Noise as Information for Illiquidity

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Introduction

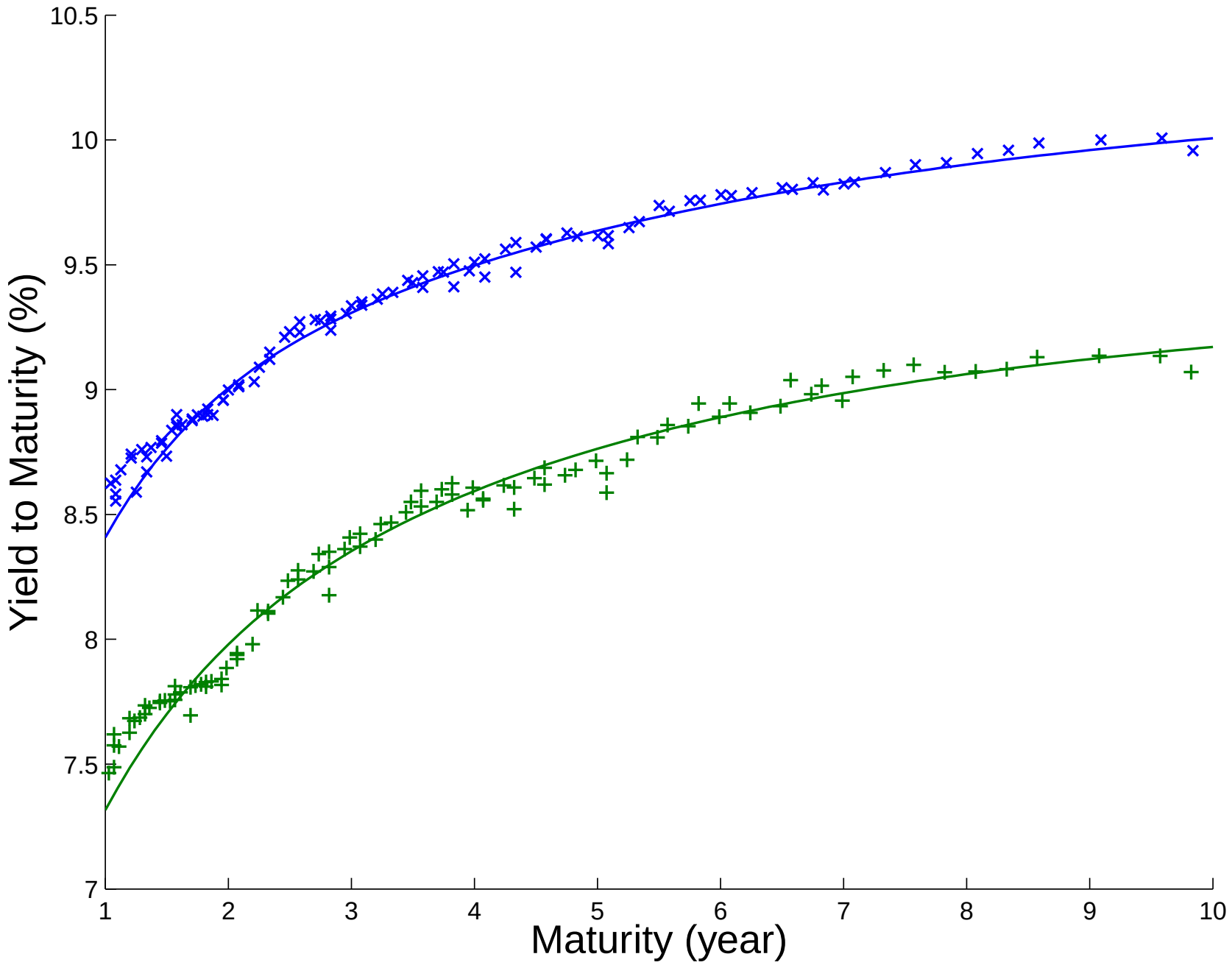
- During normal times, institutional investors such as investment banks and hedge funds have abundant capital, which they can deploy to supply liquidity.
- As a result, assets are traded at prices closer to their fundamental values; price deviations from the fundamental values are curtailed by strong arbitrage forces.
- During market crises, capital becomes scarce and/or willingness to deploy capital diminishes.
- The lack of sufficient arbitrage capital limits the force of arbitrage; assets are allowed to trade at prices significantly away from their fundamental values.

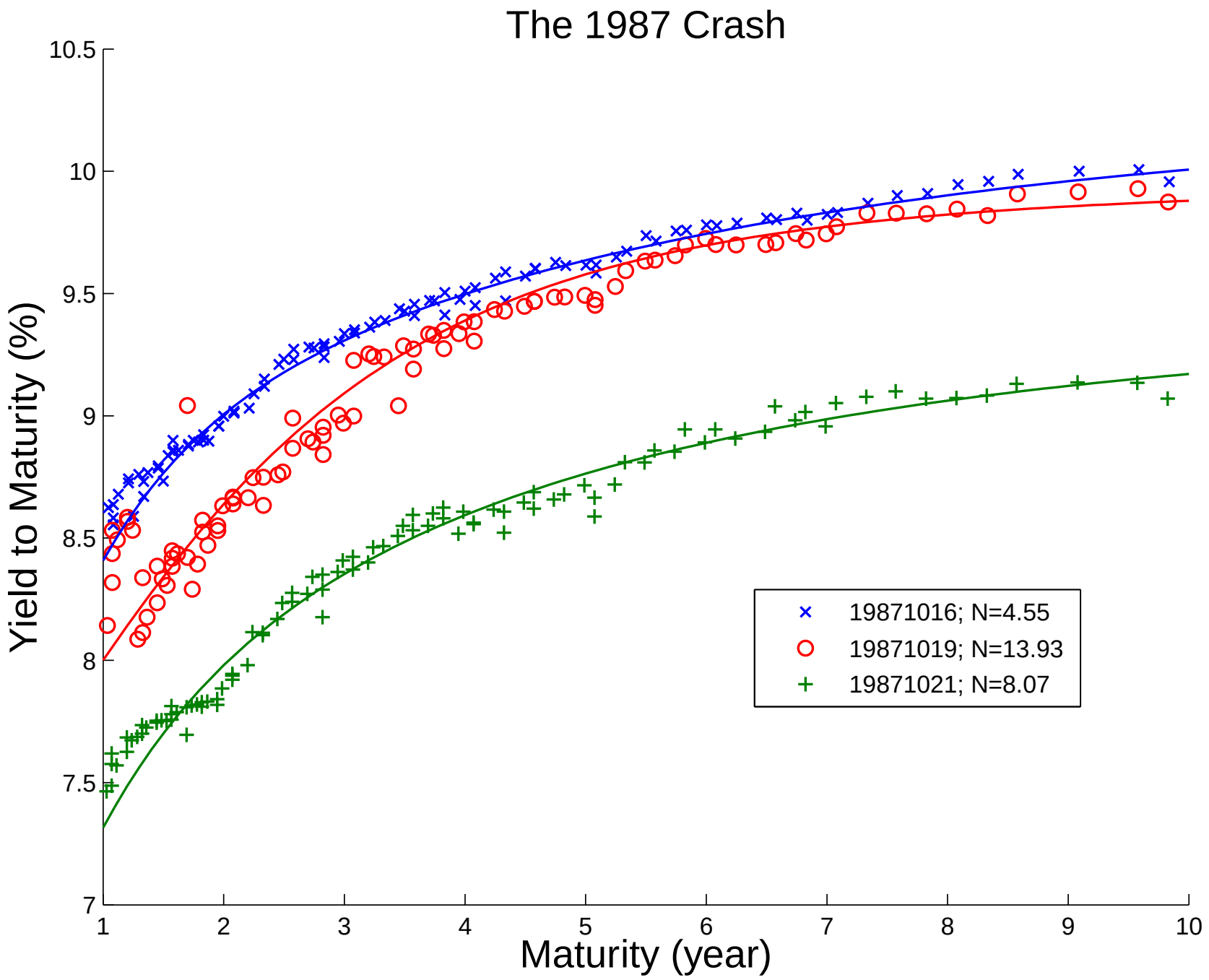
Noise as Information for Illiquidity

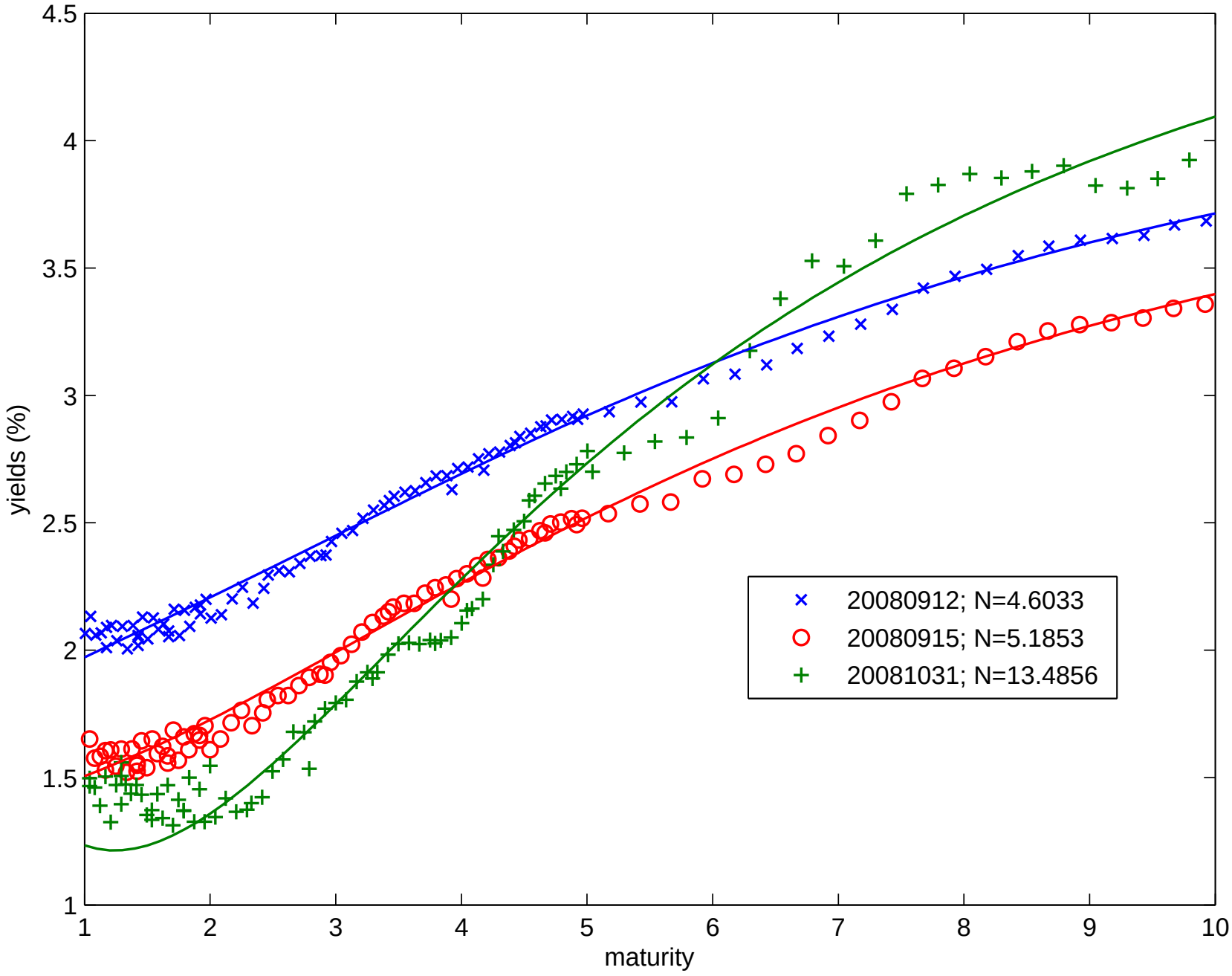
- We focus on the U.S. Treasury bond market.
- During normal times, the abundance of arbitrage capital helps smooth out the yield curve, keeping the average dispersion low.
- During liquidity crises, arbitrage capital is scarce, resulting in more "noise" in the yield curve.

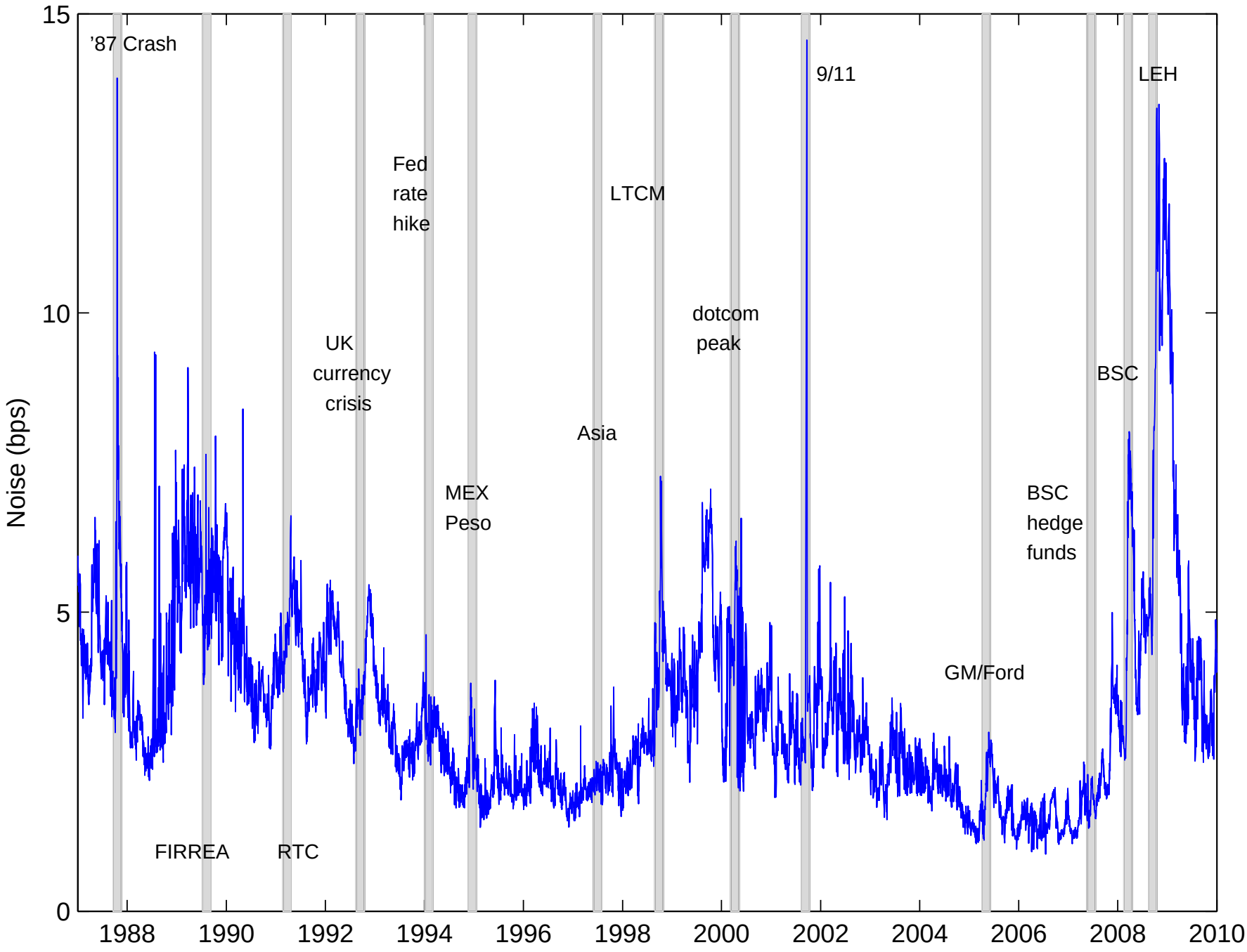
A Broad and Pure Measure of Illiquidity

- We focus on the Treasury bond market because it is by far one of the most important markets in the world.
- *Broad:* Investors of many types come to the Treasury market to trade.
- *Pure:* It is essentially free of credit risk and enjoys a high level of liquidity.
- *Simple:* The fundamental values of Treasuries are determined by a small number of factors that can be easily captured empirically.
- We argue that this measure of illiquidity is broad and pure:
  - Cost of trading measures such as bid/ask spreads and price impact are narrowly focused on the markets of concern.
  - Measures from the credit, equity, and index options markets are informative, but “contaminated” with other risk factors.


10.5
10
9.5
9
8.5
8
7.5
7
Yield to Maturity (%)
1
2
3
4
5
6
7
8
9
10
Maturity (year)


The 1987 Crash
Yield to Maturity (%)
Maturity (year)
10.5
10
9.5
9
8.5
8
7.5
7
1
2
3
4
5
6
7
8
9
10
19871016; N=4.55
19871019; N=13.93
19871021; N=8.07


4.5
4
3.5
3
2.5
2
1.5
1
yields (%)
1
2
3
4
5
6
7
8
9
10
maturity
20080912; N=4.6033
20080915; N=5.1853
20081031; N=13.4856


Noise (bps)
15
10
5
0
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
'87 Crash
FIRREA
RTC
UK currency crisis
Fed rate hike
MEX Peso
Asia
LTCM
dotcom peak
9/11
GM/Ford
BSC hedge funds
BSC
LEH

Explaining Monthly Changes in Noise

Treasury: Level, Slope and Volatility

	(1)	(2)	(3)	(4)
ΔTB3M	-0.678			-0.323
	[-2.21]			[-1.25]
ΔTerm		0.008		0.005
		[1.79]		[0.92]
ΔBondV			0.122	0.097
			[2.42]	[2.01]
Adj R2 (%)	3.15	3.13	4.31	6.28
# month	275	275	275	275

Explaining Monthly Changes in Noise

On-the-Run Premiums and RefCorp

	(1)	(2)	(3)	(4)
ΔOn5Y	0.089			0.040
	[2.35]			[1.14]
ΔOn10Y		0.139		0.101
		[3.83]		[2.61]
ΔRefCorp			0.045	0.045
			[4.81]	[5.15]
Adj R2 (%)	7.35	13.74	13.56	24.89
# month	275	275	224	224

Noise Measure vs. On-the-Run Premiums

- Our noise measure spikes up much more prominently during crises:

date	Noise	On5Y	On10Y
1987-10-19	6.45	2.00	-0.93
2001-09-21	6.83	1.15	2.63
2008-10-15	6.14	-0.37	3.98
2008-10-31	6.18	-1.78	2.50

- Our noise measure captures a collective information aggregated over the entire yield curve.
- So it is most sensitive to the commonality of “noises” across the entire yield curve.
- If this commonality heightens during crises, it will show up in our noise measure.

Explaining Monthly Changes in Noise

Stock Market: Ret, VIX, and Liquidity

	(1)	(2)	(3)	(4)
StockRet	-0.048			0.001
	[-2.59]			[0.04]
ΔVIX		0.066		0.055
		[3.89]		[3.12]
ΔPSLiq			-4.99	-3.85
			[-4.28]	[-3.86]
Adj R2 (%)	5.05	11.15	11.83	18.74
# month	275	273	263	261

Cross-Sectional Tests using Hedge Fund Returns

- Use TASS database of hedge funds from 1994 through 2009.
- Use hedge fund returns to estimate pre-ranking noise beta:

$$R_t^i = \beta_0 + \beta_i^N \, \Delta\text{Noise}_t + \beta_i^M \, R_t^M + \epsilon_t^i \, .$$

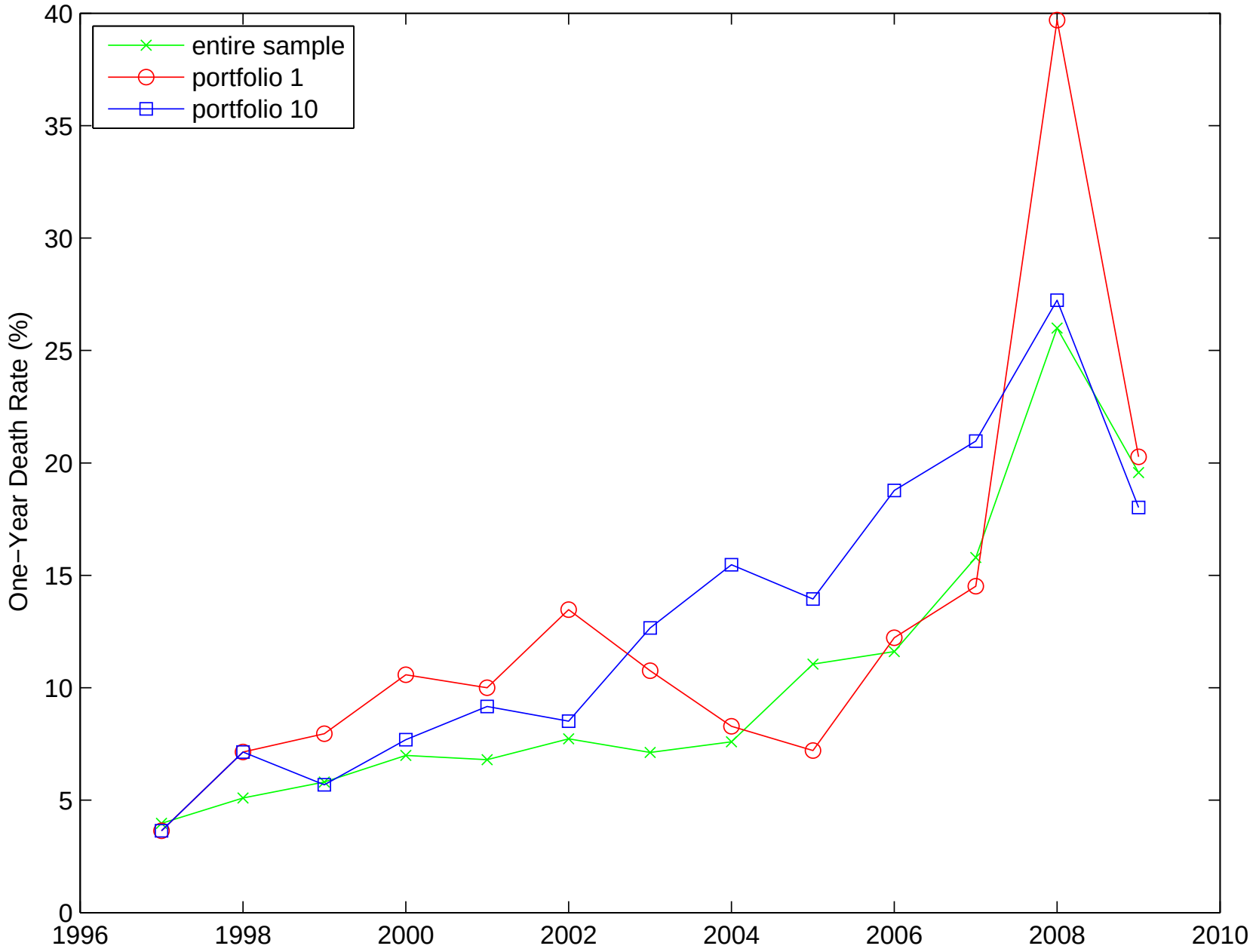
- Negative noise beta implies decreasing hedge fund returns during crises, when "noise" typically goes up.
- Sort hedge funds by their pre-ranking noise beta into 10 portfolios:
  - Portfolio 1: agressive in taking liquidity risk, high liquidity exposure.
  - Portfolio 10: perhaps more conservative in taking liquidity risk.
- In estimating the post-ranking portfolio beta's, also use:

$$R_t^p = \beta_0 + \beta_p^{\text{N}} \, \Delta\text{Noise}_t + \text{lag}\beta_p^{\text{N}} \, \Delta\text{Noise}_{t-1} + \beta_p^{\text{M}} \, R_t^M + \text{lag}\beta_p^{\text{M}} \, R_{t-1}^{\text{M}} + \epsilon_t^p$$

to account for the high serial autocorrelations in hedge fund returns.

Noise-Beta Sorted Portfolios (199401-200912)

	exret (%)	Pre Formation β^N	Pre Formation β^M	Post Formation β^N		Post Formation β^M		Post Formation β^N+lag		Post Formation β^M+lag	
1	1.17	[4.29]	-2.55	0.50	-0.40	[-1.32]	0.45	[5.97]	-1.41	[-4.36]	0.50	[8.29]
2	0.69	[3.83]	-0.99	0.33	-0.31	[-1.62]	0.32	[6.82]	-0.87	[-3.55]	0.38	[9.07]
3	0.55	[3.90]	-0.55	0.26	-0.22	[-1.59]	0.25	[7.30]	-0.65	[-4.14]	0.30	[9.31]
4	0.45	[3.88]	-0.32	0.22	-0.22	[-1.69]	0.19	[6.61]	-0.58	[-3.82]	0.24	[9.43]
5	0.41	[3.59]	-0.16	0.20	-0.26	[-2.45]	0.20	[7.75]	-0.57	[-4.38]	0.24	[9.39]
6	0.38	[3.52]	-0.02	0.21	-0.25	[-2.38]	0.19	[7.93]	-0.50	[-3.57]	0.22	[10.0]
7	0.38	[2.98]	0.16	0.24	-0.23	[-2.06]	0.23	[7.48]	-0.39	[-2.91]	0.26	[7.52]
8	0.37	[2.70]	0.42	0.27	-0.10	[-0.87]	0.27	[8.49]	-0.16	[-1.00]	0.30	[8.13]
9	0.38	[2.40]	0.84	0.36	0.02	[0.12]	0.32	[8.39]	0.03	[0.12]	0.35	[9.06]
10	0.22	[0.88]	2.29	0.50	0.18	[0.64]	0.42	[5.68]	0.54	[1.02]	0.48	[6.45]


entire sample
portfolio 1
portfolio 10
One−Year Death Rate (%)
0
5
10
15
20
25
30
35
40
1996
1998
2000
2002
2004
2006
2008
2010

Currency Carry Portfolios (198701-200912)

	exret (%)	β^{Noise}	β^{Market}	Adj-R2 (%)
6 ("asset" currencies)	0.81	-0.43	0.14	8.3
	[4.47]	[-1.83]	[2.15]	
5	0.34	-0.04	0.12	6.0
	[2.41]	[-0.25]	[2.64]	
4	0.31	-0.07	0.07	2.5
	[2.33]	[-0.36]	[1.31]	
3	0.16	0.17	0.06	2.1
	[1.25]	[1.06]	[1.32]	
2	-0.06	0.07	0.04	0.9
	[-0.51]	[0.44]	[1.06]	
1 ("funding" currencies)	-0.20	0.27	-0.01	1.5
	[-1.50]	[1.91]	[-0.18]	

Estimating Liquidity Risk Premiums

- To formally estimate the market price of risk for the noise measure, we follow Fama and MacBeth (1973) and perform monthly cross-sectional regressions:

$$R_t^i = \gamma_{0t} + \gamma_t^N \beta_i^N + \gamma_t^M \beta_i^M + \text{age}_t^i + \text{NAV}_t^i + \epsilon_t^i \,,$$

  where we added controls for hedge fund age and size.

- The time series average of γ_t^N is an estimate of the liquidity risk premium.

- We use the noise-beta sorted hedge-fund portfolios, as well as the currency carry portfolios, to estimate the market price of liquidity risk.

- We perform the same tests for a few other liquidity measures.

Liquidity Risk Premiums

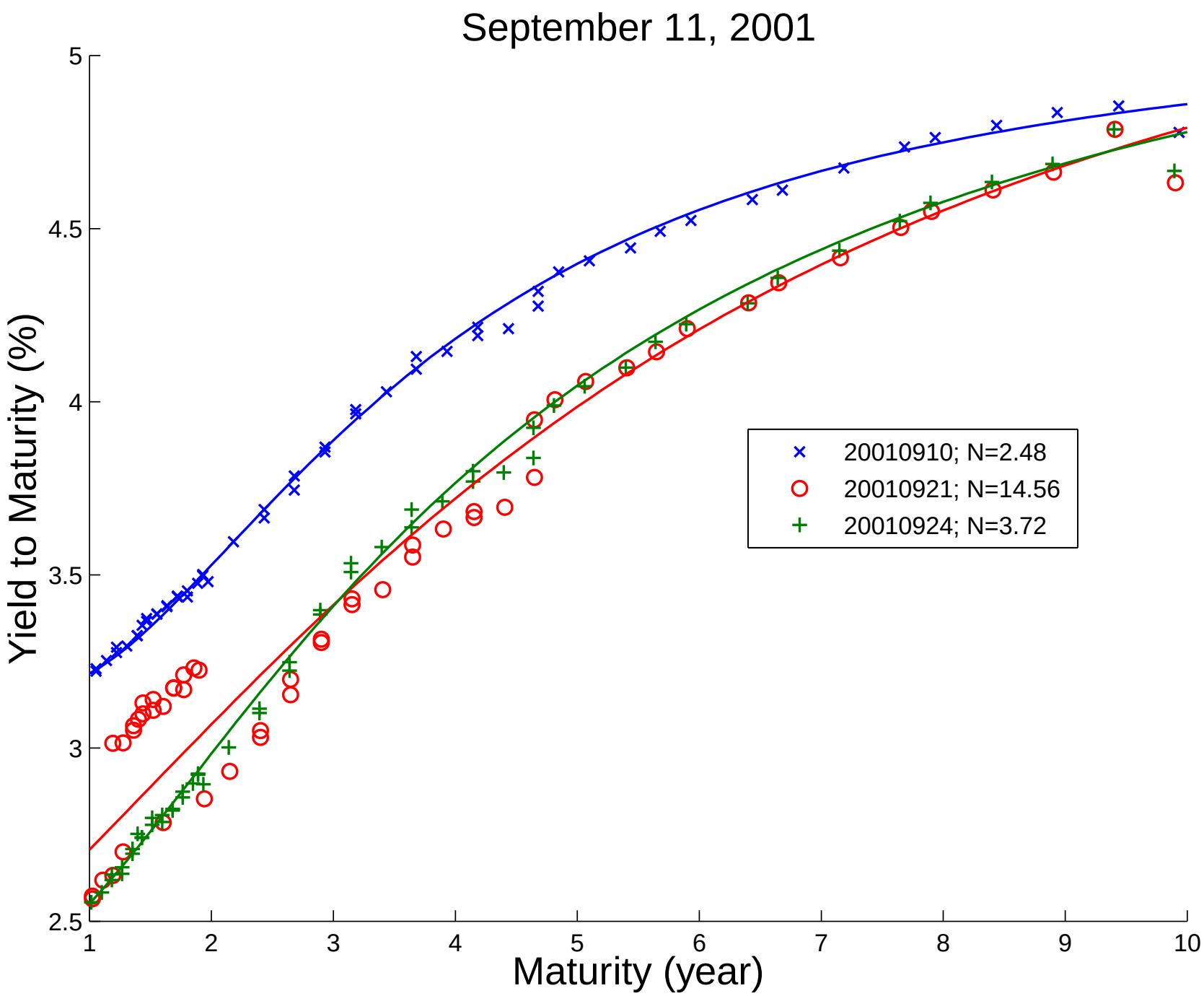
Using Hedge Fund Returns	Liquidity	Market	Age	AUM
Noise	-1.43	1.76	0.0001	-0.11
	[-2.86]	[2.60]	[0.19]	[-4.18]
Noise (beta+lag beta)	-0.44	1.00	0.0002	-0.11
	[-2.81]	[1.79]	[0.25]	[-4.24]
Factor Mimicking Portfolio	-0.29	1.47	0.0001	-0.12
	[-3.15]	[2.05]	[0.54]	[-4.26]
Noise/BASpreads	-0.98	1.56	0.0001	-0.10
	[-2.64]	[2.45]	[0.17]	[-4.11]
Using Currency Carry Portfolios	Liquidty	Market		
Noise	-0.82	2.93		
	[-2.54]	[2.29]		

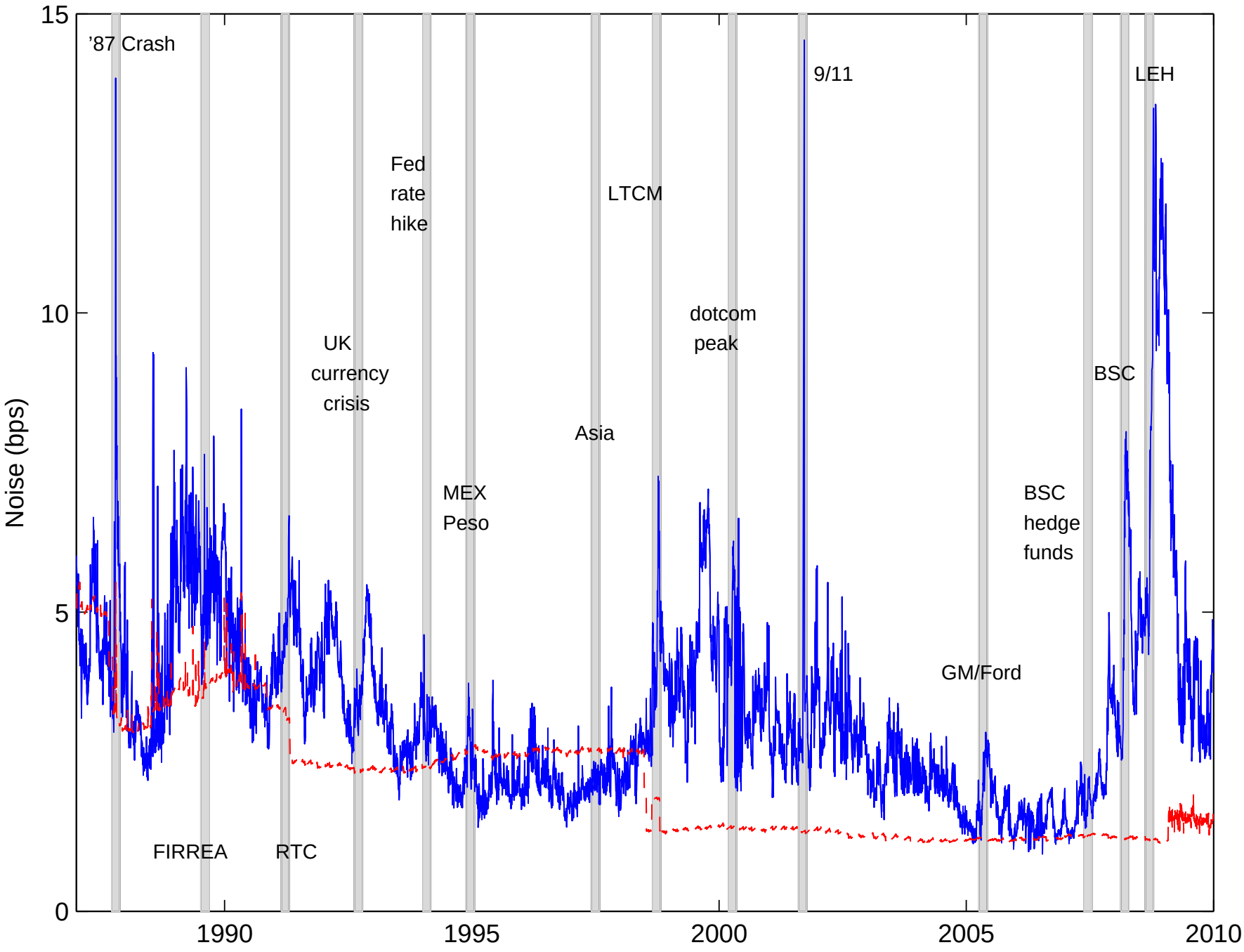
Liquidity Risk Premiums: Other Proxies of Liquidity

Factor	Liquidity	Market	Age	AUM
Noise	-1.43	1.76	0.0001	-0.11
	[-2.86]	[2.60]	[0.19]	[-4.18]
On5Y	-2.21	1.00	0.0001	-0.11
	[-0.77]	[1.76]	[0.1]	[-4.49]
On10Y	0.38	2.07	0.0001	-0.11
	[0.59]	[2.25]	[-0.08]	[-4.31]
RefCorp	-4.60	0.75	0.0001	-0.12
	[-1.26]	[1.26]	[0.36]	[-4.32]
PSLiq	0.93	-0.02	0.0001	-0.11
	[0.88]	[-0.18]	[-0.57]	[-4.36]
VIX	-0.25	1.04	0.0001	-0.11
	[-0.07]	[1.42]	[-0.04]	[-4.23]

Conclusions

- We propose a broad and pure measure of illiquidity by exploiting the connection between liquidity and and amount of arbitrage capital available in the market.
- Empirically, it does a good job in capturing the various episodes of liquidity crises, and is also found be related to other known measures of illiquidity,
- We use hedge fund returns to estimate the market price of this illiquidity risk, and find it to be significant.
- This illiquidity risk also contributes to the performance of currency carry trades.


September 11, 2001
Yield to Maturity (%)
Maturity (year)
20010910; N=2.48
20010921; N=14.56
20010924; N=3.72
5
4.5
4
3.5
3
2.5
1
2
3
4
5
6
7
8
9
10


15
10
5
0
Noise (bps)
1990
1995
2000
2005
2010
'87 Crash
FIRREA
RTC
UK
currency
crisis
Fed
rate
hike
MEX
Peso
Asia
LTCM
dotcom
peak
9/11
GM/Ford
BSC
hedge
funds
BSC
LEH

Explaining Monthly Changes in Noise

Repo, LIBOR and Default

	(1)	(2)	(3)	(4)
ΔRepo	-0.461			-0.346
	[-2.43]			[-2.33]
ΔLIBOR		0.008		0.005
		[4.41]		[3.20]
ΔDefault			0.018	0.019
			[2.25]	[2.24]
Adj R2 (%)	4.19	4.70	5.33	13.06
# month	223	275	275	223

TASS Hedge Fund Data Summary Statistics

	Total #	Graveyard #	ret %	stdret %	AUM $M	iAUM $M	reporting mn	age mn	AR(1)
1994-1999	1698	1201	1.82	4.49	60.45	11.71	127.81	29.73	0.11
2000-2006	4292	2536	0.89	3.00	123.62	17.52	88.72	42.44	0.12
2007-2009	3453	1513	0.21	4.00	240.16	20.65	89.85	75.16	0.19
ALL	4642	2702	0.73	3.75	151.40	18.89	85.33	44.09	0.20
Long/Short Equity	1219	751	0.94	4.76	110.14	13.27	86.51	44.90	0.14
Global Macro	185	113	0.84	4.28	246.34	30.25	75.09	39.54	0.07
Fund of Funds	1318	702	0.47	2.73	160.10	25.57	87.77	45.10	0.26
Fixed Income Arb	152	120	0.55	2.45	202.04	21.32	82.46	41.41	0.22
Managed Futures	239	104	0.90	5.20	164.84	10.64	101.89	55.01	0.03
Event Driven	404	277	0.84	2.63	195.76	14.87	92.12	48.35	0.26
Equity Neutral	208	150	0.54	2.63	88.32	14.15	72.32	36.40	0.11
Emerging Markets	367	154	1.01	6.30	121.93	20.57	77.84	39.22	0.24
Convertible Arb	137	102	0.56	2.65	142.94	14.82	91.47	47.72	0.38
Others	413	229	0.70	3.25	193.82	25.41	74.64	38.01	0.26

Noise-Beta Sorted Portfolios, Characteristics

Portfolio Rank	1	2	3	4	5	6	7	8	9	10
AUM ($M)	151.44	170.62	166.80	184.45	188.59	189.40	185.61	164.48	157.29	132.59
iAUM ($M)	14.12	13.91	12.13	14.19	14.68	13.63	12.65	12.54	12.86	11.47
reporting (mn)	130	132	133	134	135	135	134	133	133	131
age (mn)	72.7	73.2	72.6	73.2	73.8	73.8	73.2	73.8	74.7	73.9
stdret (%)	3.55	2.34	1.85	1.52	1.49	1.41	1.65	1.78	2.08	3.18
auto corr	0.14	0.18	0.22	0.25	0.26	0.25	0.23	0.20	0.17	0.13
Long/Short Equity	11.88	10.64	8.38	6.09	5.55	6.18	7.94	10.97	14.63	17.73
Global Macro	17.05	13.23	7.71	7.19	5.67	6.10	6.86	10.68	12.30	13.20
Fund of Funds	4.40	7.87	11.60	14.00	14.38	14.13	13.36	10.25	6.80	3.21
Fixed Income Arb	8.93	7.70	9.90	14.74	12.04	12.03	10.83	9.39	8.13	6.31
Managed Futures	22.71	13.64	6.98	4.60	3.73	5.33	5.94	7.20	10.01	19.86
Event Driven	4.51	9.94	12.58	13.04	14.22	12.43	11.59	10.02	7.55	4.11
Equity Neutral	5.72	10.70	9.38	8.29	8.94	9.70	11.51	12.61	13.61	9.56
Emerging Markets	25.77	13.32	8.64	5.45	5.02	5.05	6.45	7.91	9.17	13.22
Convertible Arb	7.30	8.95	10.32	14.50	15.25	13.98	10.59	9.95	6.10	3.07
Others	6.87	9.79	11.17	11.06	11.76	12.18	10.05	9.63	10.20	7.28