Liquidity Risk of Corporate Bond Returns (Preliminary and Incomplete)

Viral V Acharya

London Business School and Centre for Economic Policy Research (CEPR)

(joint with Yakov Amihud and Sreedhar Bharath)

Fifth Annual Credit Risk Conference organized by Moody's and Stern School of Business, New York University

14 May 2008

Outline

- **Explaining corporate bond returns**
- **Liquidity risk**
  - ✓ Framework
  - ✓ Data
  - ✓ Regime switch in liquidity betas
  - ✓ Nature of regimes
- **Interpretation of results**
- **Relationship to results for stocks**
- **Conclusions**

Explaining bond returns/spreads

- ***Changes in the spread*** are not explained well
  - ✓ By changes in factors affecting credit risk
    - Collin-Dufresne, Goldstein and Martin (2001)
  - ✓ R^2 of 30% to 40% only, higher for lower-rated bonds
  - ✓ Unexplained portion appears to have a common factor

- ***Hedge ratios*** from credit risk models are close to the empirically computed hedge ratios
  - ✓ Schaefer and Strebulaev (2006)
  - ✓ Unexplained portion thus most likely unrelated to credit risk

Possible explanations

- ***Liquidity and liquidity risk***
  - ✓ A burgeoning area of research but many open questions
- ***Time-varying risk-premium***
  - ✓ A less commonly adopted approach but potentially important
- ***This paper:***
  - ✓ Liquidity risk
  - ✓ Time-varying liquidity risk
  - ✓ Interpretation: Time-varying (liquidity) risk premium

Liquidity risk

- Framework based on
  - ✓ Pastor and Stambaugh (2002), Acharya and Pedersen (2005)
- Controls for interest rate and default risk
  - ✓ Fama and French (1993), Schaefer and Strebulaev (2006)

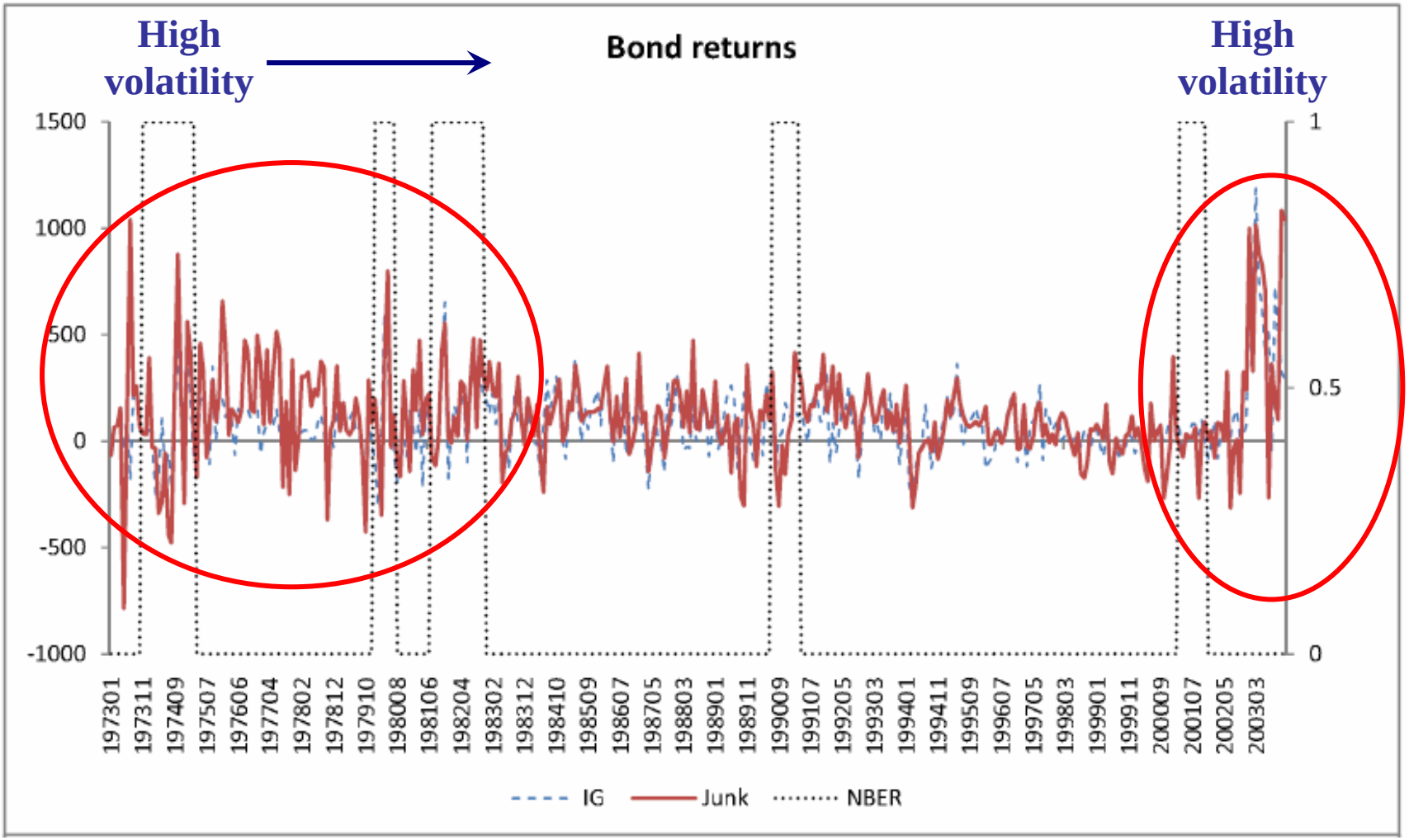
$$R_{j,t} = \alpha_j + \beta_{j,T} \times Term + \beta_{j,D} \times Def + \beta_{j,I} \times Illiqinnov + \beta_{j,BI} \times Bondilliqinnov + \epsilon_{j,t} ,$$

- ***Regime-switching analysis of betas***
  - ✓ Hamilton (1994)

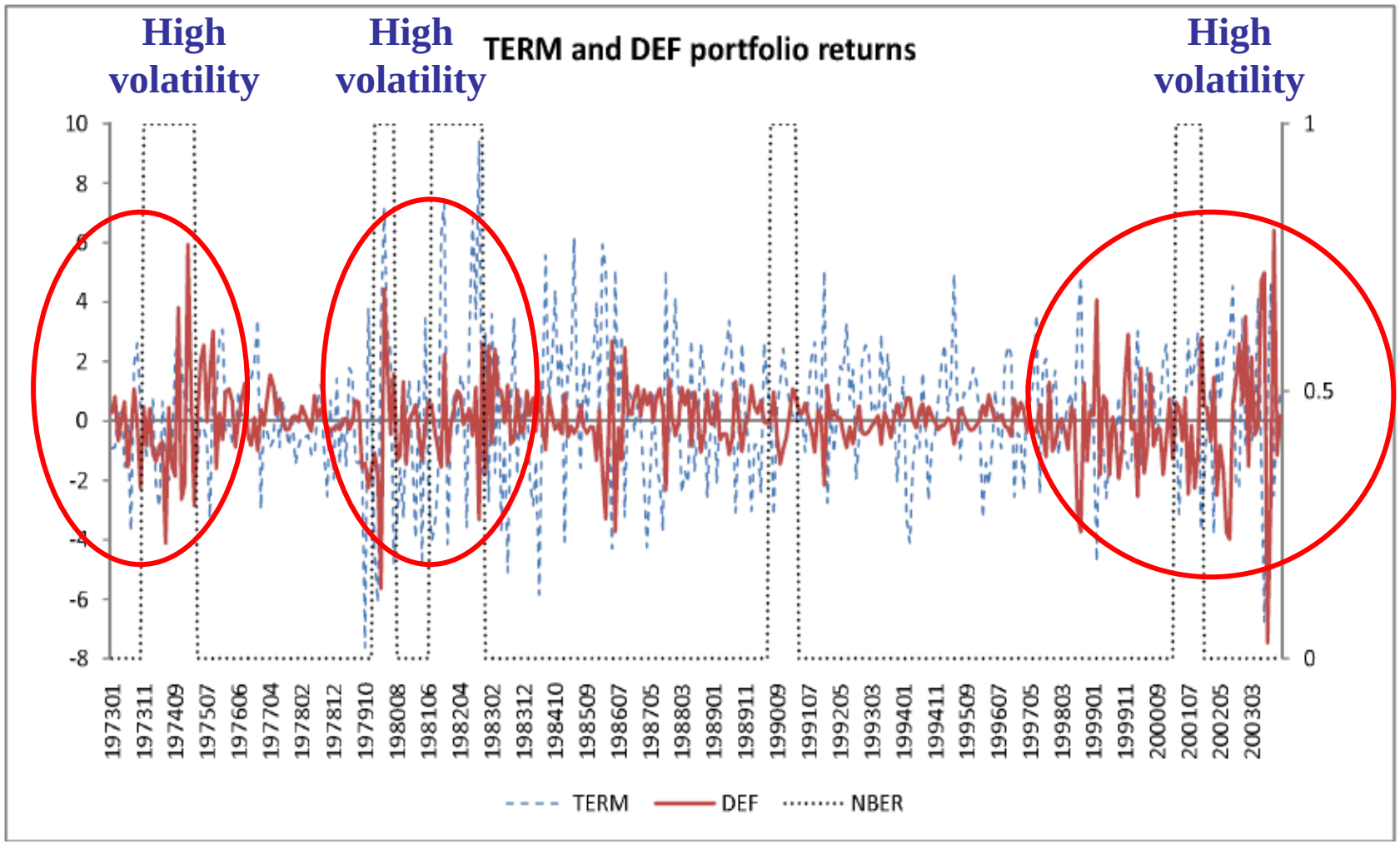
Corporate bond returns

- **Lehman Brothers Fixed Income Database** (Warga, 1998): 1971-1997
- **NAIC**: 1994 -2005
- High intersection in the overlapping period
- Elimination criteria:
  - ✓ Matrix prices
  - ✓ Special features
  - ✓ Not in Lehman Brothers bond indices
- ***Term***: Long-term govt minus one-year govt
- ***Def***: Value-wtd market of all corp bonds > 10yrs
  - ✓ Also use firm-level equity returns (Schaefer, Strebulaev (2006))

IG and Junk bond returns



Term and *Def*


High volatility
High volatility
TERM and DEF portfolio returns
High volatility
10
8
6
4
2
0
-2
-4
-6
-8
1
0.5
0
197301
197311
197409
197507
197606
197704
197802
197812
197910
198008
198106
198204
198302
198312
198410
198509
198607
198705
198803
198901
198911
199009
199107
199205
199303
199401
199411
199509
199607
199705
199803
199901
199911
200009
200107
200205
200303
TERM
DEF
NBER

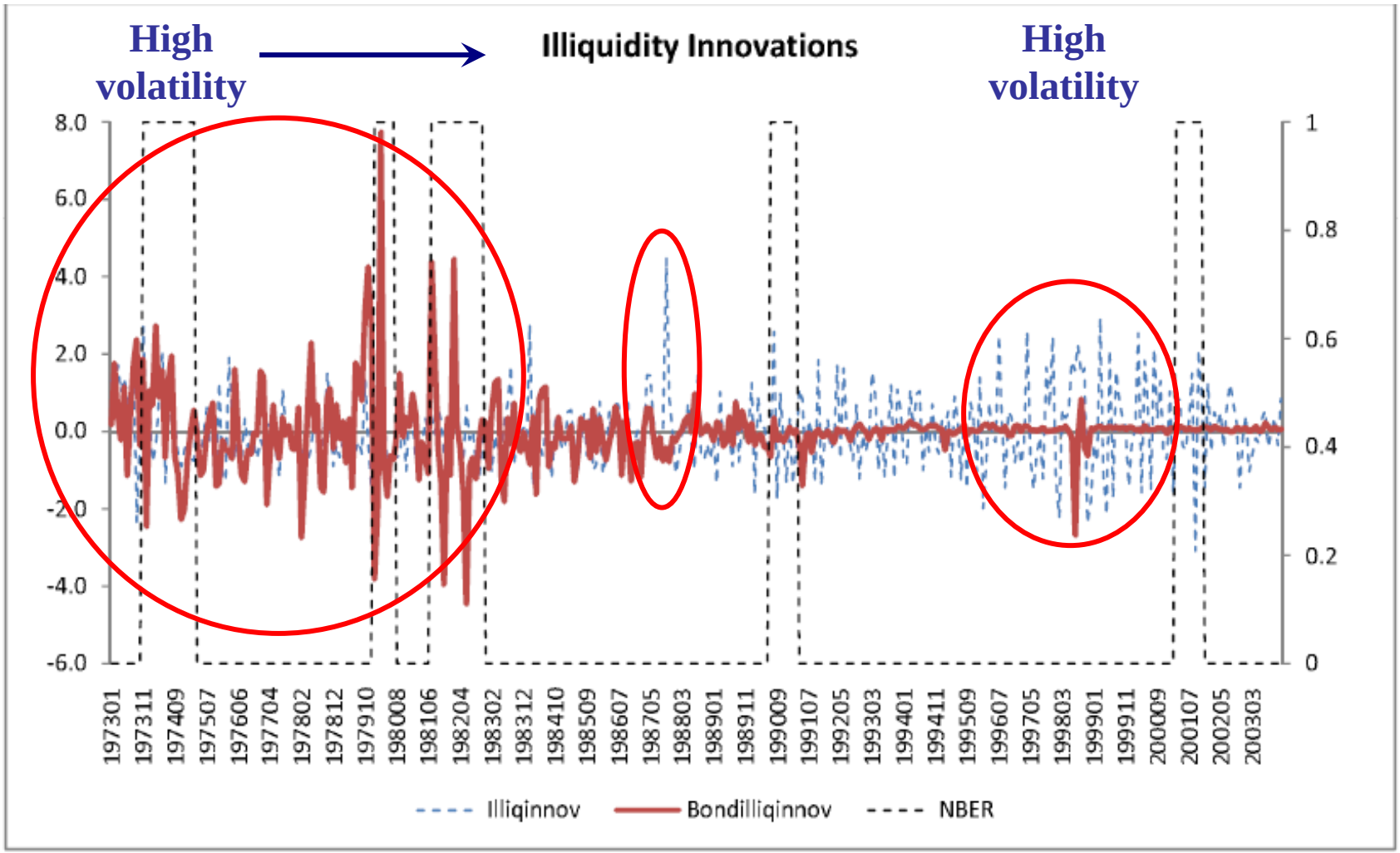
Measurement of liquidity risk

- ***Equity-market liquidity fluctuations***
  - ✓ *Illiqinnov:* AR(2) innovations in equally-weighted, monthly (average of daily) price-impact measure *ILLIQ* of Amihud (2002)
    - Acharya and Pedersen (2005), de Jong, Driessen (2005)

- ***Treasury-market liquidity fluctuations***
  - ✓ *Bondilliqinnov*: First difference in the monthly quoted % bid-ask on off-the-run treasuries, equally-weighted across maturities
    - Longstaff, Mithal, Neis (2004), Goyenko (2005), de Jong, Driessen (2005)

- ***Corporate bond-market factor***
  - ✓ Downing, Underwood and Xing (2005), Chacko (2005)
  - ✓ Limited data prevents significant time-series analysis

Illiqinnov and *Bondilliqinnov*



Correlation amongst risk factors

	TERM	DEFAULT	ILLIQINNOV	BONDILLIQINNOV
TERM	1			
DEF	-0.3816	1		
ILLIQINNOV	-0.0146	-0.0705	1	
BONDILLIQINNOV	-0.0916	-0.1273	0.1117	1

Unconditional liquidity risk

	Coefficients					
Rating	α	β_t	β_d	β_i	β_{bi}	Adj-Rsq
AAA	56.34	47.48	21.96	-31.80	-596.97	0.60
AA	58.80	56.52	45.04	-49.30	-1371.50	0.76
A	93.10	58.82	56.37	-74.67	-448.04	0.27
BBB	84.34	60.16	84.23	-46.07	-305.24	0.38
BB	96.92	46.66	41.62	-184.17	-2166.04	0.16
B	96.55	42.17	66.59	-155.02	-2555.24	0.22
CCC & below	145.32	21.04	48.41	-337.70	-5802.63	0.09
Unrated	76.37	36.91	27.37	-149.36	-1652.47	0.12

Economic magnitude *small*

- ***IG and Junk differences significant, except for Def***

	Ratio to $\sigma_{returns}$ of			
Rating	σ_t	σ_d	σ_i	σ_{bi}
AAA	82%	23%	4%	4%
AA	91%	43%	6%	8%
A	56%	32%	6%	2%
BBB	60%	50%	4%	1%
BB	41%	22%	13%	7%
B	41%	38%	12%	9%
CCC and Below	15%	20%	18%	15%
Unrated	36%	16%	11%	6%

- ***IG:*** Effect of liquidity risk of the order of 10 bps in returns
- ***Junk:*** 30 bps in returns (smaller than de Jong, Driessen)

Time-varying betas

- ***Estimate a Markov regime-switching model***
  - ✓ ***Regime-shift absent in IG, but strong in Junk betas***

Regime 1: $$R_{Junk,t} = \alpha^1_{Junk} + \beta^1_{Junk,T} Term_t + \beta^1_{Junk,D} Def_t + \beta^1_{Junk,I} Illiqinnov_t + \beta^1_{Junk,BI} Bondilliqinnov_t + \epsilon^1_{Junk,t}$$

Regime 2: $$R_{Junk,t} = \alpha^2_{Junk} + \beta^2_{Junk,T} Term_t + \beta^2_{Junk,D} Def_t + \beta^2_{Junk,I} Illiqinnov_t + \beta^2_{Junk,BI} Bondilliqinnov_t + \epsilon^2_{Junk,t}$$

Markov switching probability for state transition:

$$P(s_t = 1 \mid s_{t-1} = 1) = p$$
$$P(s_t = 2 \mid s_{t-1} = 2) = q$$

Liquidity beta changes substantially

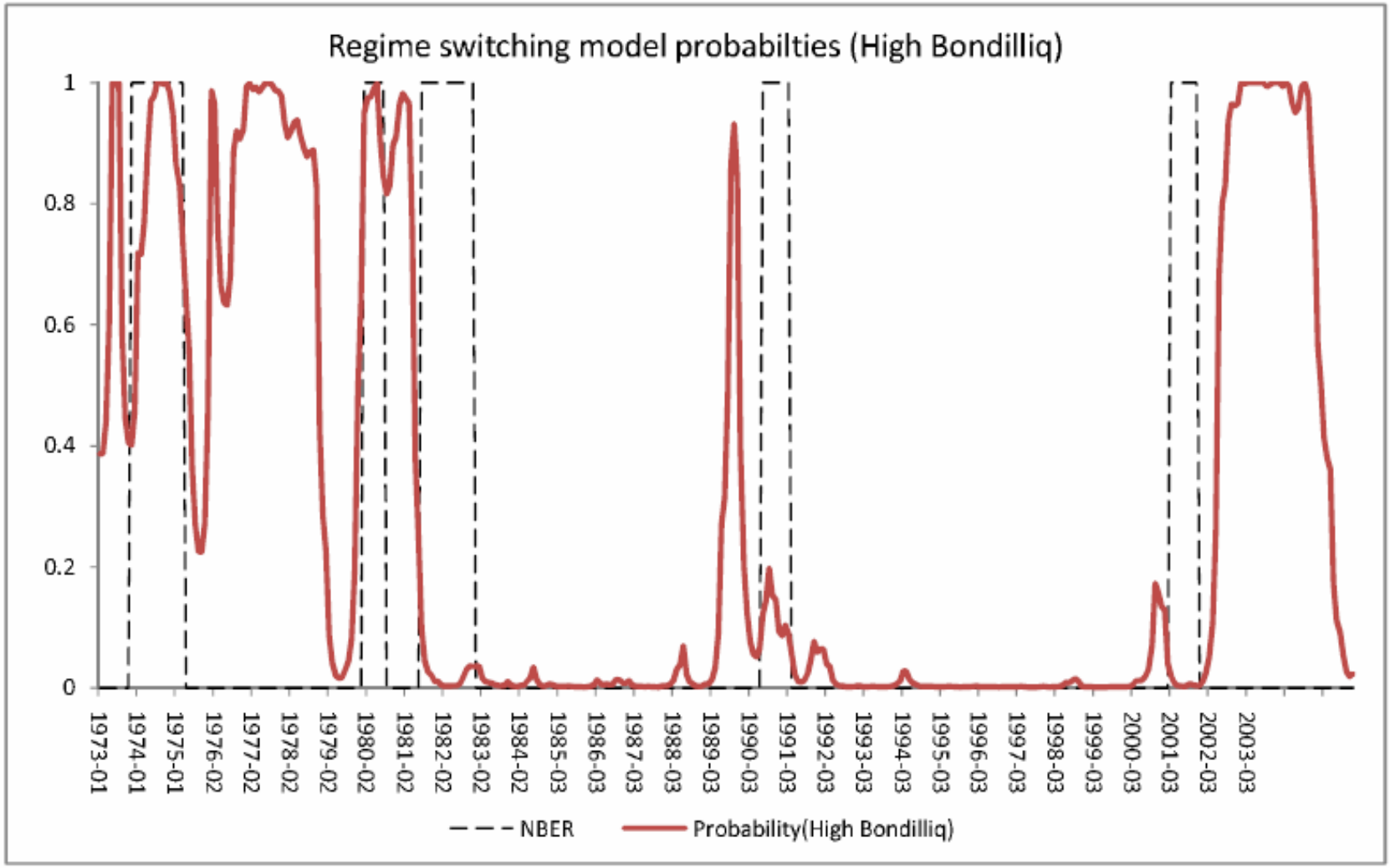
Junk Grade

	Regime 1		Regime 2		Parameters	
	Coeff	t-stat	Coeff	t-stat		
Constant	81.61	9.91	196.22	6.38	p	0.974
Term	41.11	10.33	40.76	3.01	q	0.932
Def	60.09	7.13	58.16	3.89		
Illiqinnov	-81.05	-1.81	-619.69	-5.04		
Bondilliqinnov	-1355.63	-18.31	-4147.74	-35.94		
σ_i	119.91		320.22			

Wald tests for differences in coefficients between Regime 1 and Regime 2

	Chi-Sq	p-value
Term	6.30	0.012
Def	4.82	0.028
Illiqinnov	28.54	0.000
Bondilliqinnov	458.22	0.000
Log Likelihood	-2412.83	
Sample Period	1973:01 - 2005:12	

Regime (weakly) linked to recession



High liquidity risk ("stress") regime

- ***Striking characteristics:***
  - ✓ IG and Junk bond returns ***more variable***
  - ✓ Stock-market illiquidity shocks ***more skewed***
  - ✓ Treasury illiquidity ***more variable***
  - ✓ Stock and treasury illiquidity ***more correlated***
- ***Relationship to macroeconomic factors:***
  - ✓ Positively linked to
    - ***Recession:*** NBER, Stock and Watson, Hamilton
    - ***Downturn in stock markets***
    - ***MKMV aggregate EDF***
- ***57% likelihood of switching out in a year***

Economic magnitude *large*

- ***Is higher volatility driving higher betas?***
  - ✓ Correlations with liquidity factors increase too
- ***Effect of liquidity risk magnifies three-four times***
  - ✓ Little shift in effect of *Term* and *Def*

Regime 1	Coeff	σ	$Coeff * \frac{\sigma_{factor}}{\sigma_{return}}$
Return		149.25	
Junk * Term	41.11	2.32	64%
Junk * Default	60.09	1.17	47%
Junk * Illiqinnov	-81.05	0.1962	11%
Junk * Bondilliqinnov	-1355.63	0.0074	7%
Regime 2			
Return		214.76	
Junk * Term	40.76	2.42	46%
Junk * Default	58.16	2.18	59%
Junk * Illiqinnov	-619.69	0.135	39%
Junk * Bondilliqinnov	-4147.74	0.01102	21%

10-16 bps in returns

80-150 bps in returns

Robustness checks

- ***Controlling for changes in expected cash flows***
  - ✓ Default likelihood: MKMV's aggregate EDF
  - ✓ LGD: Altman et al's aggregate recovery fn (agg EDF)
  - ✓ *Little effect*
- ***Controlling for changes in (equity-mkt) volatility***
  - ✓ *Little effect*
- ***Schaefer-Strebulaev (2006) model***
  - ✓ Average firm-level equity return as *Def*
  - ✓ *Liquidity betas remain strong in stress regime*
  - ✓ *Term and Def betas even less significant than before*

Regime-shift with SS (2006) model

Junk Grade

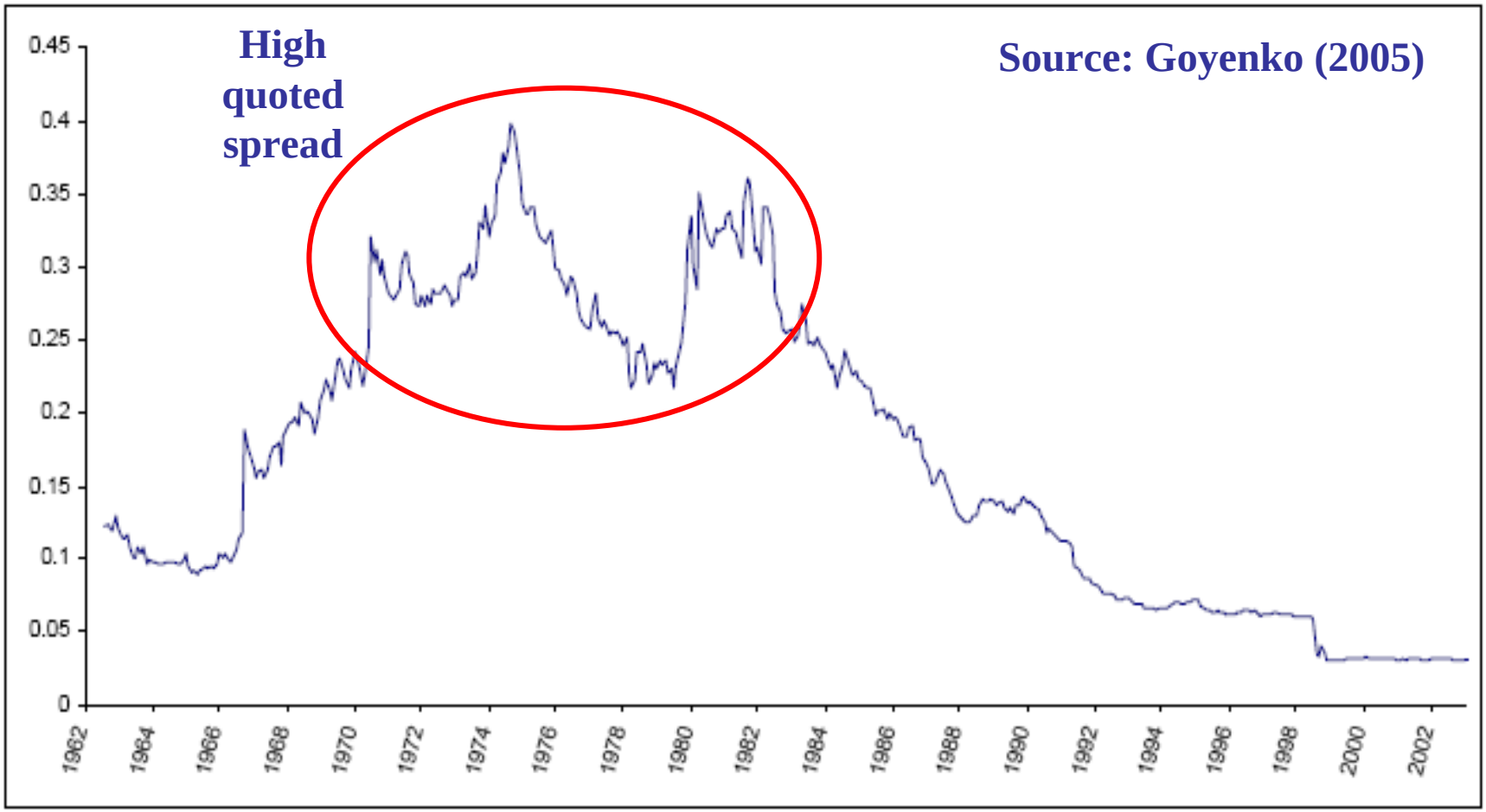
	Regime 1		Regime 2		Parameters	
	Coeff	t-stat	Coeff	t-stat		
Constant	60.72	2.69	55.81	0.09	p	0.945
Term	29.27	10.56	3.67	0.04	q	0.690
Def	92.47	2.09	13.62	0.01		
Illiqinnov	-106.68	-0.72	-581.58	-1.75		
Bondilliqinnov	-2168.89	-2.81	-5231.23	-3.32		
σ_i	91.19		285.75			

Relationship to liquidity risk of stocks

- ***Acharya and Pedersen (2005)***
  - ✓ Illiquid stocks are also more liquidity risky
  - ✓ This paper: Junk bonds are more illiquid and liquidity risky than IG bonds (also de Jong, Driessen 2005)
  - ✓ *Additional:* Liquidity risk is time-varying and economically substantial primarily in stress periods

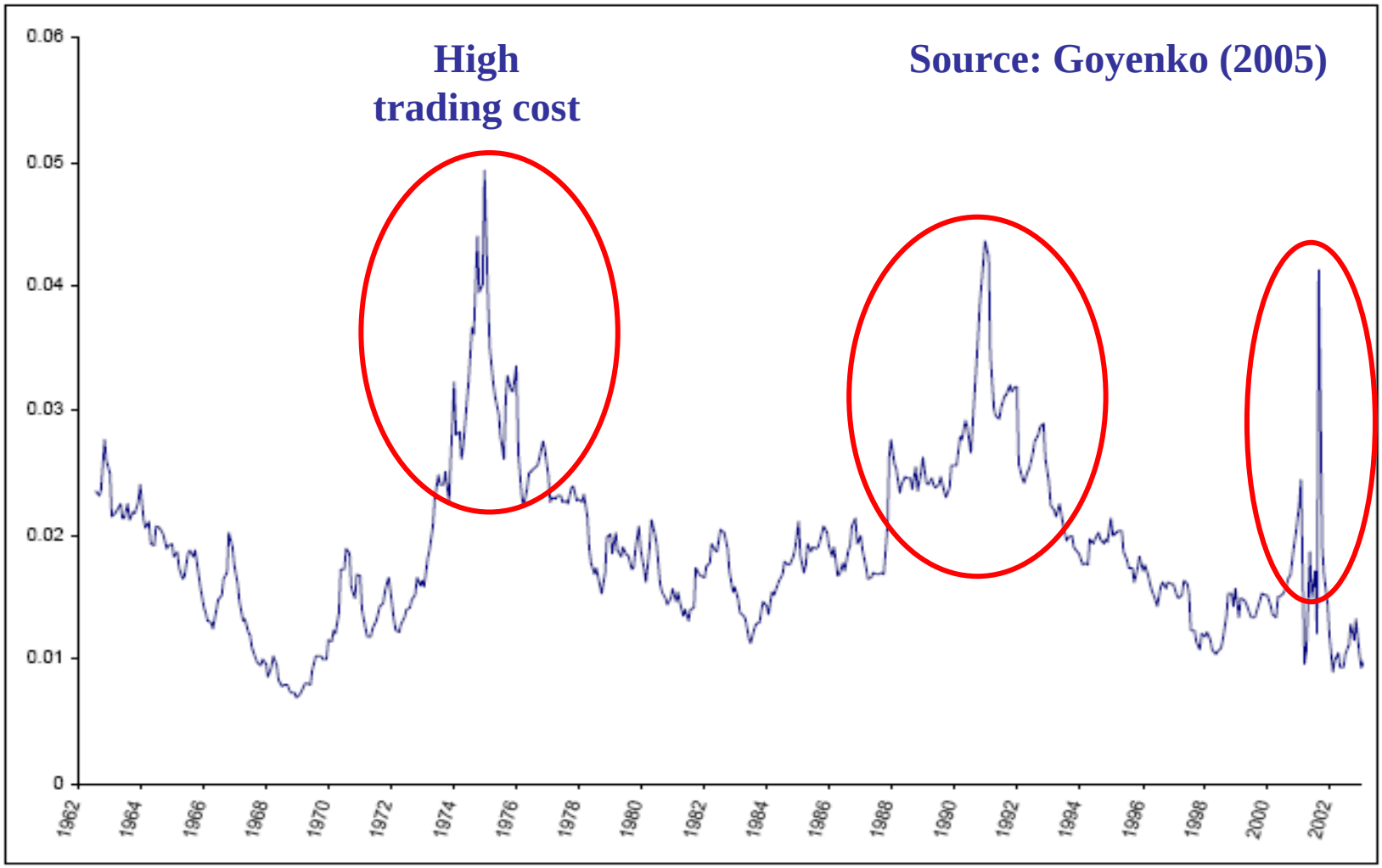
- ***Watanabe and Watanabe (2007)***
  - ✓ Stock betas on *ILLIQ* innovations also show regimes
  - ✓ Regimes correspond to high and low *ILLIQ*
  - ✓ This paper: Provides a similar result for junk bonds
  - ✓ Liquidity risk is priced more in cross-section in stress

Treasury market (il)liquidity



London Business School

Stock market effective tick size



Interpretation

- Beta = Cash flow beta + Expected return beta
- For corporate bonds, cash flow beta should be small (controlled)

- ***Higher liquidity beta in stress (high volatility) regime***

-> Higher beta of expected return on liquidity risks,
But not so for interest rate and default risks

- ***"Flight to quality/liquidity"***
  - ✓ Effect of market liquidity on (junk bond) risk premium

- ***How does this relate to the risk-premium being apparently common across equities and bonds?***
  - ✓ Chen, Collin-Dufresne, Goldstein (2005): Habit pricing kernel
    - BBB-AAA: ***credit*** spread, AAA-Tsy: ***liquidity*** spread

Conclusion

- ***Much has been accomplished over the past few years***
  - ✓ Measuring corporate bond market liquidity
  - ✓ Quantifying the liquidity risk of corporate bonds
  - ✓ Relating liquidity and liquidity risk to spreads
- ***Our paper:***
  - ✓ Focused on ***time-varying liquidity risk*** of corporate bonds
  - ✓ Evidence for time-varying liquidity betas for junk bonds
  - ✓ Consistent with "flight to quality/liquidity" in volatile/stress periods
  - ✓ Conditional liquidity risk effects large, unconditional effects small
- ***Much remains to be done…***
  - ✓ Relating these effects to time-series of spread changes
  - ✓ Differentiating fully liquidity risk premium from the usual one
  - ✓ Identifying "stress" periods in corporate bond market liquidity

Corporate bond liquidity measures

One-way or round-trip cost (bid-ask spread)	Chen, Lesmond and Wei (2005), Goldstein, Hotchkiss and Sirri (2005)
Price impact based on Stulz (2001) approach, TRACE	Bessembinder, Maxwell and Venkataraman (2005), Edwards, Harris and Piwowar (2005), Goldstein, Hotchkiss and Sirri (2005)
Price impact based on daily data using Amihud (2002)	Downing, Underwood and Xing (2005)
Frequency of zero returns and its variants	Lesmond, Ogden and Trzcinka (1999), Chen, Lesmond and Wei (2005)
Accessibility: Turnover of portfolios holding the bond	Chacko (2005), Chacko, Mahanti, Mallik and Subrahmanyam (2005)