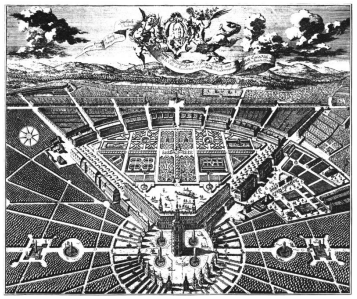

10th Symposium on Finance, Banking, and Insurance

Universität Karlsruhe (TH), December 14 – 16, 2005

Opening Lecture

Prof. Richard Roll

University of California

Recent Research about Liquidity

Universität Karlsruhe
14 December 2005

Northern Finance Association

Vancouver,
October 1, 2005

L'Association de Finance du Nord

Vancouver,
le premier Octobre, 2005


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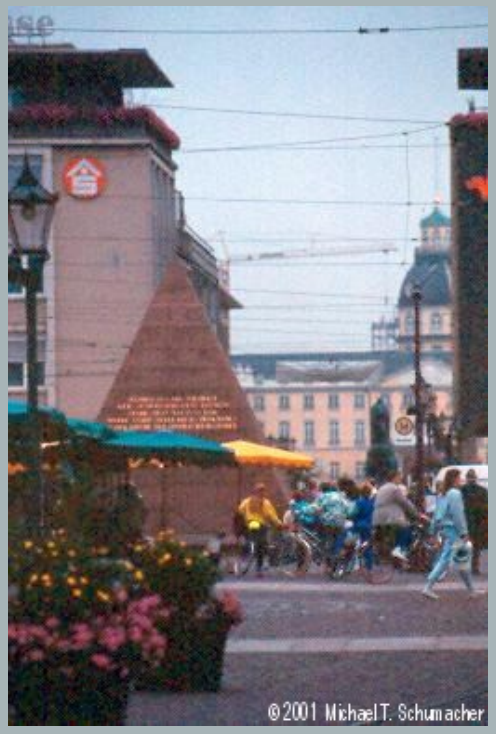
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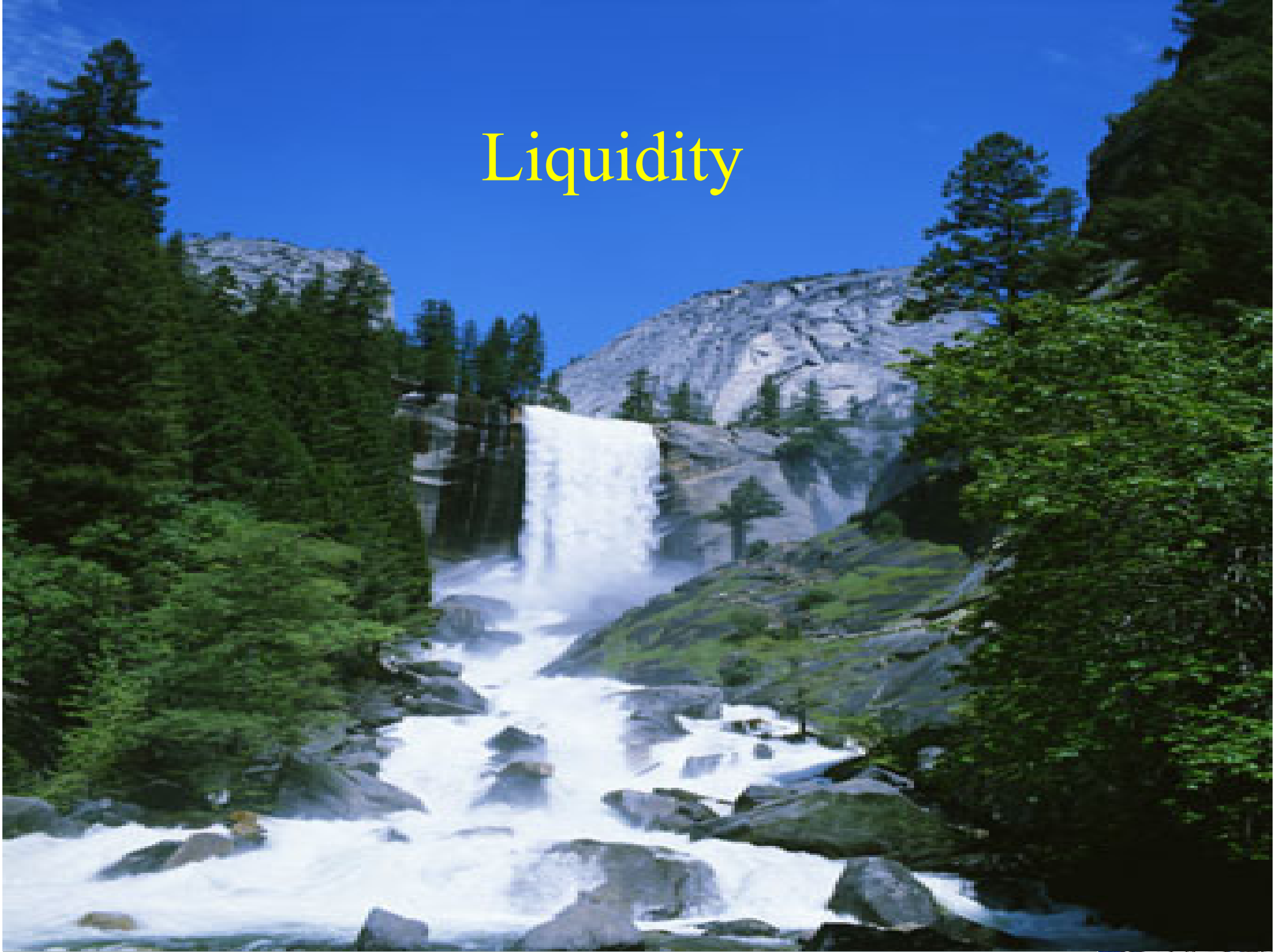
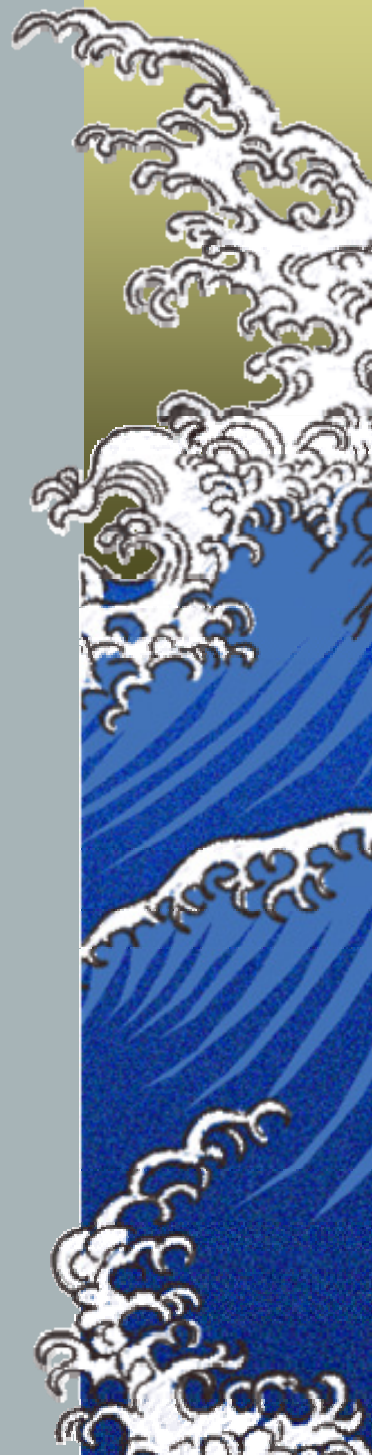

Liquidity

Presented by

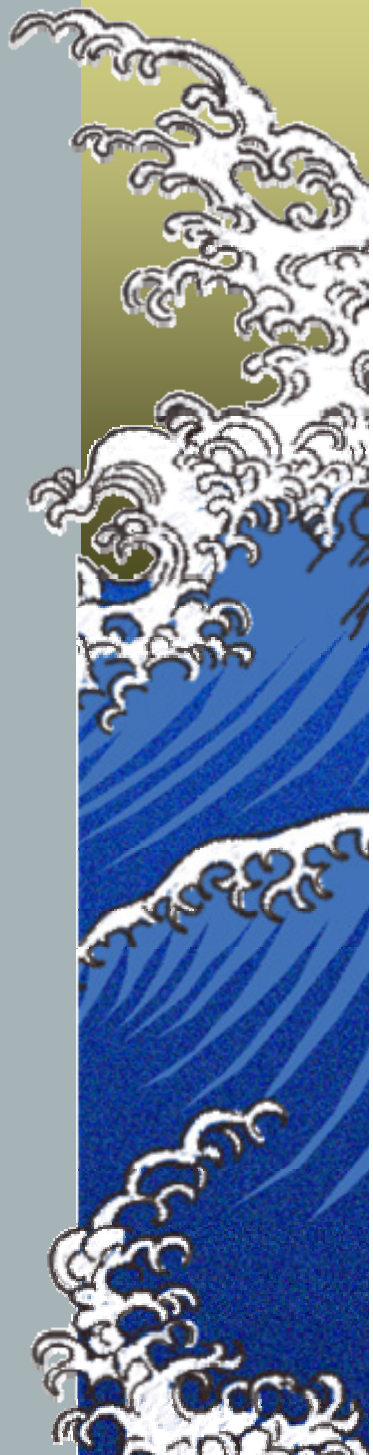
Recent Research About Liquidity

- *Liquidity: What is it?*
- *Like the U.S. Supreme Court said about pornography, "it's hard to define but we know it when we see it!"*
- *Liquidity was always a focus of market professionals but was not the subject of intensive academic research until recently*



Liquidity Literature

- *Using the keywords "liquidity" or "illiquidity," to search the econlibrary.com data base returns 934 papers with these words in the title*
- *However, many of these are not pertinent to market liquidity; e.g.,*
  - *The "liquidity trap"*
  - *Liquidity preference and risk*
  - *Liquidity premium term structure theory*
- *Also, some are purely theoretical; I'm focusing on empirical issues*



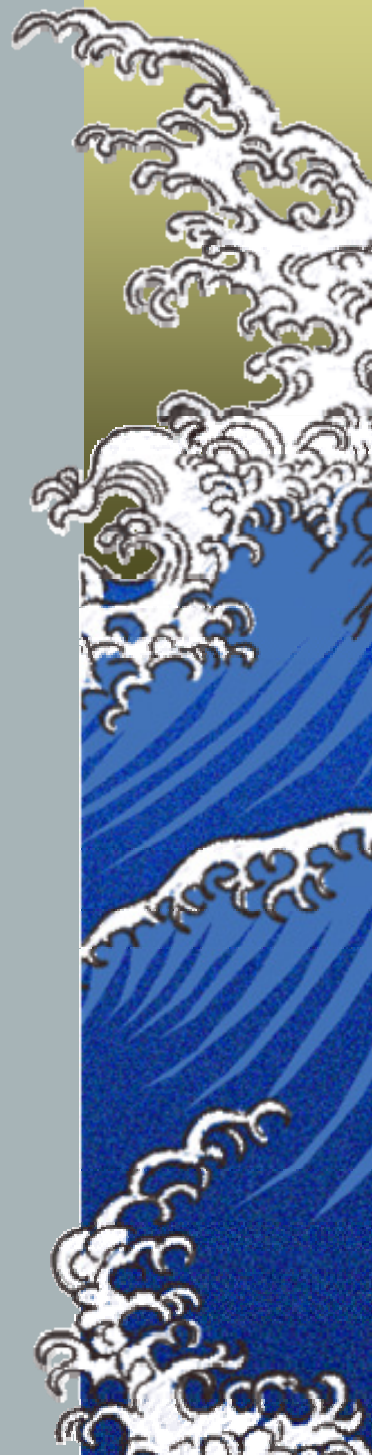
Liquidity Literature (2)

- *In the following journals:*

FAJ, JBF,JB,JF,JFQA,JFE,JFM,JPE,PBFJ,RFS

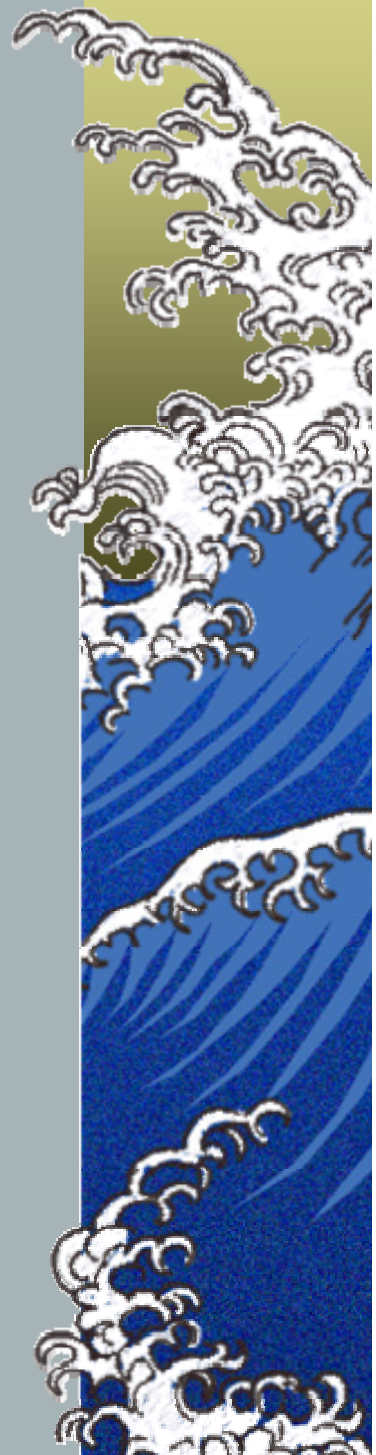
- *there are 147 papers on market liquidity in the following decades:*

1950s	*3*
1960s	*11*
1970s	*10*
1980s	*10*
1990s	*45*
2000s	*68*



Liquidity Literature (3)

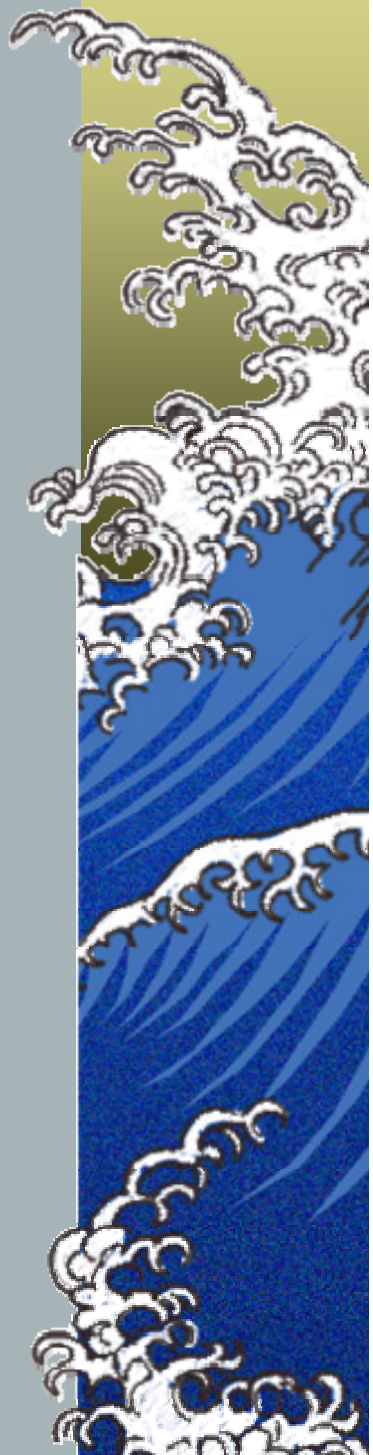
- *The fourth oldest paper:*
- *Alan Greenspan, "Liquidity As A Determinant Of Industrial Prices And Interest Rates," Journal of Finance, 1964*
- *I initially had high hopes for this paper, but it's about using the quantity theory of money to forecast interest rates; and here's what he said*



" 'Twas brillig, and the slithy toves Did gyre and gimble in the wabe; All mimsy were the borogoves, And the mome raths outgrabe fifty basis points."

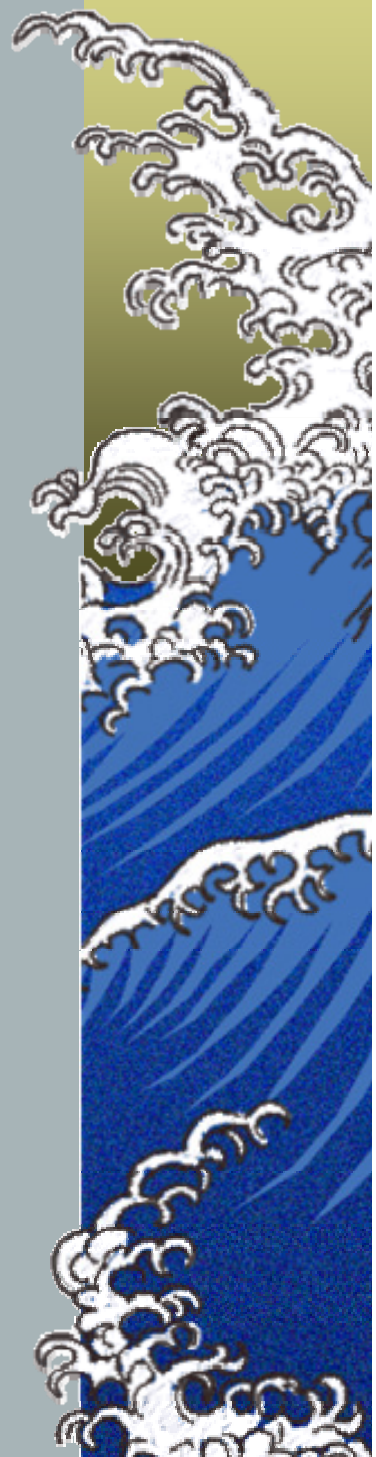
Empirical Definitions of Liquidity

- *Aitken and Comerton-Forde (PBFJ, January 2003)*
  - *68 different measures used in the literature*
  - *Two basic types*
    - *Trade-based measures*
      - *Volume*
      - *Number of trades, etc.*
    - *Order-based measures*
      - *Bid-ask spreads, quoted depth, depth of order book*



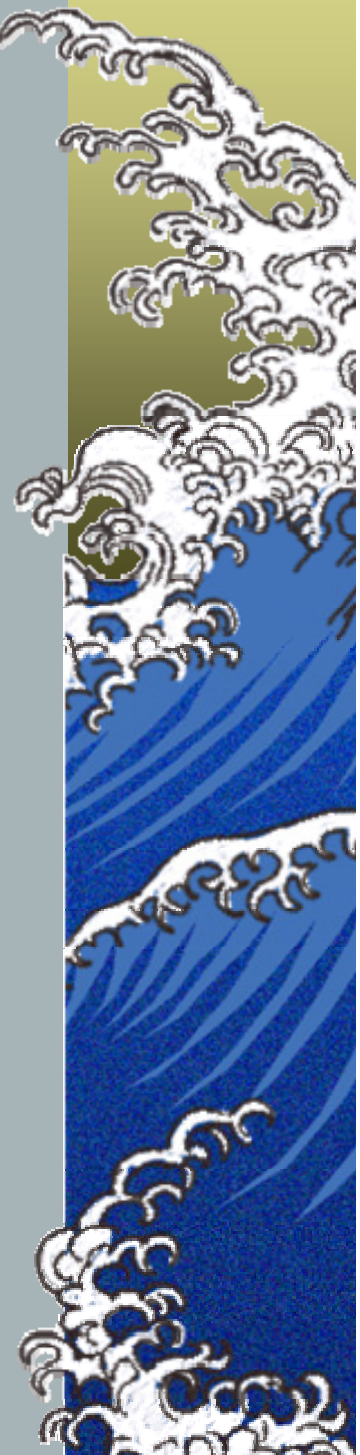
Trade-based measures

- *Volume, frequency of trading, dollar value of shares traded, etc.*
- *Intuitively, these are not good because they can be high when the market is in a crisis and liquidity is actually low*
- *Also, they're not very correlated with order-based measures; e.g., volume and spreads often have negative correlation*



Order-based measures

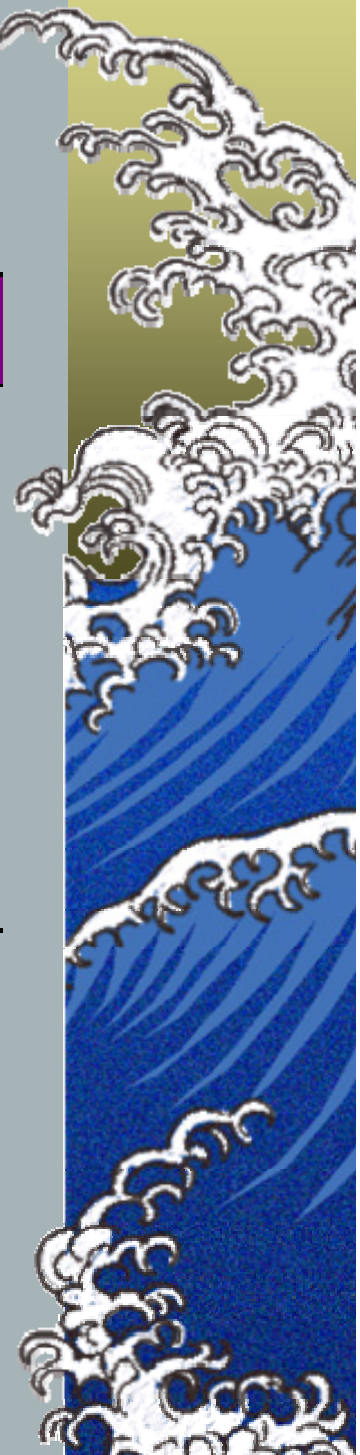
- *Quoted spreads, effective spreads, depth and combinations*
- *Generalizations using orders in the book, when available*
- *These are the focus of much recent research, which is partly driven by the availability of transactions data, (e.g., TAQ and similar data bases)*



Commonly-used empirical liquidity measures

	Acronym	Definition	Units
Quoted Spread	QSPR	$P_A - P_B$	$
Proportional Quoted Spread	PQSPR	$(P_A - P_B)/P_M$	None
Depth	DEP	$\frac{1}{2}(Q_A + Q_B)$	Shares
Effective Spread	ESPR	$2\lvert P_t - P_M \rvert$	$
Proportional Effective Spread	PESPR	$2\lvert P_t - P_M \rvert / P_t$	None

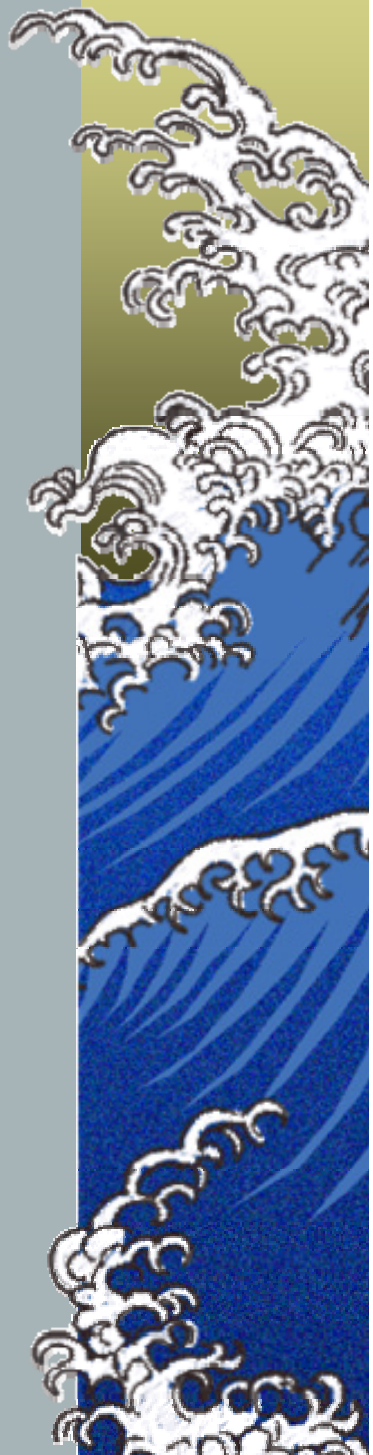
P denotes price and subscripts indicate: t=actual transaction, A=ask, B=bid, M=bid/ask midpoint. Q denotes the quantity guaranteed available for trade at the quotes, (with subscripts: A=ask, B=bid.)



Summary Statistics for NYSE

Cross-sectional statistics for time-series means

	Mean	Median	Standard Deviation
QSPR	0.3162	0.2691	1.3570
PQSPR	0.0160	0.0115	0.0136
DEP	3776	2661	3790
ESPR	0.2245	0.1791	1.3051
PESPR	0.0111	0.0077	0.0132



Liquidity is highly volatile

Cross-sectional statistics for time-series means

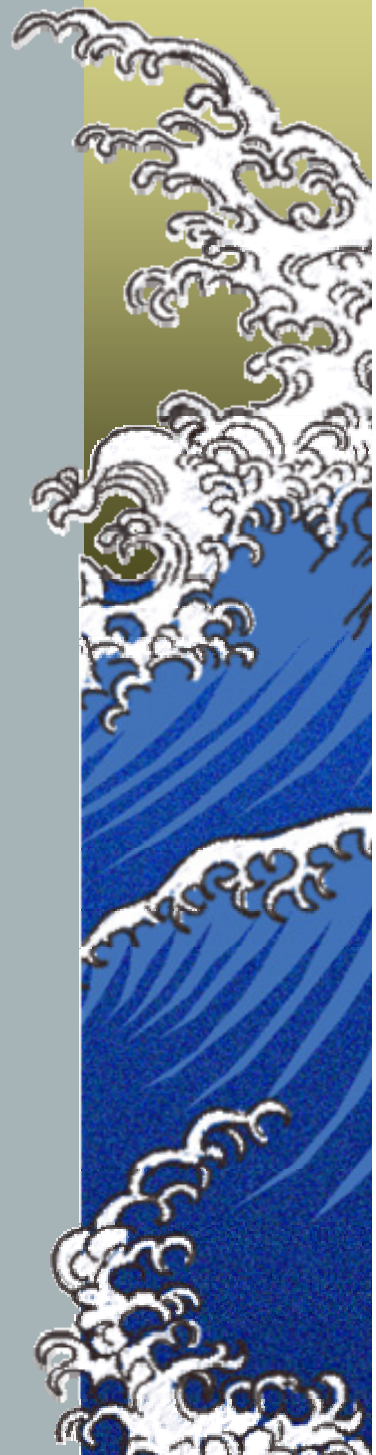
	Mean	Median	Standard Deviation
|DQSPR|	0.2396	0.2373	0.0741
|DPQSPR|	0.2408	0.2386	0.0742
|DDEP|	0.7828	0.6543	0.4533
|DESPR|	0.3148	0.2976	0.1367
|DPESPR|	0.3196	0.2977	0.1811

"D" preceding the acronym, e.g., DQSPR, denotes a proportional change in the variable across successive trading days; i.e., for liquidity measure L, $DL_t \equiv (L_t - L_{t-1})/L_{t-1}$ for trading day t. $|DL_t|$ denotes the absolute value of the daily proportional change.

- *Individual percentage changes in spreads and depth have volatilities that exceed that of returns themselves!*

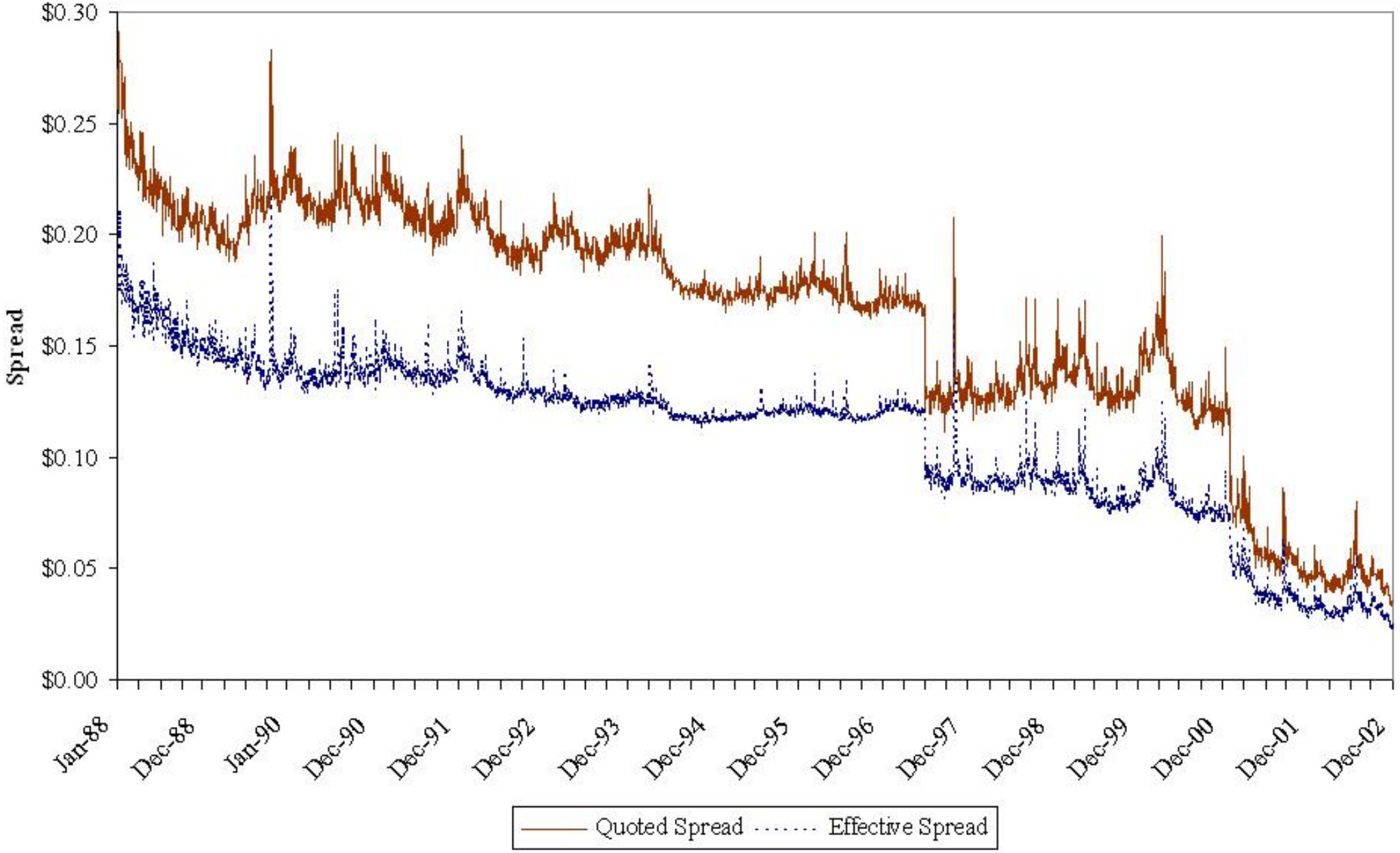
Liquidity, micro or macro?

- *Until recently, liquidity research examined individual assets*
  - *Poor liquidity reduces an asset's value (Amihud and Mendelson)*
  - *Analogous to yield premium on low-grade debt*
- *More recently, it has become clear that liquidity is a market-wide phenomena*
- *There is commonality across assets (co-movement) in liquidity*
- *The raises the question of whether it might be a non-diversifiable risk*

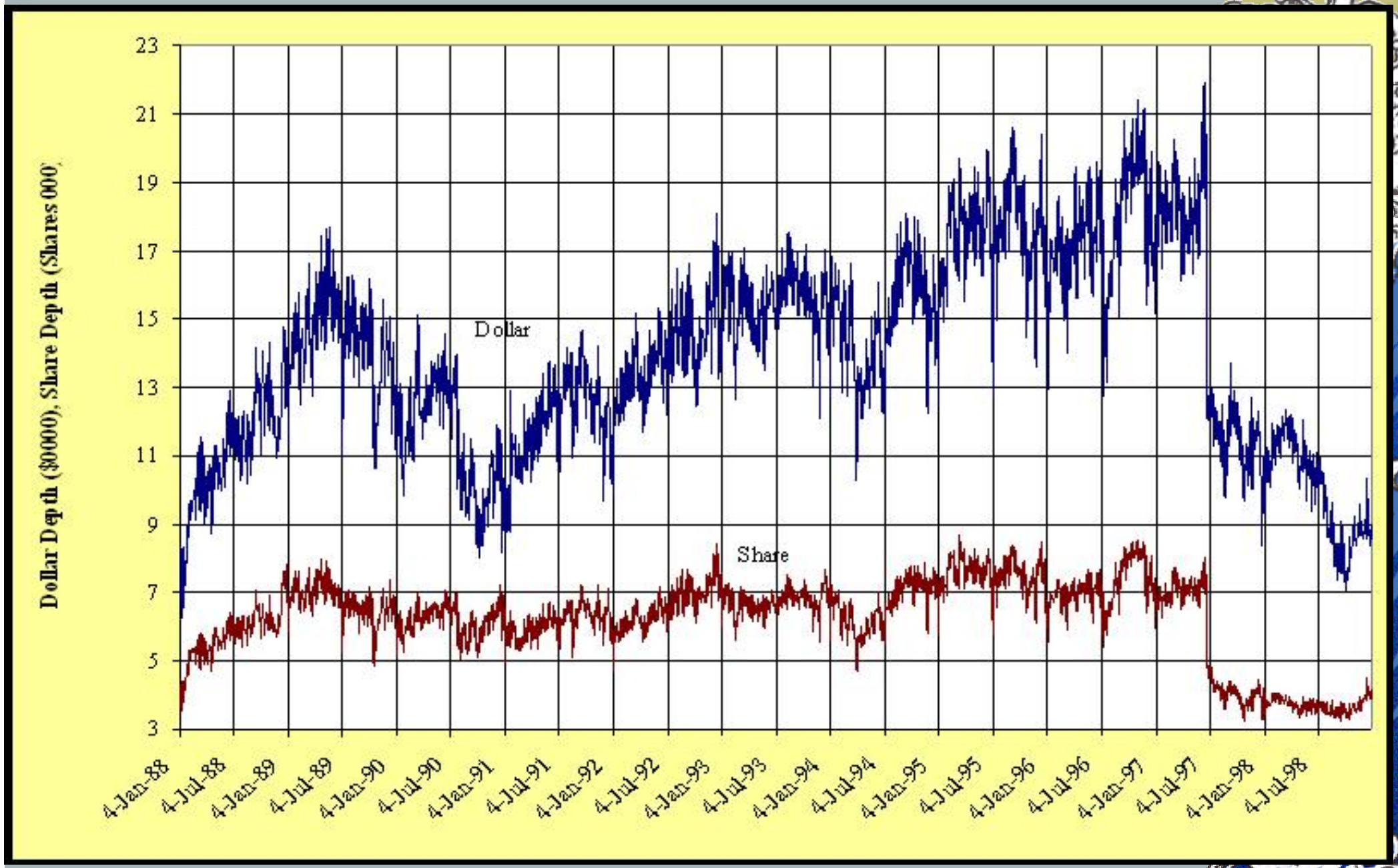


Value-Weighted NYSE Composite Average Spreads

Figure 2. Liquidity Measures Over Time



Average (EW) Depth
NYSE, 1988-1998

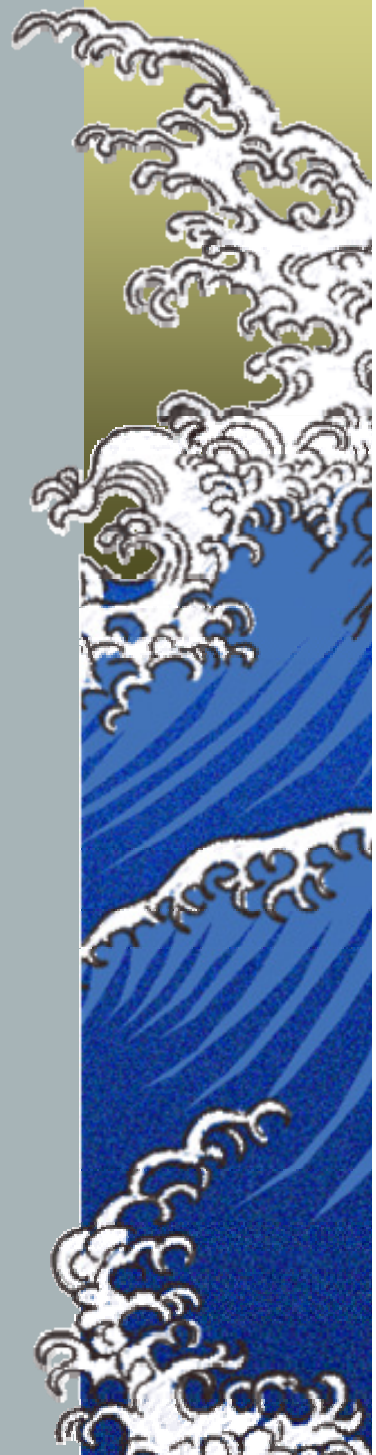


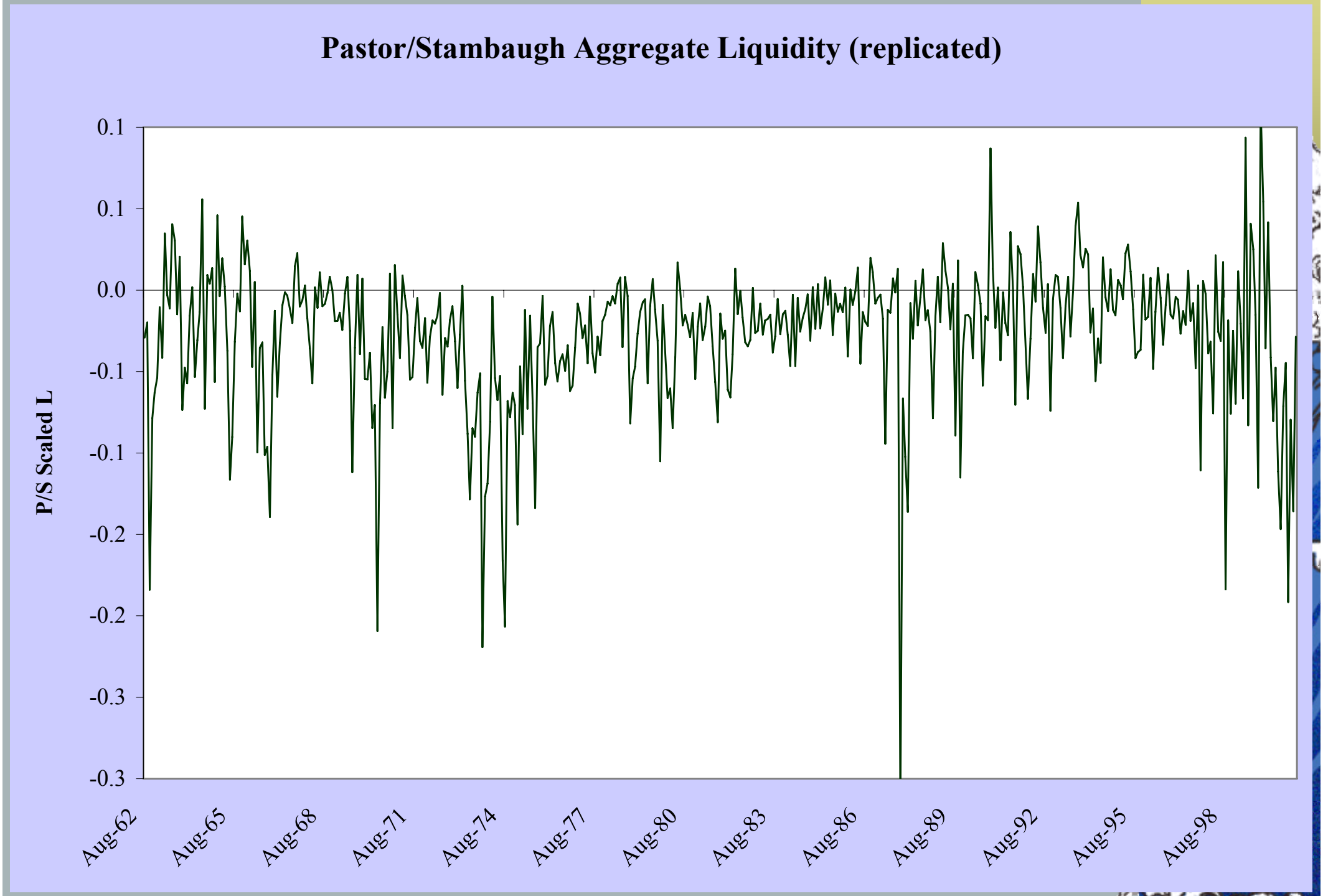
Liquidity Risk

- *Pastor/Stambaugh, JPE, 2003*
- *Based on daily regressions for individual stock excess returns in a calendar month*

$$r_{t+1} = a + b r_t + g[sign(r_t)]\$Volume_t$$

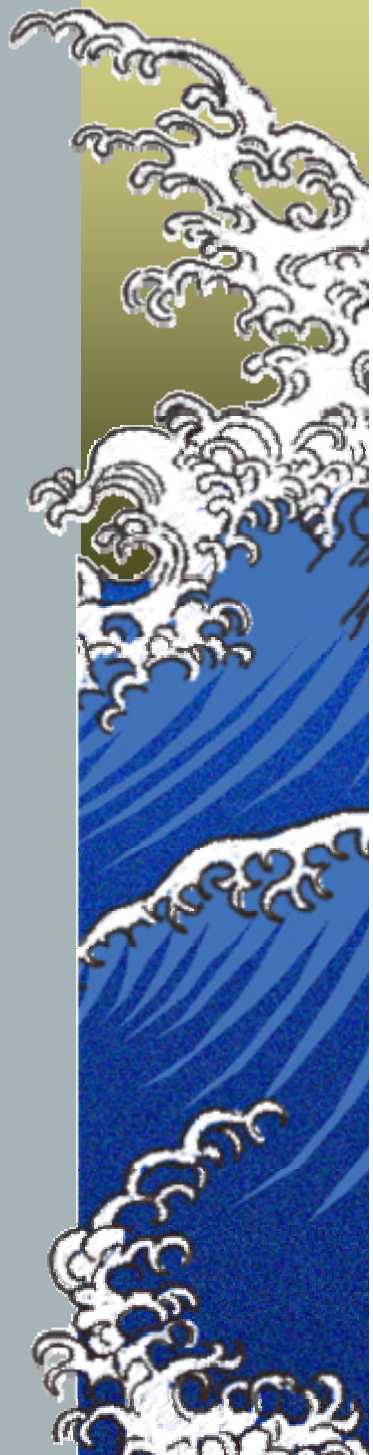
- *Then aggregate g across stocks and scale it for growing dollar volume*
- *Intuition: high volume moves prices away from equilibrium and they rebound the following day; hence, g is typically negative*



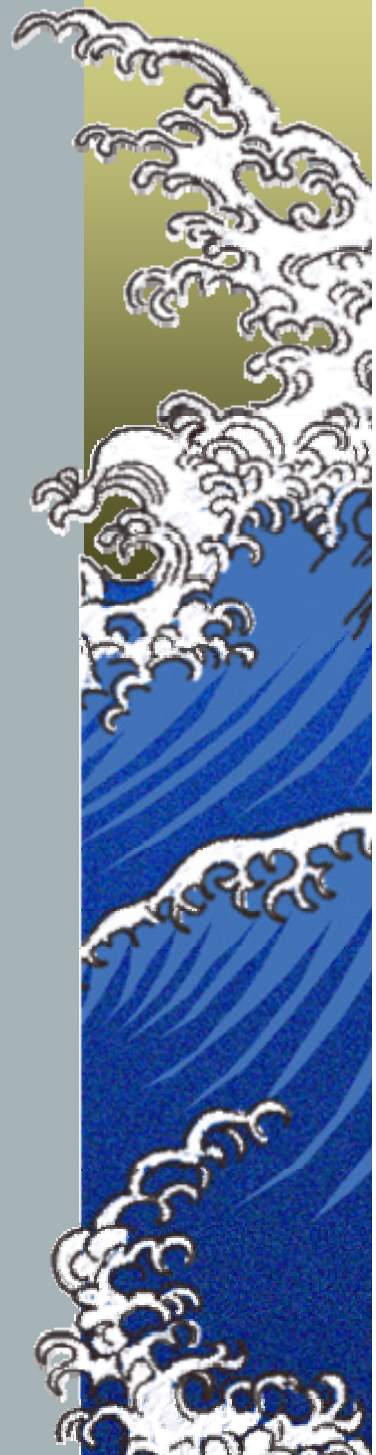

Pastor/Stambaugh Aggregate Liquidity (replicated)
P/S Scaled L
0.1
0.1
0.0
-0.1
-0.1
-0.2
-0.2
-0.3
-0.3
Aug-62
Aug-65
Aug-68
Aug-71
Aug-74
Aug-77
Aug-80
Aug-83
Aug-86
Aug-89
Aug-92
Aug-95
Aug-98

Priced liquidity risk?

- *Regress individual stock returns monthly on traditional factors and also on P/S aggregate scaled liquidity*
- *Test whether "betas" on liquidity are associated with higher returns*
- *P/S Result: "the average return on stocks with high sensitivities to liquidity exceeds that for stocks with low sensitivities by 7.5 percent annually" adjusted for market, size, value and momentum*



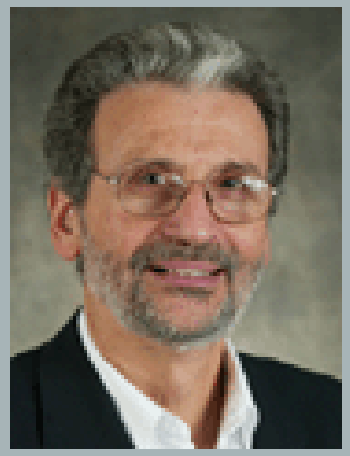
Still unpublished recent research, a few examples



Liquidity and the Law of One Price

- *Working Paper, 2005, with*

Eduardo Schwartz *Avanidhar Subrahmanyam*

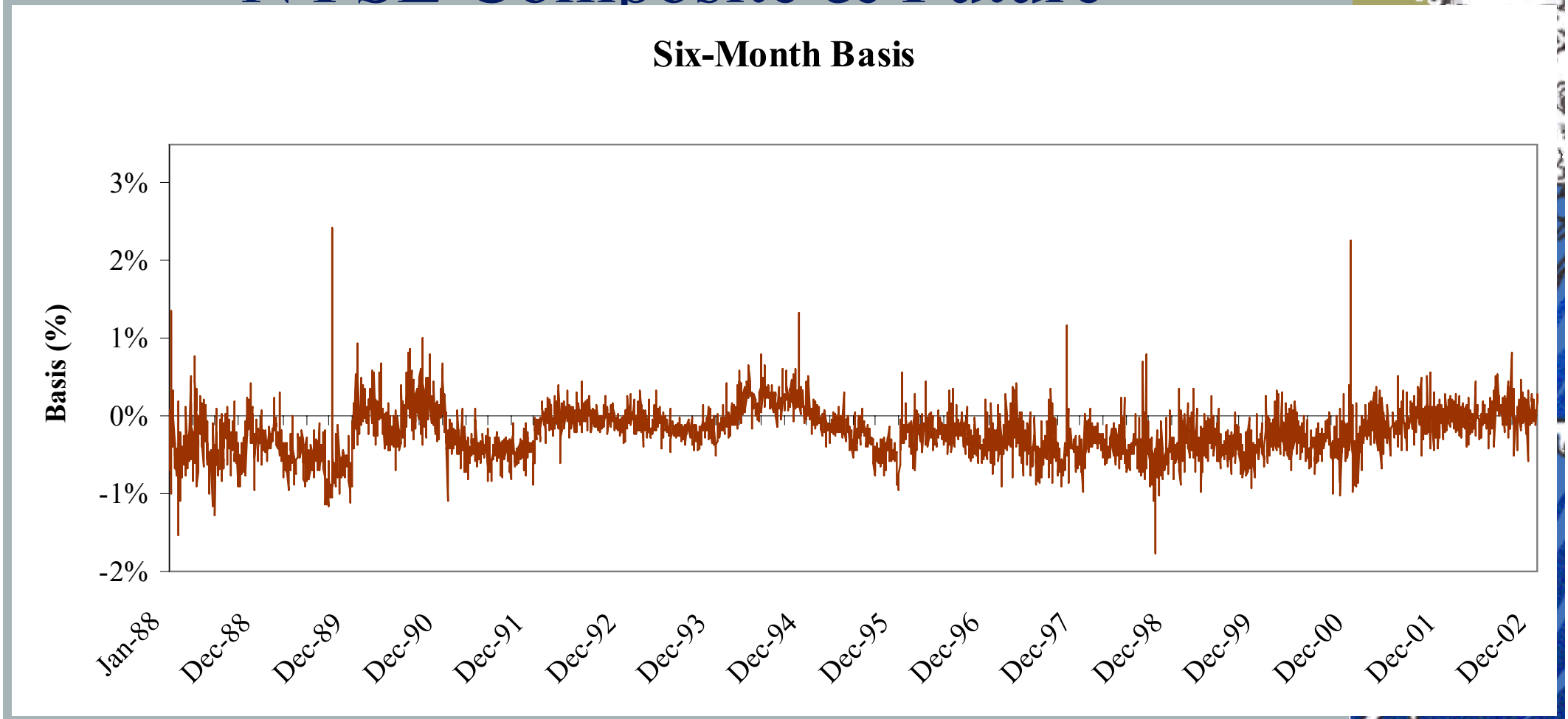


The absolute relative basis

$$\frac{\left| Fe^{-(r-\delta)t} - S \right|}{S}$$

- F = Futures Price
- S = Spot Price (Cash index level)
- r = Interest rate
- δ = Dividend yield
- t = Term until expiration of futures contract

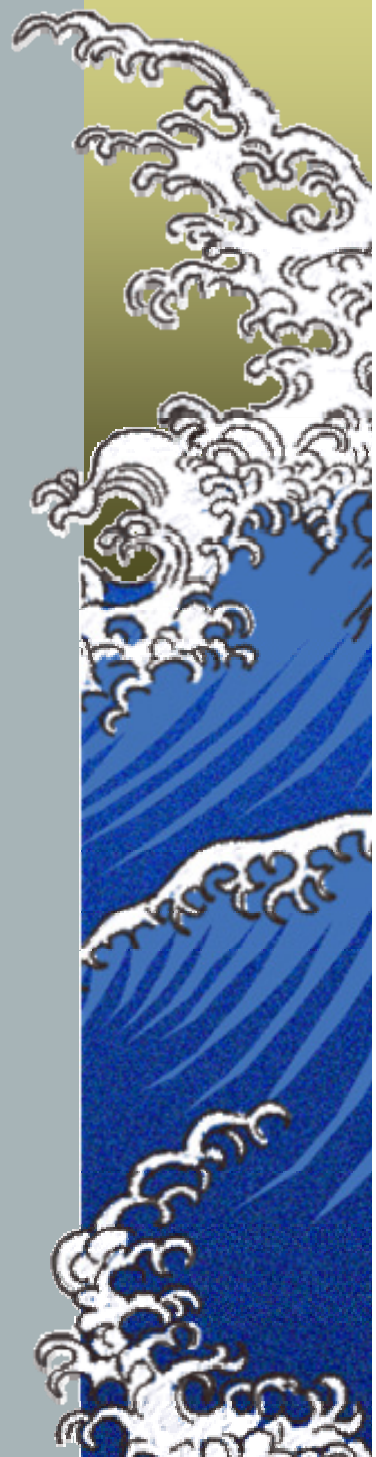
Plot of the six-month basis NYSE Composite & Future



Correlations of average absolute basis and average liquidity across contracts

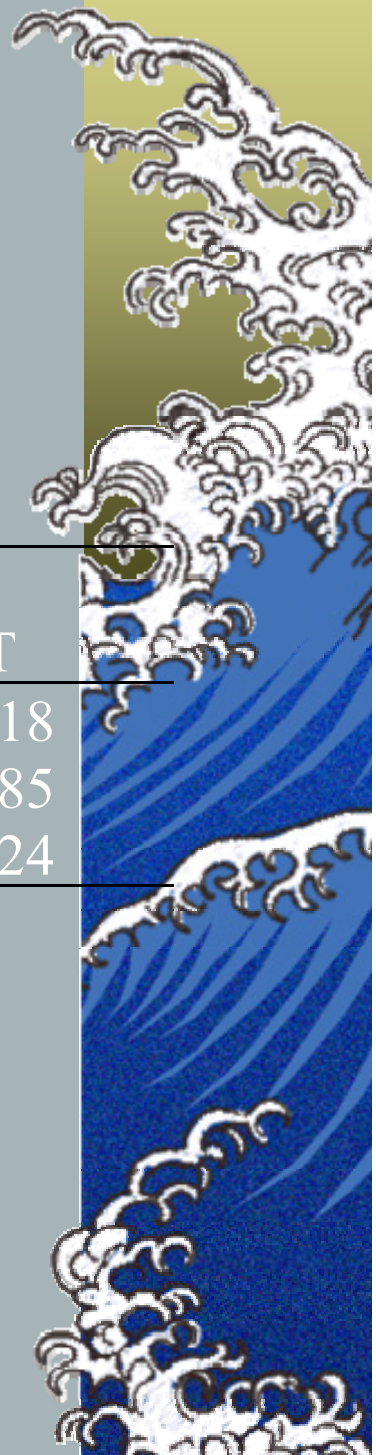
	Quoted spread	Effective Spread
3-month absolute basis	0.253 (0.049)	0.293 (0.022)
6-month absolute basis	0.260 (0.043)	0.290 (0.024)
9-month absolute basis	0.201 (0.120)	0.211 (0.102)

(P-values in parentheses)



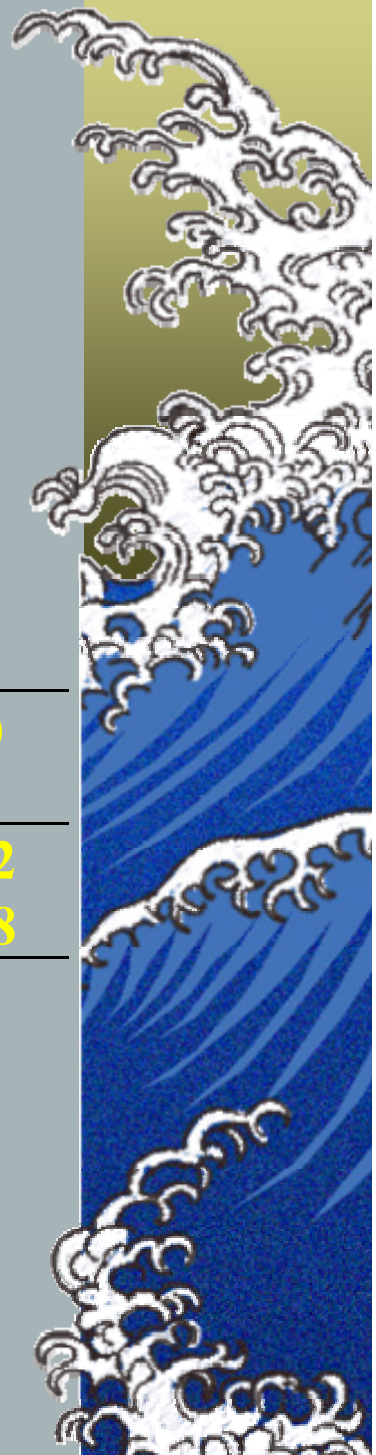
Predicting the basis with spreads lagged one day

	Independent variable			
	Lag(QSPR)		Lag(ESPR)	
	Coefficient	T	Coefficient	T
ABAS3	0.764	3.01	2.379	6.18
ABAS6	0.263	0.83	3.770	7.85
ABAS9	0.014	0.03	3.342	5.24



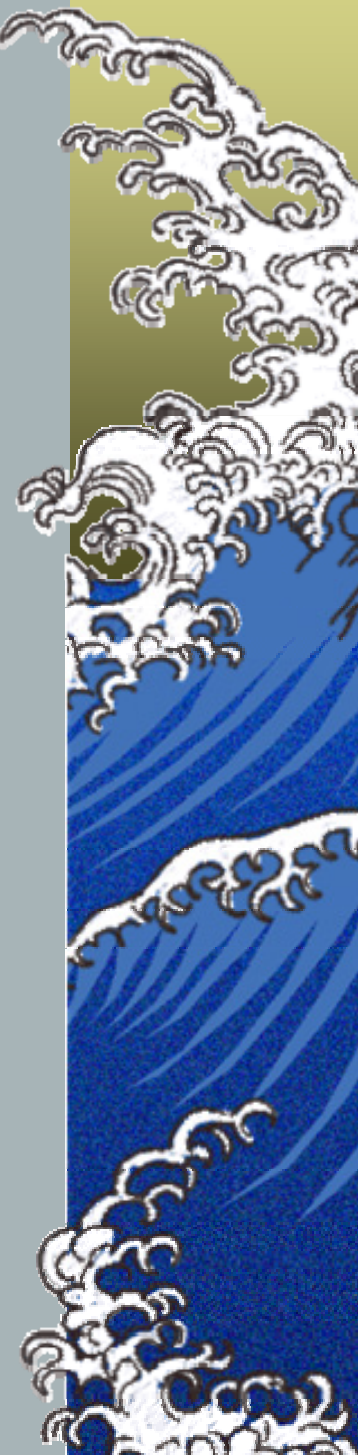
Predicting spreads with the bases lagged one day

	Independent variable					
	Lag(ABAS3)		Lag(ABAS6)		Lag(ABAS9)	
	Coefficient	T	Coefficient	T	Coefficient	T
QSPR	0.752	7.29	0.232	2.80	0.033	0.52
ESPR	0.843	7.60	0.587	10.93	0.237	5.78



Summary of Empirical Results

- *Deviations from the basis (NYSE composite) and liquidity are jointly determined*
- *There is bi-directional causality*
  - *Lower liquidity impedes arbitrage and allows larger deviations from the basis*
  - *Arbitrage trading to eliminate basis deviations absorbs liquidity and raises trading costs*
  - *VARs show that the impact lasts a few days*
  - *Controlled for non-synchronous trading, interest rates, and a host of other influences*



Liquidity and Market Efficiency

- *Very high frequency returns are predictable to some extent; e.g., five-minute autocorrelations are positive*
- *Arbitrageurs can take advantage of this if they have enough liquidity to trade*
- *Implication: inefficiencies should be more pronounced when the market is illiquid*
- *Evidence: a new paper with Chordia and Subra,"Liquidity and Market Efficiency"*

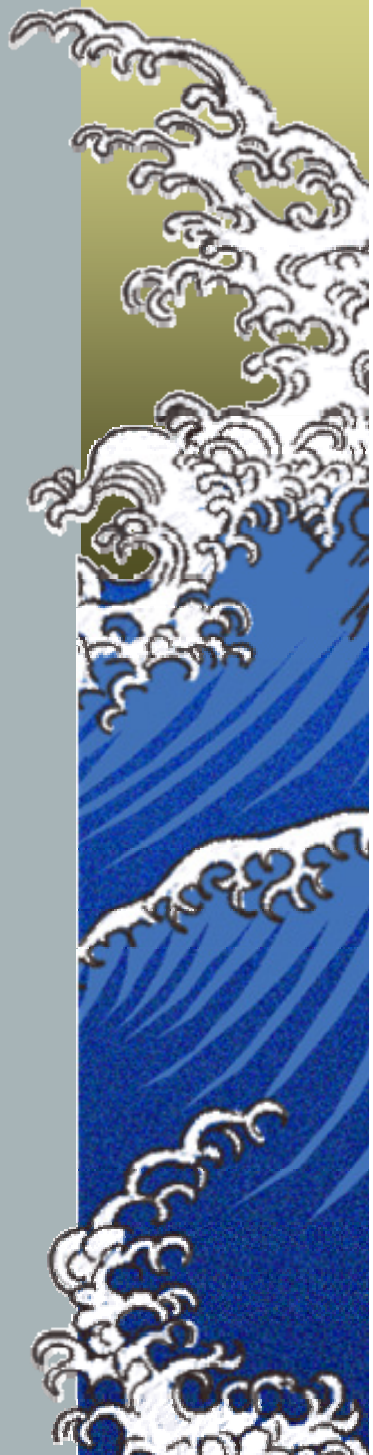
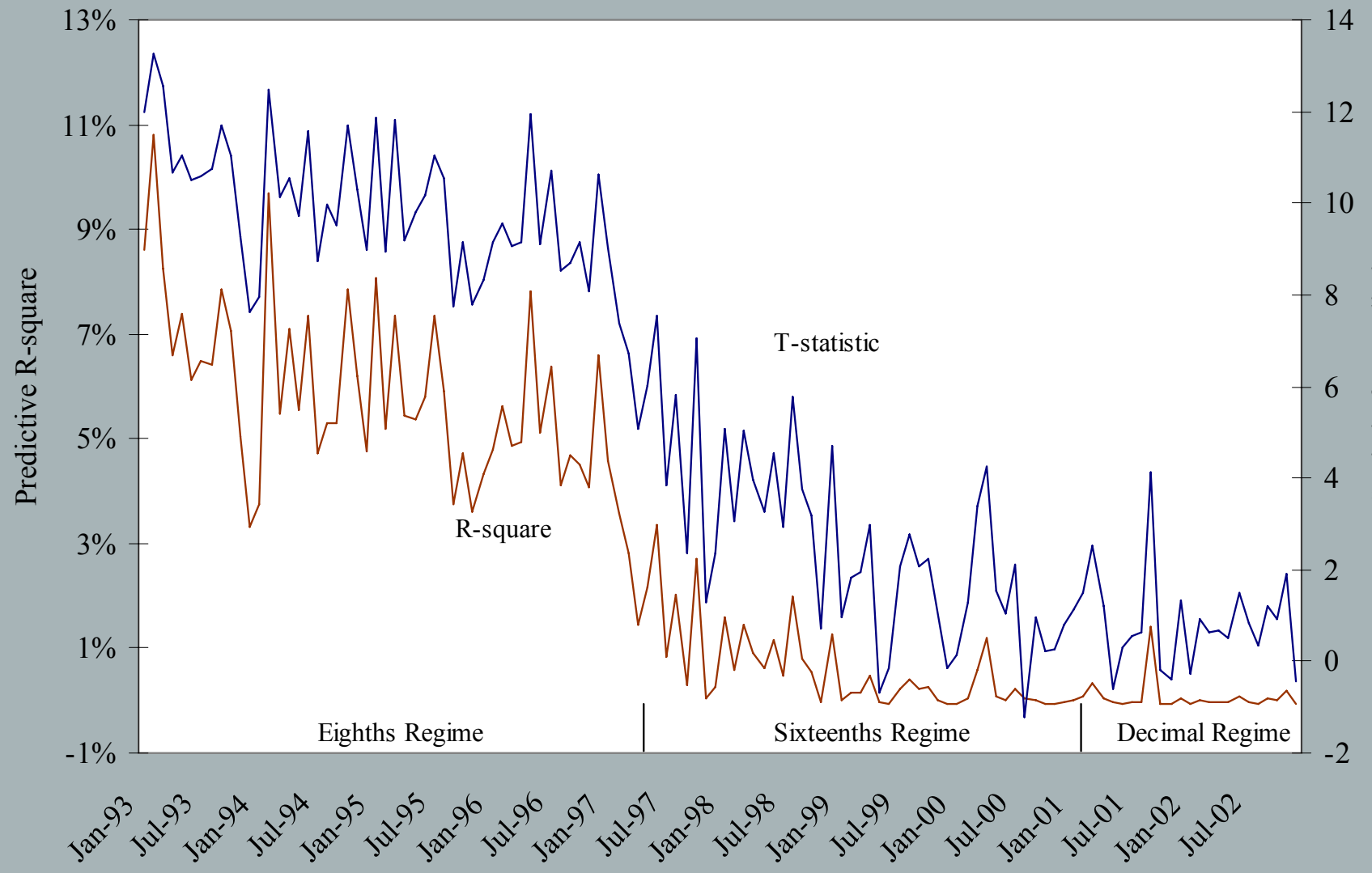


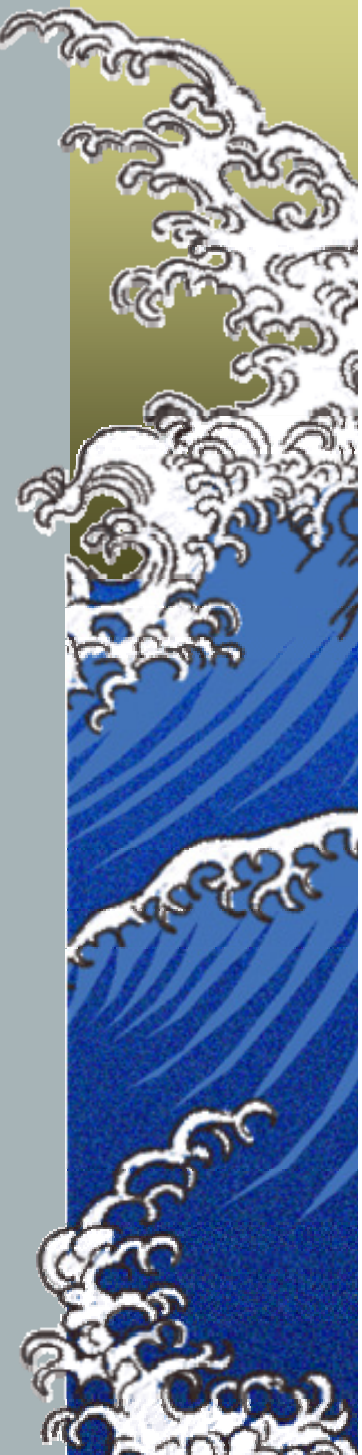
Figure 1. Market Inefficiency Trend, NYSE, 1993-2002

Five-Minute Return Predictions Using Lagged (by five minutes) Dollar Order Imbalance



Illiquid periods

- *Defined as days where the de-trended effective spread is more than one standard deviation above its mean within each tick size regime*
- *We use an indicator variable, ILD, which is one on illiquid days*

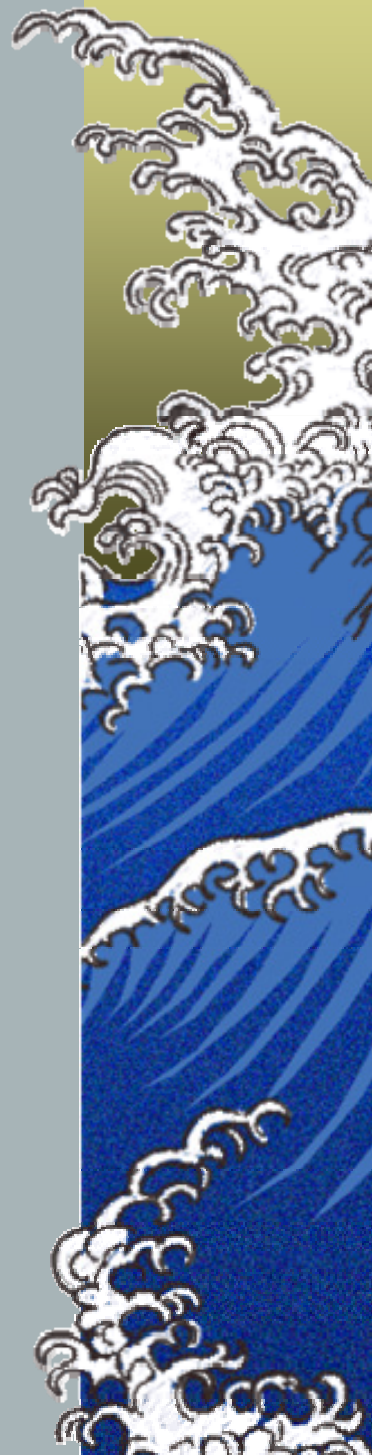


Regressions predicting returns using illiquidity indicator ILD (dependent variable is mid-quote return at time t)

		All Firms		Large Firms		Mid-Cap Firms		Small Firms	
		Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Eighths Regime (n=85852)	$OIB\$_{t-1}$	0.0358	56.98	0.0349	50.11	0.0256	59.70	0.0168	55.78
	$OIB\$_{t-1}$*ILD	0.0258	15.01	0.0245	12.36	0.0099	9.11	0.0103	13.23
	Intercept	-0.0017	-9.43	-0.0014	-7.10	-0.0016	-10.96	-0.0015	-12.39
	Adjusted R^2	0.0519		0.0393		0.0528		0.0497	
Sixteenths Regime (n=68993)	$OIB\$_{t-1}$	0.0212	12.14	0.0103	6.57	0.0339	29.24	0.0342	39.13
	$OIB\$_{t-1}$*ILD	0.0590	11.06	0.0674	10.83	0.0363	11.53	0.0388	16.45
	Intercept	-0.0020	-5.17	-0.0014	-3.05	-0.0028	-9.69	-0.0029	-12.05
	Adjusted R^2	0.0055		0.0030		0.0196		0.0360	
Decimal Regime (n=36552)	$OIB\$_{t-1}$	0.0094	2.66	0.0058	1.58	0.0173	5.67	0.0369	13.89
	$OIB\$_{t-1}$*ILD	0.0257	3.12	0.0266	3.02	0.0246	3.68	0.0344	6.02
	Intercept	-0.0007	-0.98	-0.0005	-0.62	-0.0017	-2.64	-0.0040	-6.83
	Adjusted R^2	0.0007		0.0004		0.0018		0.0089	

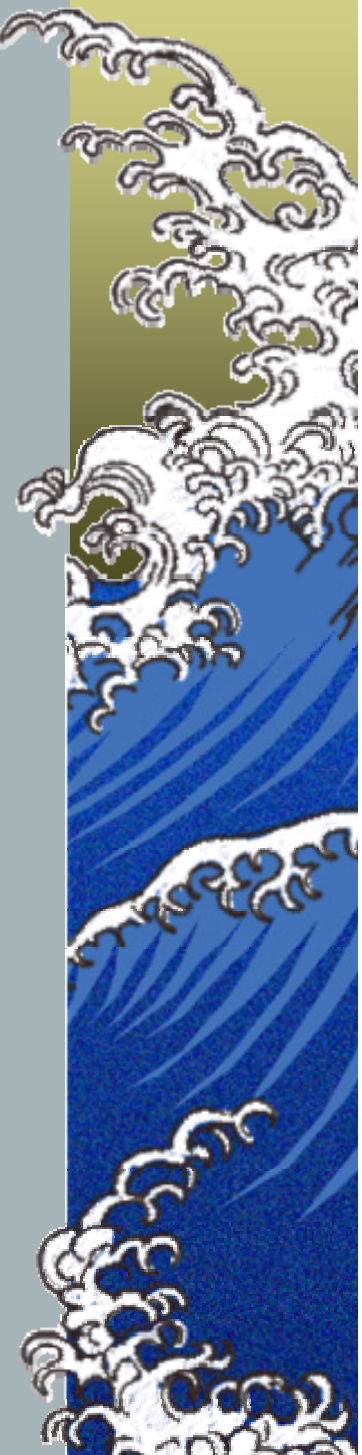
Liquidity and predictability

- *The predictability of returns from lagged order flows is greater on more illiquid days*
- *The effect is present in every tick regime*



Market efficiency by time of day

- *Since spreads vary by time of day (McInish and Wood, 1992), there is reason to expect a similar pattern in return predictability*
- *We define two dummies, morn (9:30-12), and eve (14:00-16:00)*

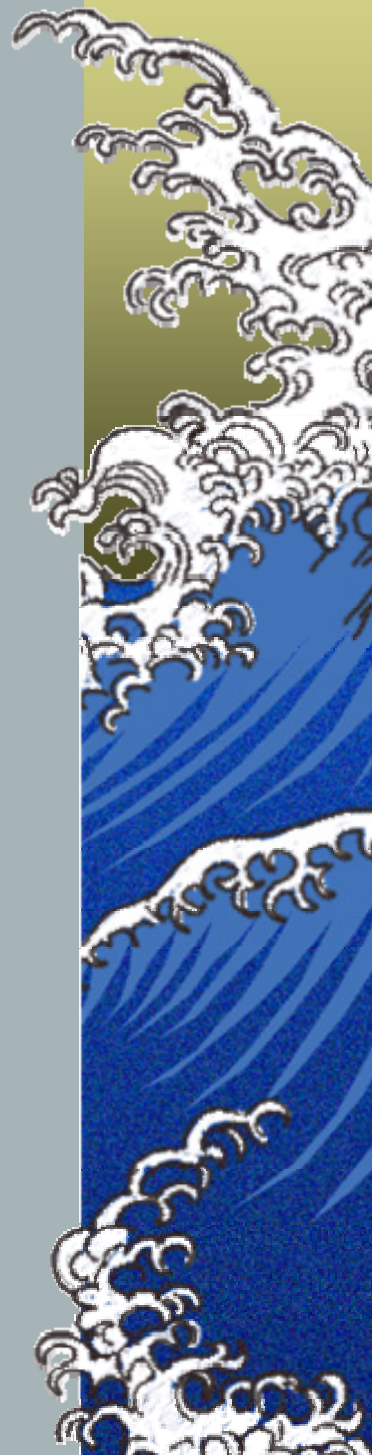


Time-of-day effects

		Large Firms		Small Firms	
		Coefficient	t-statistic	Coefficient	t-statistic
Eighths Regime N=86974	$OIB\$_{t-1}$	0.0291	24.70	0.0137	27.23
	$OIB\$_{t-1}$*ILD	0.0201	5.82	0.0065	4.94
	$OIB\$_{t-1}$*morn	0.0087	4.98	0.0051	6.85
	$OIB\$_{t-1}$*ILD*morn	0.0088	5.37	0.0047	6.61
	$OIB\$_{t-1}$*eve	0.0078	1.53	0.0054	2.75
	$OIB\$_{t-1}$*ILD*eve	0.0054	1.14	0.0064	3.44
	Intercept	-0.0015	-7.23	-0.0015	-12.54
	Adjusted R^2	0.0398		0.0509	
Decimal Regime N=36985	$OIB\$_{t-1}$	0.0038	0.61	0.0326	8.04
	$OIB\$_{t-1}$*ILD	-0.0077	-0.50	0.0042	0.43
	$OIB\$_{t-1}$*morn	-0.0018	-0.20	0.0177	3.10
	$OIB\$_{t-1}$*ILD*morn	0.0071	0.86	-0.0024	-0.43
	$OIB\$_{t-1}$*eve	0.0284	1.30	0.0204	1.44
	$OIB\$_{t-1}$*ILD*eve	0.0735	3.42	0.0669	4.84
	Intercept	-0.0005	-0.62	-0.0042	-7.02
	Adjusted R^2	0.0008		0.0091	

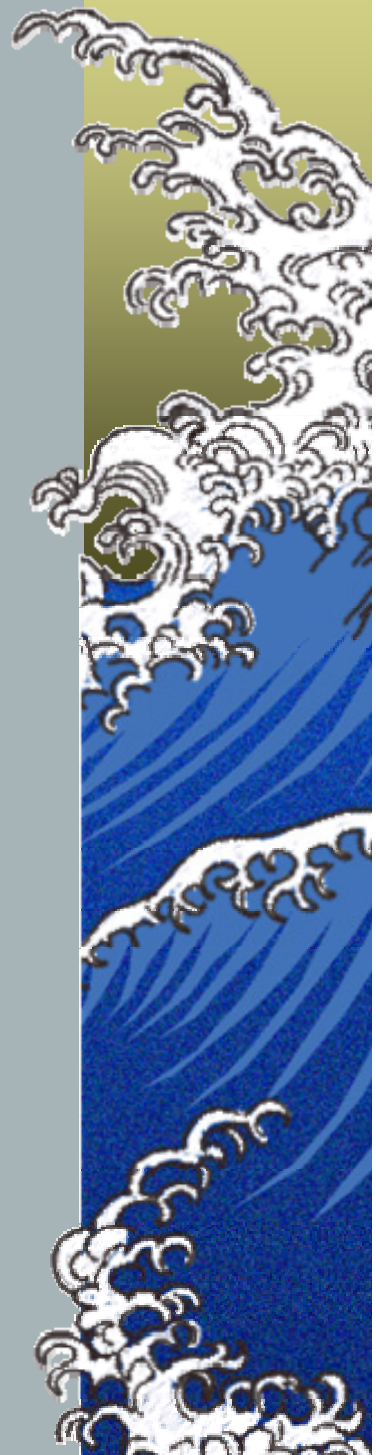
Intraday efficiency results

- *The market's ability to accommodate order flows was smaller during the morning and, to a lesser extent, the evening period within the eighth regime*
- *This effect has declined considerably during the decimal period*



Plenty of Questions Left

- *Why does liquidity have seasonals?*
- *Does liquidity really beget liquidity?*
  - *Does lower liquidity feed on itself?*
  - *What arbitrage force can correct this?*
- *What can we learn from improved empirical measures such as depth of limit order book?*
- *Who provides and absorbs liquidity in different international markets?*
  - *Individuals, Institutions, foreign investors?*
- *More details on liquidity as risk*
  - *It's negatively associated with idiosyncratic risk*
  - *If it's systematic, how does it vary across asset classes?*



Thanks for your kind attention