Reason: During extreme deleveraging situations, investors offload the most liquid, highest quality securities to meet redemptions/margin calls, given these are easiest to sell
 - August 07 (Quant crisis) and August 08 (Credit crisis)



Stock Liquidity Rating (SLR) – Feb 02 2009

LARGE CAP

Highest Liquidity Risk	Lowest Liquidity Risk
CNH GLOBAL NV	APPLE INC
CNA FINANCIAL CORP	EXXON MOBIL CORP
WHITE MTNS INS GROUP LTD	GOOGLE INC
CNX GAS CORP	PROCTER & GAMBLE CO
LEVEL 3 COMMUNICATIONS INC	WAL-MART STORES INC
SOVEREIGN BANCORP INC	GOLDMAN SACHS GROUP INC
VIRGIN MEDIA INC	MICROSOFT CORP
NAVISTAR INTERNATIONAL CORP	GENERAL ELECTRIC CO
LOGITECH INTL SA	WELLS FARGO & CO
MILLICOM INTL CELLULAR SA	CHEVRON CORP

MID CAP

Highest Liquidity Risk	Lowest Liquidity Risk
COMVERSE TECHNOLOGY INC	IMCLONE SYSTEMS INC
VALHI INC	POLO RALPH LAUREN CP -CL A
ELBIT SYSTEMS LTD	SANDISK CORP
ASM INTERNATIONAL NV	SMUCKER (JM) CO
AMERICAN NATIONAL INSURANCE	PHILADELPHIA CONS HLDG CORP
WESCO FINANCIAL CORP	ITT EDUCATIONAL SERVICES INC
CTC MEDIA INC	HEALTH CARE REIT INC
ALLIANCE HOLDINGS GP LP	DRYSHIPS INC
SYNUTRA INTERNATIONAL INC	LIBERTY PROPERTY TRUST
ISTAR FINANCIAL INC	DELTA AIR LINES INC

SMALL CAP

Highest Liquidity Risk	Lowest Liquidity Risk
GEOMET INC	AMR CORP/DE
NATIONAL WESTERN LIFE -CL A	FIRST NIAGARA FINANCIAL GRP
CREDIT ACCEPTANCE CORP	RALCORP HOLDINGS INC
ARDEN GROUP INC -CL A	JETBLUE AIRWAYS CORP
ORBOTECH LTD	MENTOR CORP
ASPEN TECHNOLOGY INC	DICKS SPORTING GOODS INC
ALTRA HOLDINGS INC	UAL CORP
CAPITAL SOUTHWEST CORP	CONCUR TECHNOLOGIES INC
EXPONENT INC	CONTINENTAL AIRLNS INC -CL B
GRUMA SA DE CV -ADR B	HEARTLAND EXPRESS INC

ADR

Highest Liquidity Risk	Lowest Liquidity Risk
BRITISH AIRWAYS PLC	BAIDU.COM INC
51JOB INC	TEVA PHARM INDS
AUSTRALIA & NW ZLND BK	GOLD FIELDS LTD
METSO CORP	NOKIA CORP
CHINA TECHFAITH WIRELESS	TAIWAN SEMICONDUCTOR
NATIONAL AUSTRALIA BK -ADS	UNILEVER NV
INDUSTRIAS BACHOCO SAB	CHINA LIFE INS CO
KONAMI CORP	PETROCHINA CO LTD
LAFARGE SA	TOTAL SA
WNS (HOLDINGS) LTD	ANGLOGOLD ASHANTI LTD

Liquidity Risk is estimated using trailing one month intra-day trading data

Stocks are grouped into Large Cap, Mid Cap and Small Cap using market capitalization as of 6/30/2008

Large Cap: Largest 500 U.S. Securities

Mid Cap: Largest 500 to 1000 U.S. Securities

Small Cap: Largest 1000 to 2000 U.S. Securities

Liquidity Analysis presents alpha generation opportunities – US and India evidence

	ANNUALIZED MEAN		ANNUALIZED STD	
	PRIOR LIQUIDITY IMPROVING	PRIOR LIQUIDITY DETERIORATING	PRIOR LIQUIDITY IMPROVING	PRIOR LIQUIDITY DETERIORATING
DJI	9.04%	6.81%	14.02%	19.43%
Russell 2000	18.35%	-5.34%	15.36%	23.95%
NIFTY	35.82%	12.56%	17.96%	28.28%
NIFTY JR	57.92%	-6.58%	20.85%	32.34%

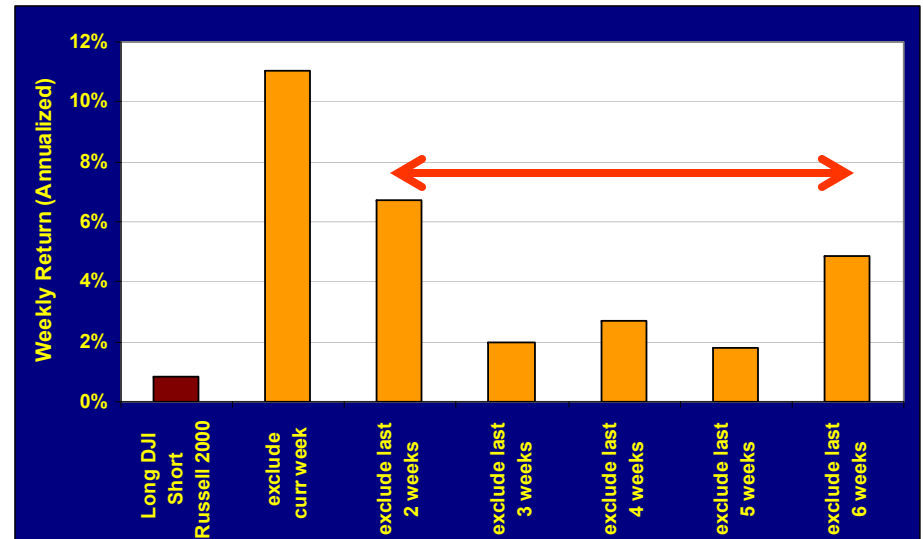
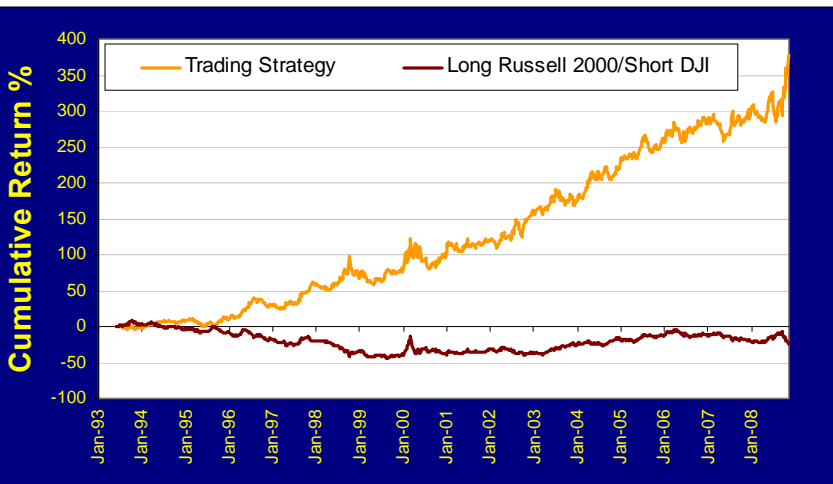
US MIL and Index Data (Jan 1993 - Nov 2008), India MIL and Index Data (Feb 2001 - Dec 2007)

- When Market Illiquidity Level (MIL) **increases** (i.e., as liquidity deteriorates)
 - Investors favor liquid securities over illiquid securities
 - US: Russell 2000 (proxy for illiquid securities) **underperforms** DJ Industrial Average (proxy for liquid securities)
 - India: NIFTY JR (proxy for illiquid securities) **underperforms** NIFTY Average (proxy for liquid securities)

- When Market Illiquidity Level (MIL) **decreases** (i.e., as liquidity improves)
 - Market participants favor illiquid securities over liquid securities
 - US: Russell 2000 **outperforms** DJ Industrial Average
 - India: NIFTY JR **outperforms** NIFTY

Liquidity Analysis presents alpha generation opportunities

- When MIL increases
 - **Short** Russell 2000 (RUT)
 - **Long** Dow Jones Industrial Average (DJI)
- When MIL decreases
 - **Long** Russell 2000 (RUT)
 - **Short** Dow Jones Industrial Average (DJI)
- Weekly rebalancing



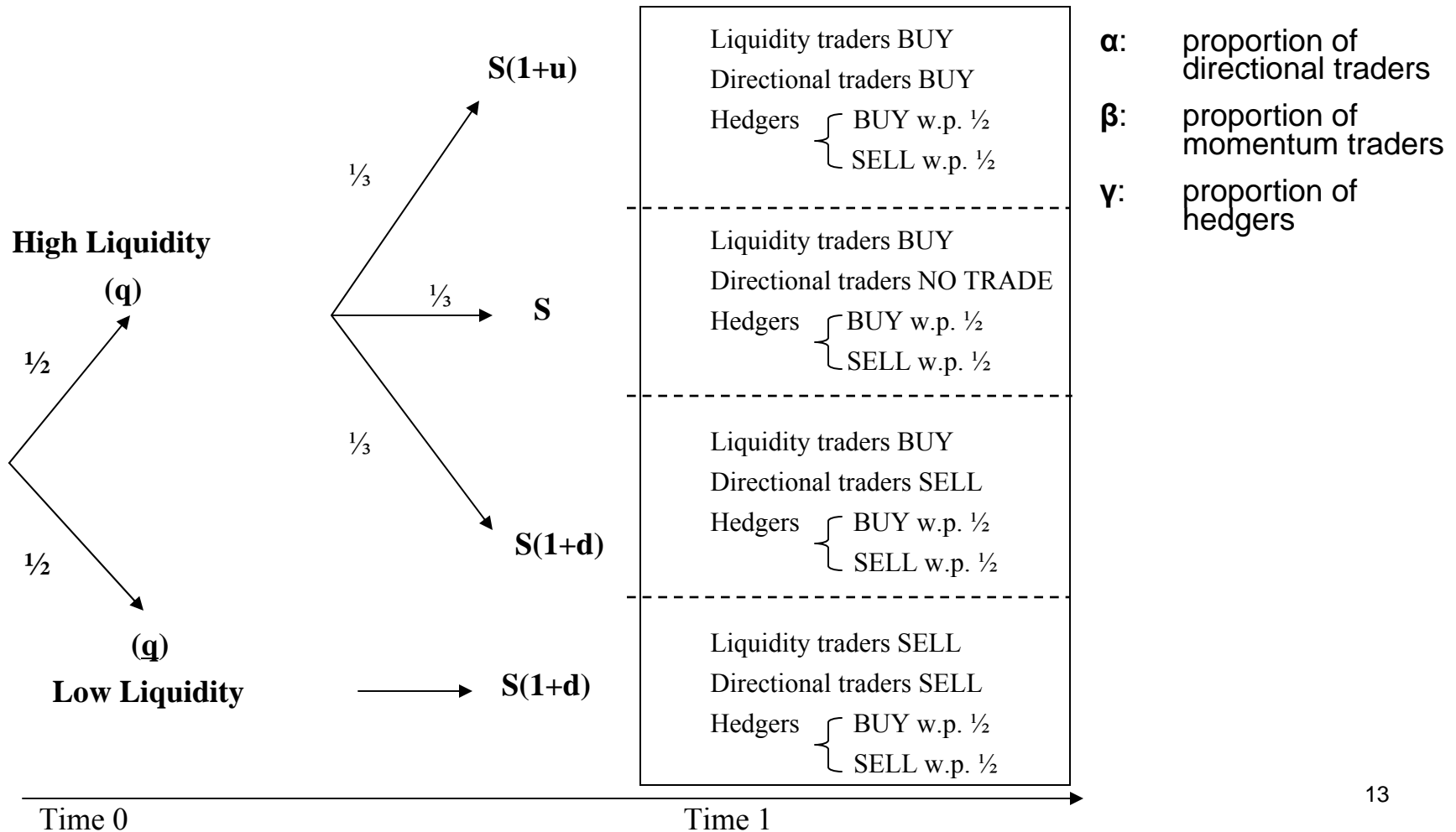
- Outperforms
 - Naïve Long DJI / Short RUT strategy
 - HFR Equity Market Neutral strategy
- The MIL based trading signal is persistent
- Results does not consider transaction costs

Trading Agents and Liquidity Risk

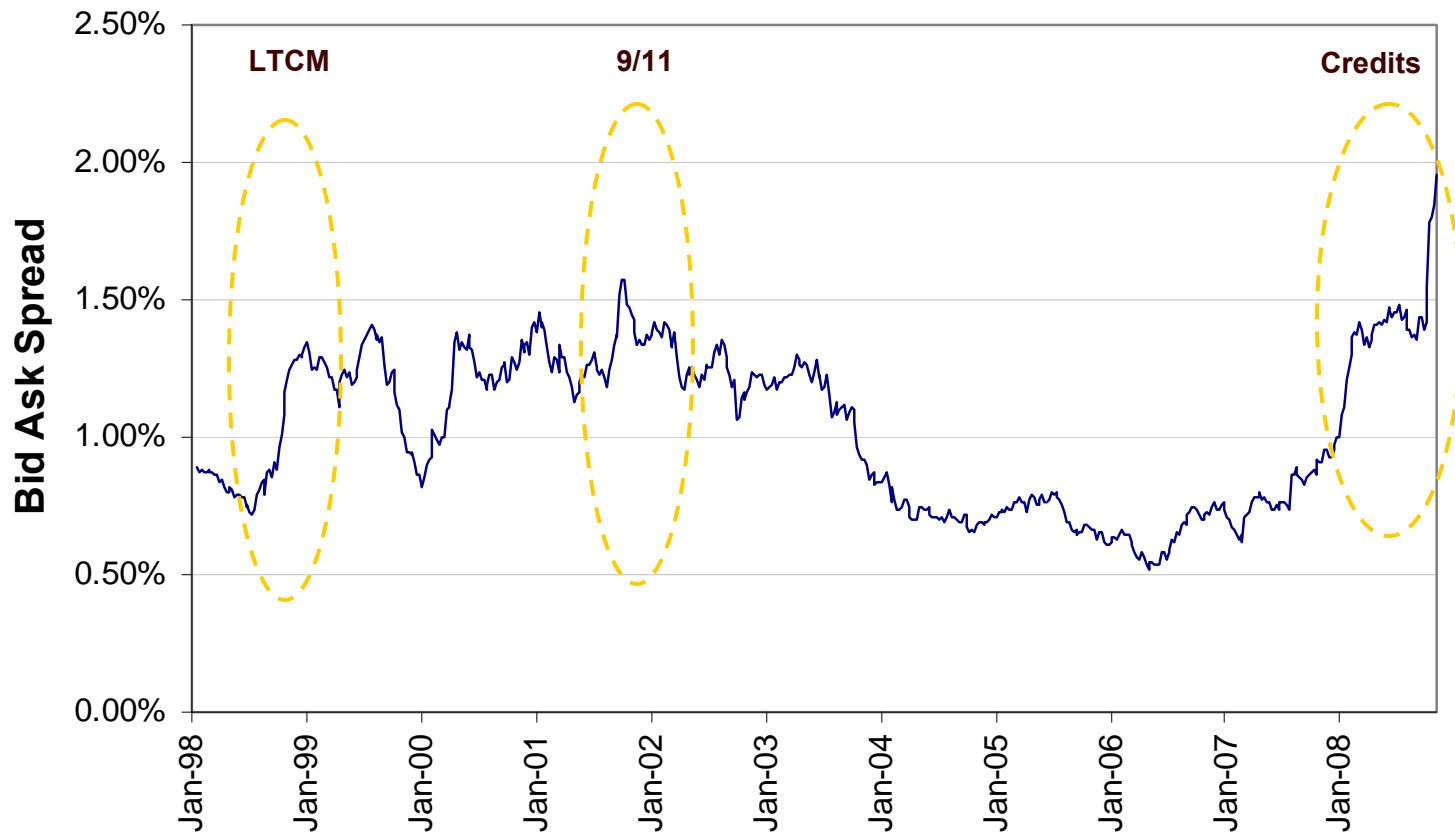
- Model Trading agents as
 - Directional Traders: Informed about stock market's direction (insiders, momentum traders)
 - Liquidity Traders: Informed about liquidity conditions. Trading is influenced by strategic liquidity needs
 - Hedgers: Trading is influenced by hedging requirements (uninformed)

- Provides a theoretical framework for forecasting future liquidity **given** there is persistence in agents' behavior

Trading Agents and Liquidity Risk

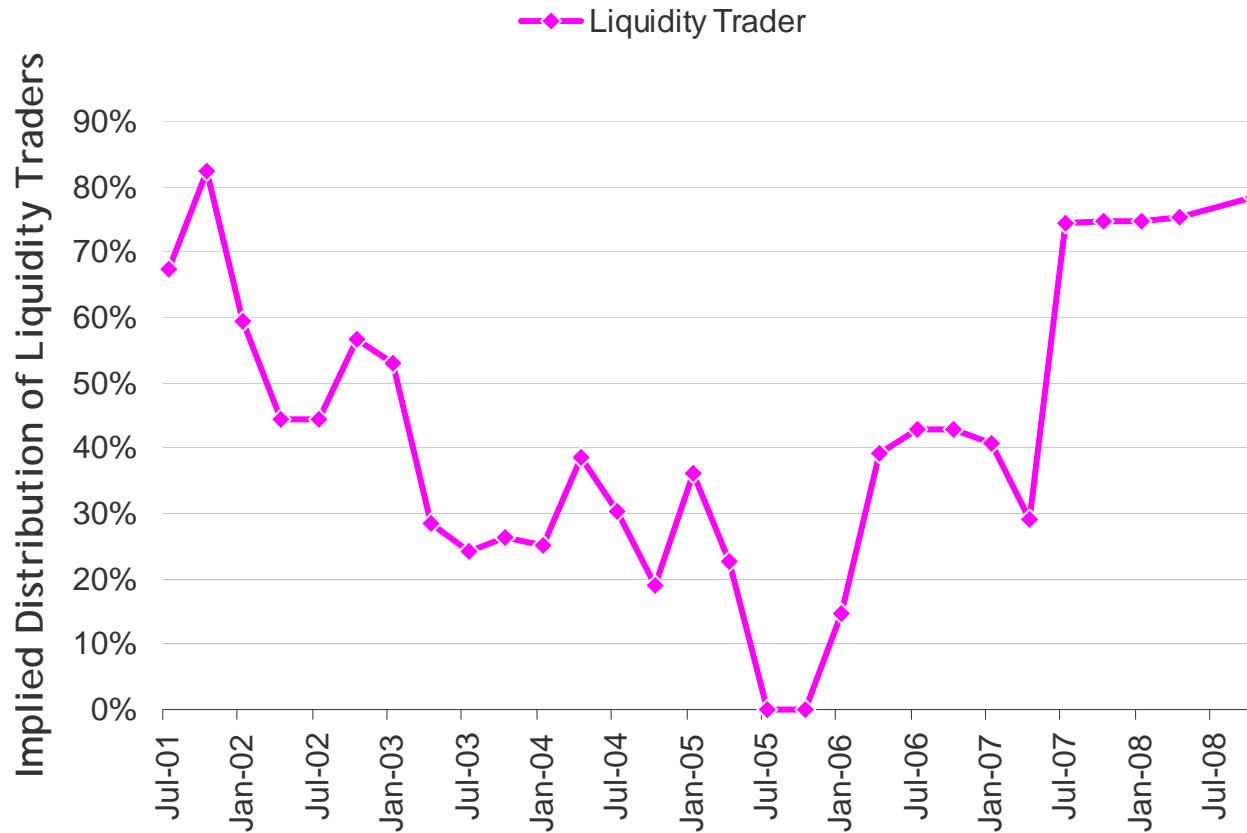


Application – Forecasting Future Liquidity



Universe: Largest 3000 U.S. Equities

Liquidity Traders – Time Series Distribution



Summary

- Liquidity Risk an important source of risk and still being understood
- We introduced empirical metrics to estimate liquidity risk using **intraday** data that have predictive ability
- By conjoining the empirical model with the theoretical one, we established a framework to forecast future liquidity
- Introduce simple trading strategies to exploit liquidity risk

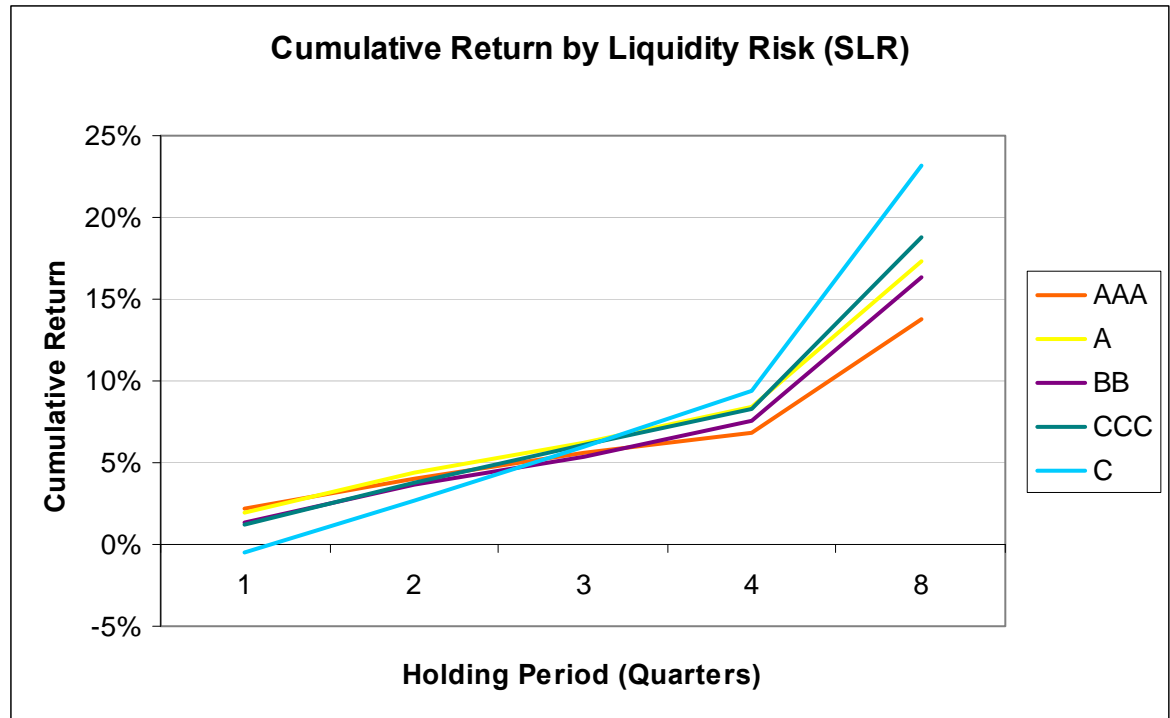


Appendix

Appendix: Applications in portfolio management: The evidence

The U.S. evidence suggests

- for shorter holding periods (less than 3 quarters) **liquid securities** provide a higher return on investments
- for longer holding periods (more than 3 quarters) **illiquid securities** provide a higher return on investments



Notes

1. Liquidity Risk is expressed using the Stock Liquidity Rating (SLR) scheme: (AAA, AA, A, BBB, BB, B, CCC, CC, C and D) with AAA having lowest risk and D having highest risk
2. Cumulative Return is the equally weighted return for given SLR portfolio, adjusted for round trip market impact cost. A SLR portfolio is defined as all stocks with a given SLR selected from the universe of largest 3000 U.S. stocks. The average size of a portfolio is \$300 million. The portfolio is held constant throughout the holding period.
3. Period analyzed: Jan 1993 – Jun 2008

Appendix: Size and Turnover proxies insignificant in regression with liquidity risk

- Panel regression of security's future quarter return against various explanatory variables
- Regression is performed with fixed effects using quarterly time series data across public U.S. equities from 1993-2007
- Various variables enter the regression as a percentile number (0-1), where the percentile value is recomputed every quarter
- The explanatory variables include the current quarter's Security Illiquidity level (SIL), Security Liquidity Rank (SLR), market capitalization, turnover, book value/price (using trailing 1 year data) and eps/price (using trailing 1 year data)

Explanatory variable (previous quarter value)	Coefficient
previous_quarter_return	-0.04 (-18.25)
illiquidity	0.23 (-43.93)
liquidity_risk	0.01 (-2.51)
market_cap	0.04 (-0.95)
turnover	0.00 (-0.09)
bookvalue_by_price	0.08 (-20.69)
eps_by_price	0.01 (-1.53)
constant	0.3475896 (-25.13)

Appendix: Trading Agents and Liquidity Risk

Main Results

Result 1 (BID / ASK Prices)

a) *The equilibrium ASK Price is given by:*

$$S(1+u)(1+q)(\alpha + \beta + 1)/(6 - 4\alpha) + S(1+q)(1 + \beta - \alpha)/(6 - 4\alpha) \\ + S(1+d)(1+q)(1 + \beta - \alpha)/(6 - 4\alpha) + S(1+d)(1+q)(3(1 - \alpha - \beta))/(6 - 4\alpha)$$

b) *The equilibrium BID Price is given by:*

$$S(1+u)(1+q)(1 - \alpha - \beta)/(6 + 2\alpha) + S(1+q)(1 - \alpha - \beta)/(6 + 2\alpha) \\ + S(1+d)(1+q)(1 + \alpha - \beta)/(6 + 2\alpha) + S(1+d)(1+q)(3 + 3\alpha + 3\beta)/(6 + 2\alpha)$$

Result 2 (BID / ASK Spread)

$$\frac{1}{2} \{ S(1+u)(1+q) [(6-\alpha)(\alpha+\beta) + 3\alpha] + S(1+q) [(6-\alpha)(3\alpha+\beta) - 15\alpha] \\ + S(1+d)(1+q) [(6-\alpha)(\beta-\alpha) + 3\alpha] + 3*S(1+d)(1+q) [\uparrow(6-\alpha)(\alpha+\beta) + 3\alpha] \} / \\ [(3+\alpha)(3-2\alpha)]$$

Appendix: Liquidity is important in explaining asset returns

- Traditional asset pricing models are based on frictionless markets.
- However markets are plagued by some form of illiquidity
 - Prices are not always at fundamental and are affected by trading activity
- Hence asset pricing models should incorporate liquidity
 - Macroeconomic factors (e.g., Risk free rate, LIBOR OAS)
 - Market factors
 - Size factor
 - Value factor
 - Market sentiment (e.g., VIX)
 - **Liquidity** (MIL)

Appendix: Liquidity is important in explaining asset returns

- Market Illiquidity Level (MIL) measures the illiquidity level aggregated for the entire market (run at the index level)

	Intercept	Size	Value	T-Bill	T-Bill LIBOR OAS	VIX	MIL	Adjusted R ² without MIL	Adjusted R ² with MIL
Russell 2000	0.84	0.56	-0.71	-0.34	-0.02	-0.03	-0.07	0.40	0.48
S&P 500	0.89	-0.52	-0.86	-0.79	-0.01	-0.03	-0.07	0.31	0.42
DJI	0.84	-0.58	-0.62	-0.94	-0.01	-0.03	-0.08	0.20	0.32
Hang Seng	0.76	-0.14	-0.52	-0.93	0.04	-0.03	-0.08	0.06	0.11
DAX	1.25	-0.29	-0.69	-0.16	-0.02	-0.05	-0.09	0.13	0.22
FTSE	0.79	-0.28	-0.45	0.19	-0.01	-0.04	-0.06	0.11	0.18

Coefficients in **bold** indicate significance level greater than 99%

Appendix: Definitions

- **Market Illiquidity Level (MIL)** is the median illiquidity level for stocks, as captured by the Stock Illiquidity Level (SIL), for the entire market of stocks selected from a universe of 3000 largest public U.S. equities by market capitalization, as determined at the beginning of the quarter. The weekly SIL for each stock is determined using intra-day trading data ($ILLIQ_t$). The median SIL across the universe is denoted as MIL. The MIL is based on an initial value of 100 registered on Jan 8, 1993. An increase in MIL indicates deteriorating liquidity conditions. When MIL declines, illiquid securities can be expected to outperform liquid securities. When MIL increases, illiquid securities can be expected to underperform liquid securities.
- **Stock Liquidity Rating (SLR)** measures a stock's liquidity risk, given by the uncertainty associated with the cost of liquidating a position (ε_t). SLR categorizes a stock into one of ten liquidity risk buckets (AAA, AA, A, BBB, BB, B, CCC, CC, C, D), with AAA having the least risk and D the greatest risk
- **Market Illiquidity Factor (MIF)** measures how liquidity risk is priced by market participants. It measures the cumulative return of illiquid securities relative to liquid securities as ranked by the stock-level liquidity rating system (SLR). The MIF for the U.S Equities Market is created through analysis of the 3,000 largest U.S. stocks. The MIF is based on an initial value of 100 registered on April 1, 1993.

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