

Measuring CDS Liquidity

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Quotes

> **Paul Samuelson**

- “What we know about the global financial crisis is that we don’t know very much”

> **Raymond DeVoe, Dec 11th 1995**

- “Every mania in financial history has been liquidity driven. You can go back to the South Sea Bubble or tulips in Holland. As long as the money is coming in, everything is fine.”

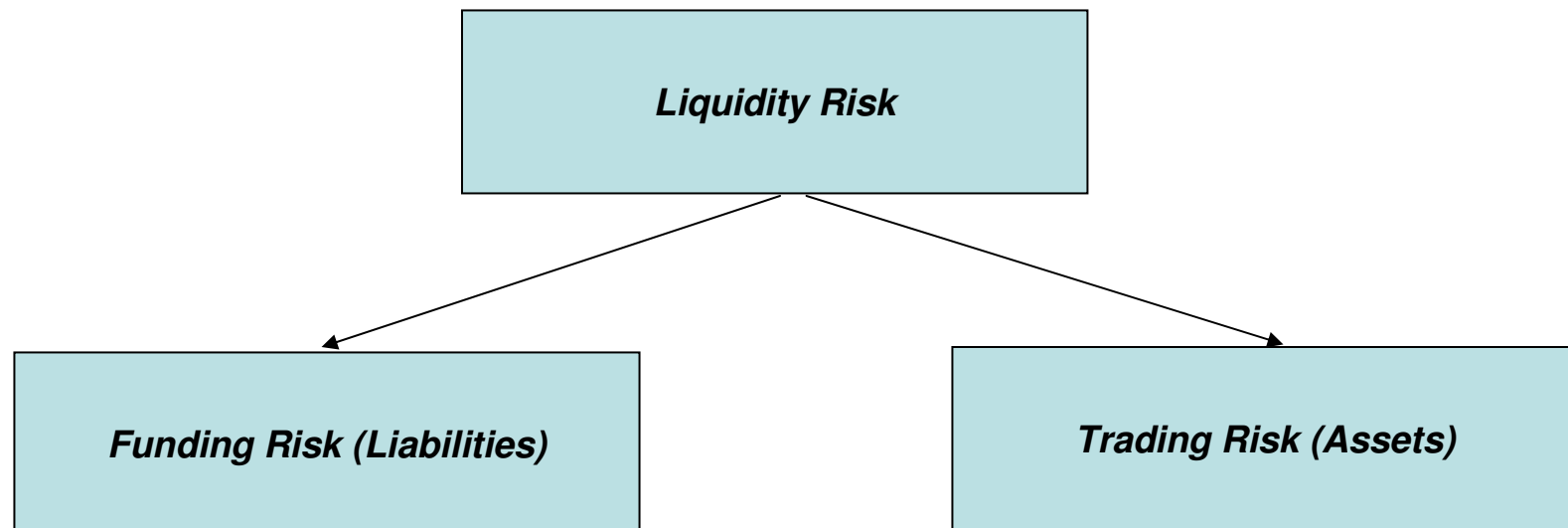
> **Ben Bernanke May 15th 2008**

- “We are working through the Basel Committee on Banking Supervision to develop enhanced guidance on the management of liquidity risk”

> **O’Hara, 1995**

- “... liquidity, like pornography, is easily recognized but not so easily defined.”

What is Liquidity Risk?



Funding Risk is the risk that the firm will not be in a position to honour its obligations to pay cash flows; such inability is likely to jeopardise its financial condition.

Trading Risk is the risk that the firm will not be able to easily offset a position because of inadequate market depth or market disruption.

More on Liquidity Risk...

- > Liquidity risk is a second-order risk (often arises pursuant to the realisation of some other risk factor, e.g. credit risk, currency crisis, and so forth)
- > Liquidity risk and investor rationality are not positively correlated: investor behavior reflects panic, mania and herding behavior
- > Thus, Liquidity Risk typically is observed with presence of contagion in the market
- > As credit, currency and some other financial risks liquidity trading risk has a systematic and idiosyncratic components
- > Liquidity Risk is not actively managed by risk managers...

Possible Causes for Illiquidity in Financial Markets


- > Nature of asset (lack of standardization search costs)
- > Demand/Supply Imbalances due to market concentration
- > Demand/Supply Imbalances due to information sets
- > Demand/Supply Imbalances due to inherent shocks and extreme events in the market
- > Trading/Regulatory constraints (e.g. shortselling)
- > Temporary or permanent state of uncertainty (in a Knightian sense)

Liquidity Risk in CDS Markets



- > **Generic usage:** Liquidity is the ability to convert an asset into cash *easily*
 - > Low cost, quick trades

- > **Aggregate liquidity measures** (across financial markets)
 - Asset classes: Currencies, bonds/interest rates, equities
 - Regions: US, Europe, Japan, etc.
 - Some metrics for systemic illiquidity floated by central banks, int'l organisations

- > **Specific CDS contract's liquidity**
 - “CDS on Alcoa is more liquid than the CDS on American Express today” 
 - > Operational measure
 - > “Reduced-form” approach
 - Uses available CDS spread information across various contributors to measure changing trends (treats spread and bid-offer quotes as *exogenous*)
 - Key challenges
 - > Must be able to analyse liquidity without real-time (traded) CDS volumes or notional outstanding information

Targets



- > Single, unified model that measures CDS liquidity
- > At reference entity level and at various composite levels
 - E.g. “CDS on Ford is more liquid than CDS on Alcoa (today)”.
 - E.g. “CDS on financials are less liquid in 2007 than CDS on Technology”
 - E.g. “Is the distribution of liquidity skewed?”
- > Works for global portfolios
 - E.g, if Deutsche Telekom & Ford in same portfolio, their liquidity metrics should be comparable
- > Makes liquidity comparable across credit quality
 - Data on both High Yield and Inv. Grade names pooled together
 - Aim to exclude default risk from liquidity scores
- > Is dynamic
 - Should be able to compare liquidity scores of individual reference entities (and market liquidity indicators) *over time* (e.g. less market liquidity in Dec 2006 vs Dec 2007 in Asia)
 - Can be regularly updated (e.g. daily) using current market indicators of the CDS market

Targets (continued)

- > Utilise quote information up to individual contributor level;
- > Aggregate individual measures of liquidity based on views of major participants;
- > Liquidity is estimated independent of credit risk.

Related Papers

- > Tang and Yan (2007)
 - Use five liquidity measures ('Bid-Ask Spread (BAS)', 'Volatility to Volume (V2V)', 'Number of Contracts Outstanding (NOC)', 'Trade To Quote Ratio (T2Q)', 'Volume') to investigate liquidity premia in CDS spreads
 - Mixed Results: Liquidity premia for the protection seller (BAS, V2V) or protection buyer (NOC, Volume)
- > Bongaerts, de Jong and Driessen (2007)
 - Use the liquidity-adjusted CAPM (Acharya and Pedersen (2005)) to estimate expected liquidity and liquidity risk premia in the CDS market.
 - Use the Bid-Ask Spread as a measure of liquidity
 - Liquidity premia for the protection seller
- > Chen, Cheng and Wu (2005)
 - Use a reduced-form model to model interest rate risk, credit risk and liquidity risk in a unified framework
 - Use the percentage of days with zero changes in the mid-quote as a measure of liquidity
 - Liquidity premia for the protection buyer

Model Details (1 of 8)

Data Snapshot

Ford Motor Company

Date	Field	Contributor ID											
		_4	_7	_8	_11	_12	_13	_18	_20	_21	_27	_35	_42
22/09/2008	Mid	1521	1675	1624	1716	1150	1685	1725	1737	1600	.	1700	1516
22/09/2008	Bid-Ask	.	.	11	.	.	8	.	10	.	.	.	.
23/09/2008	Mid	1521	1825	1742	1849	1150	1781	1900	1761	1850	.	1600	1761
23/09/2008	Bid-Ask	.	.	12	.	.	8	.	10	.	.	.	.
24/09/2008	Mid	2057	1975	1935	1907	1150	2081	2100	1967	1850	1737	1600	1886
24/09/2008	Bid-Ask	.	.	13	.	.	8	.	10	.	10	.	.
25/09/2008	Mid	1936	2005	1936	2130	1150	2081	2200	1967	1850	1737	2050	1892
25/09/2008	Bid-Ask	.	.	13	.	.	8	.	10	.	10	.	.
26/09/2008	Mid	1936	2005	1998	2133	1150	2031	2350	2121	1850	1737	2050	1954
26/09/2008	Bid-Ask	.	.	14	.	.	8	.	10	.	10	.	.
29/09/2008	Mid	1936	2255	2204	2433	1150	2131	2625	2631	1850	.	2050	2250
29/09/2008	Bid-Ask	.	.	16	.	.	8	.	10	.	.	.	.
30/09/2008	Mid	1936	2305	2381	2554	1150	2281	2625	2544	2300	2106	2300	2365
30/09/2008	Bid-Ask	.	.	17	.	.	8	.	10	.	10	.	.

Model Specification

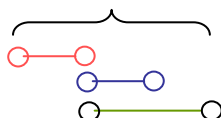


- > A regression-based model that employs a handful of intuitive predictors of “liquidity”

Composite Liquidity Score = f (inactivity & staleness of quotes,
dispersion in midquotes across contributors,
scaled bid-ask spread)



IoN: Inactivity on a Name



MAD / median: robust measure of *dispersion* across contributors (scaled)



Bid-ask spread (scaled by each name’s running average *midquote*)

- > A responsive variable (0 or 1) is constructed based on a short list of names perceived as “liquid” by major market makers.
- > Interpretation of score
 - > Model-generated scores provide an ordinal (or ranking-based) measure
 - Not a “liquidity rating” or a *long-term view* of that name’s *funding liquidity*
 - Model score not a liquidity premium (e.g. 10 bps) but closely related

Inactivity on a Name (IoN)

Illustration of how IoN works

date	A	B	C	D	E
02 January 2006	---	---	33	30	---
03 January 2006	---	---	33	30	---
04 January 2006	---	---	25	29	---
05 January 2006	---	---	25	28	---
06 January 2006	---	---	25	27	---
09 January 2006	---	---	25	28	---
10 January 2006	---	---	25	29	---

5 Contributors on a reference entity

- Inactivity and staleness measured as a binary (1/0) counter in the first instance

$$b_{tj}^{(i)} = 1 \text{ or } b_{tj}^{(i)} = 0$$

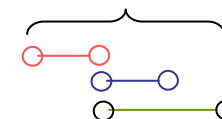
Quotes



Binary

date	A	B	C	D	E	
02 January 2006	1	1	0	0	1	
03 January 2006	1	1	1	1	1	
04 January 2006	1	1	0	0	1	
05 January 2006	1	1	1	0	1	
06 January 2006	1	1	1	0	1	
09 January 2006	1	1	1	0	1	
10 January 2006	1	1	1	0	1	

Median absolute deviation / median (Example)



$$[MAD/Median]_t^{(i)} = \text{median} | q_{tj}^{(i)} - \text{median}(q_{tj}^{(i)}) | / \text{median}(q_{tj}^{(i)}),$$

Time	C1	C2	C3	C4	C5	change in avg midquote	MAD	MAD / median	std dev	scaled std dev
	98	99	100	101	102	---	1	1.00%	1.58	1.58%
	114	110	106	104	102	7.20%	4	3.77%	4.82	4.49%
	114	116	118	120	128	11.19%	2	1.69%	5.40	4.53%
	152	140	132	130	128	14.43%	4	3.03%	9.84	7.21%
	152	156	164	176	192	23.17%	12	7.32%	16.25	9.67%

C1	C2	C3	C4	C5
98	99	100	101	102
114	110	106	104	102
114	116	118	120	128
152	140	132	130	128
152	156	164	176	192

x 5

C1	C2	C3	C4	C5
490	495	500	505	510
570	550	530	520	510
570	580	590	600	640
760	700	660	650	640
760	780	820	880	960

Change in avg midquote	MAD / median
---	1.00%
7.20%	3.77%
11.19%	1.69%
14.43%	3.03%
23.17%	7.32%

MAD / median more robust to outliers / irregularities in contributor data than std dev

Robust to midquote *levels*



Model Details (5 of 8)

- **Method:** Logistic regression
- Use index membership as a *proxy* for liquidity
 - Identify key variables that determine index membership
 - Generalise this method to *all* reference entities (including those not part of well-traded index, e.g. sovereigns)

• Regression

- Regress log-odds ratio on RHS of transformation shown below

$$z_{it} = \text{logit}(p_{it}) := \log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \beta_1 IoN_{it} + \beta_2 SBAS_{it} + \beta_3 (M / M)_{it} + \text{various dummies}$$

- $y_{it} = 1$ if i is an index member at time t
- $y_{it} = 0$ if not;
- Each name i has separate p_{it}
- $p_{it} = y_{it} / n_{it}$

Linear model

• Alternatives were considered

- Single predictors (e.g. bid—ask spread) not as effective
- Using OLS regression where CDS spread is regressed on similar RHS variables

A liquid premium is extracted from the total spread

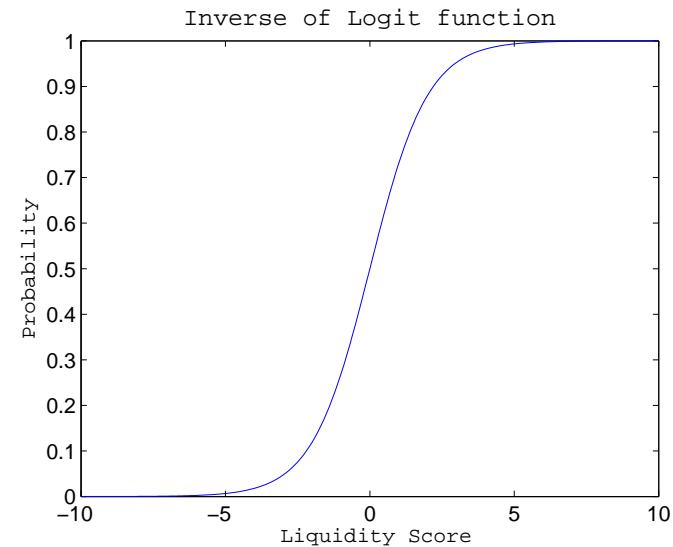
Model Details (6 of 8)



> Logistic regression because

$$p(z) = \frac{1}{1 + e^{-z}}$$







Logistic function



- Obtained by inverting the logit transformation
- Nonlinear relationship between liquidity score, z , and probability, p , of index membership
 - > Index membership is “sticky”
- Analogous models used in Medicine, in Business (e.g. RMBS within Fitch)

Model Details

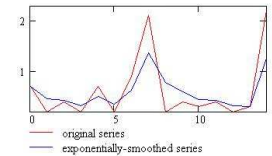
Important qualitative relationships

Liquidity		IoN	
Liquidity		Scaled Bid-Ask spread	
Liquidity		MAD / median	

- *Inverse* relationship between liquidity predictors and model liquidity score
 - Or, put another way, *direct* relationship between variables and *Illiquidity*
- Relationship holds for all regions
- “Liquidity score” *mirrored* onto positive axis

$$\tilde{z}_{it} = - \text{Score obtained from regression}$$

Model Details (8 of 8)



- > Liquidity score, \tilde{z}_{it} , for a reference entity **always positive**
 - 0: most *liquid* ; higher scores more *illiquid*
 - > More palatable for clients
 - Closer to “liquidity premium” interpretation of illiquidity
 - > (e.g. Wachovia’s CDS spread pushed by a few bps if Wachovia is perceived to be more illiquid)
- > Liquidity predictors { IoN, SBAS, MAD / Median } *smoothed*
 - Rationale
 - > Index membership not updated *daily*
 - power of model blunted if predictors update regularly but response variable does not
 - > Usual statistical reasons: noisy data!
 - Exponentially smoothed values of SBAS, MAD/Median and IoN improve quality of fit

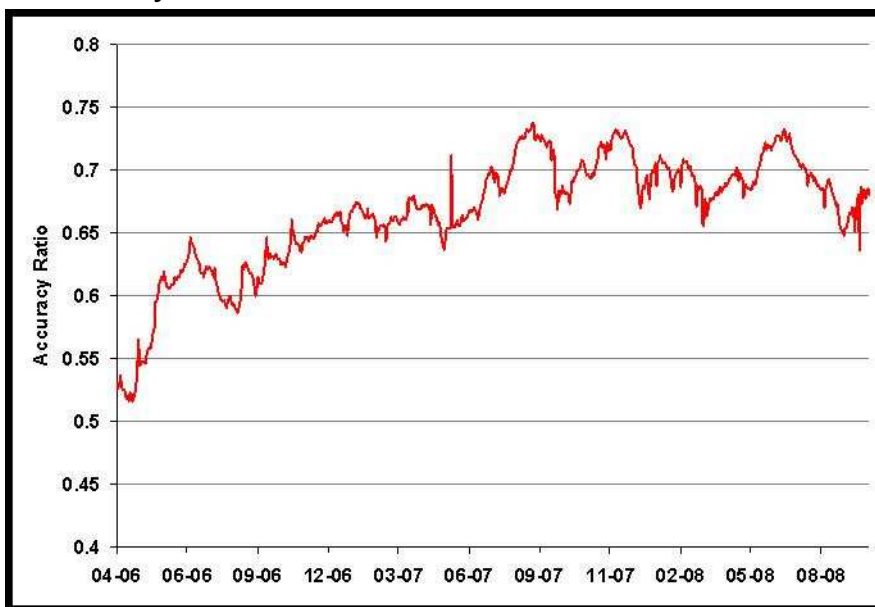
Various statistical properties

> Relationship between variables

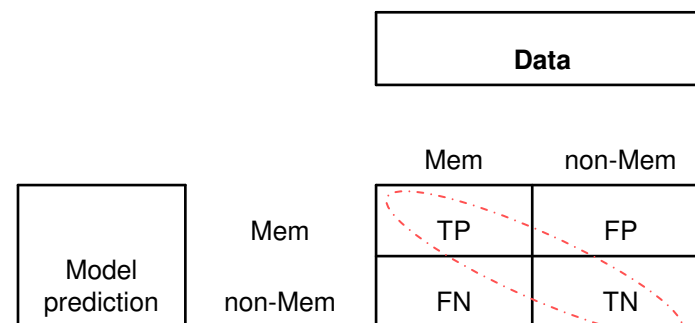
Correlations between liquidity variables

	Scaled BA	MAD/Median	ION
Scaled BA	100%	19%	29%
MAD/Median		100%	36%
ION			100%

> Accuracy ratio



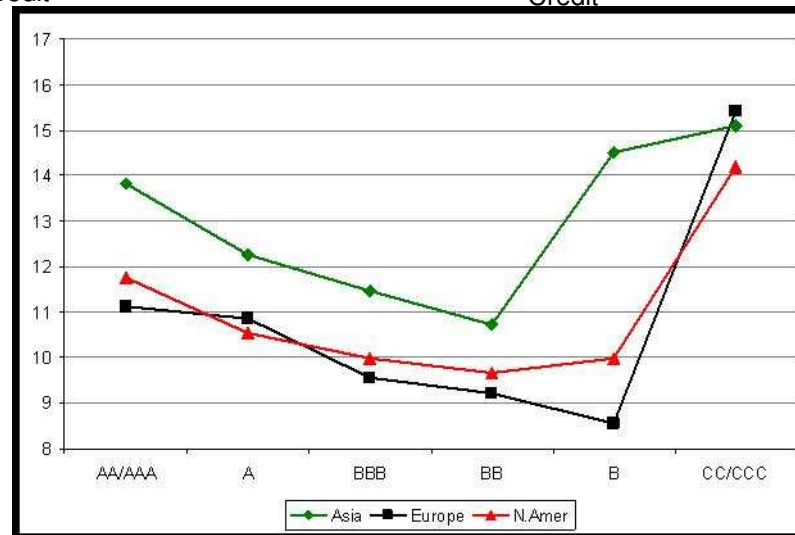
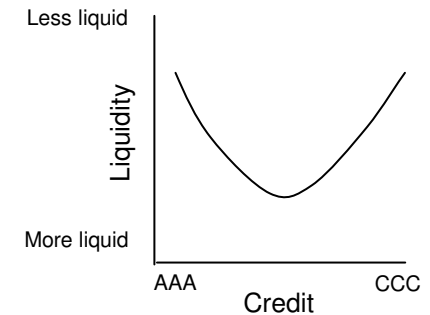
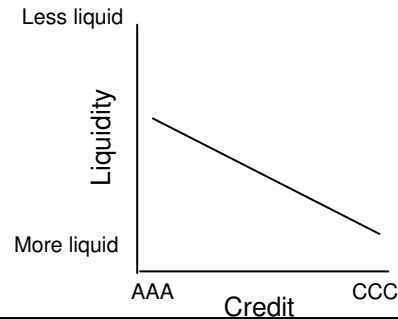
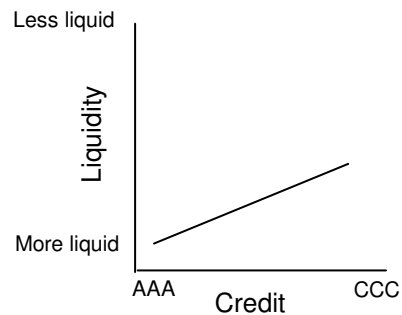
Understanding
Accuracy ratios



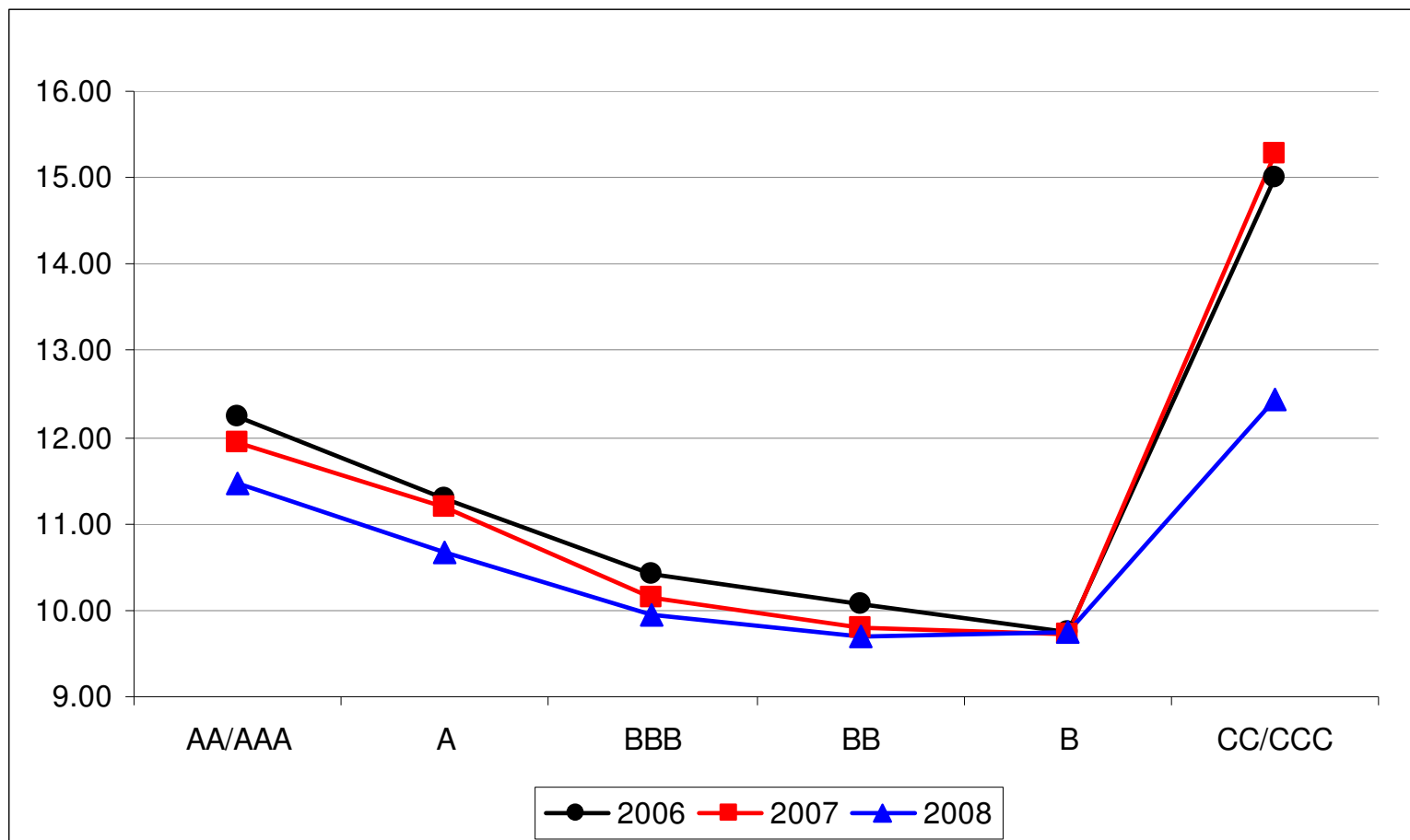
Liquidity and credit: the inseparable twins?



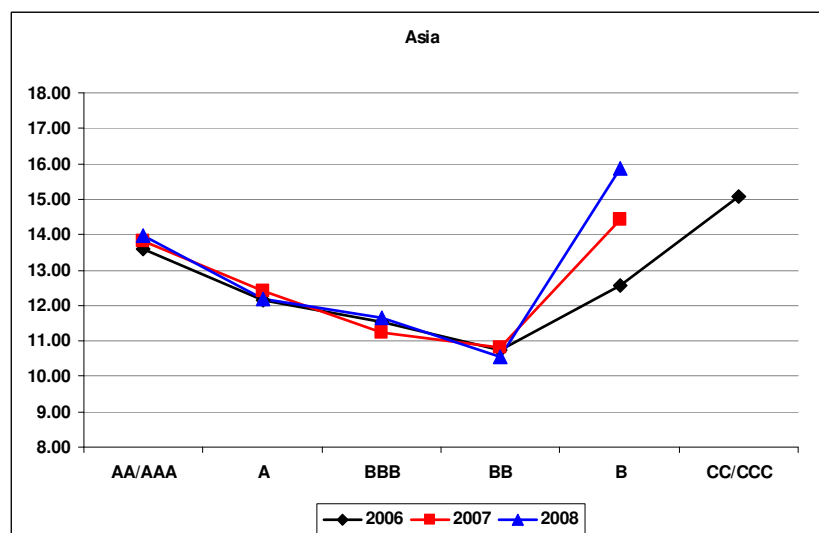
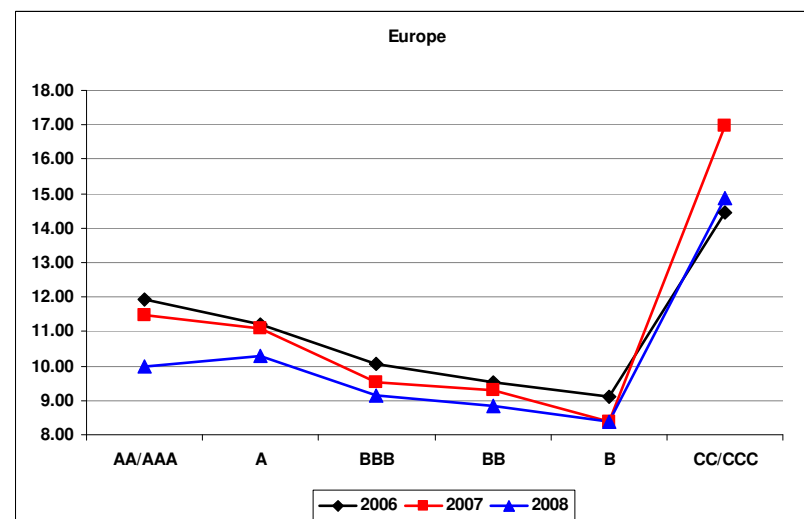
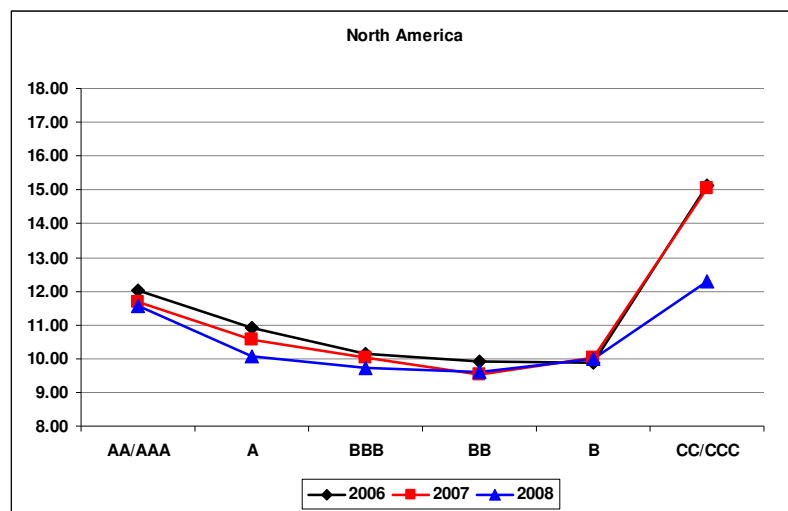
- > Liquidity and credit should be related
 - But H_0 is anybody's guess



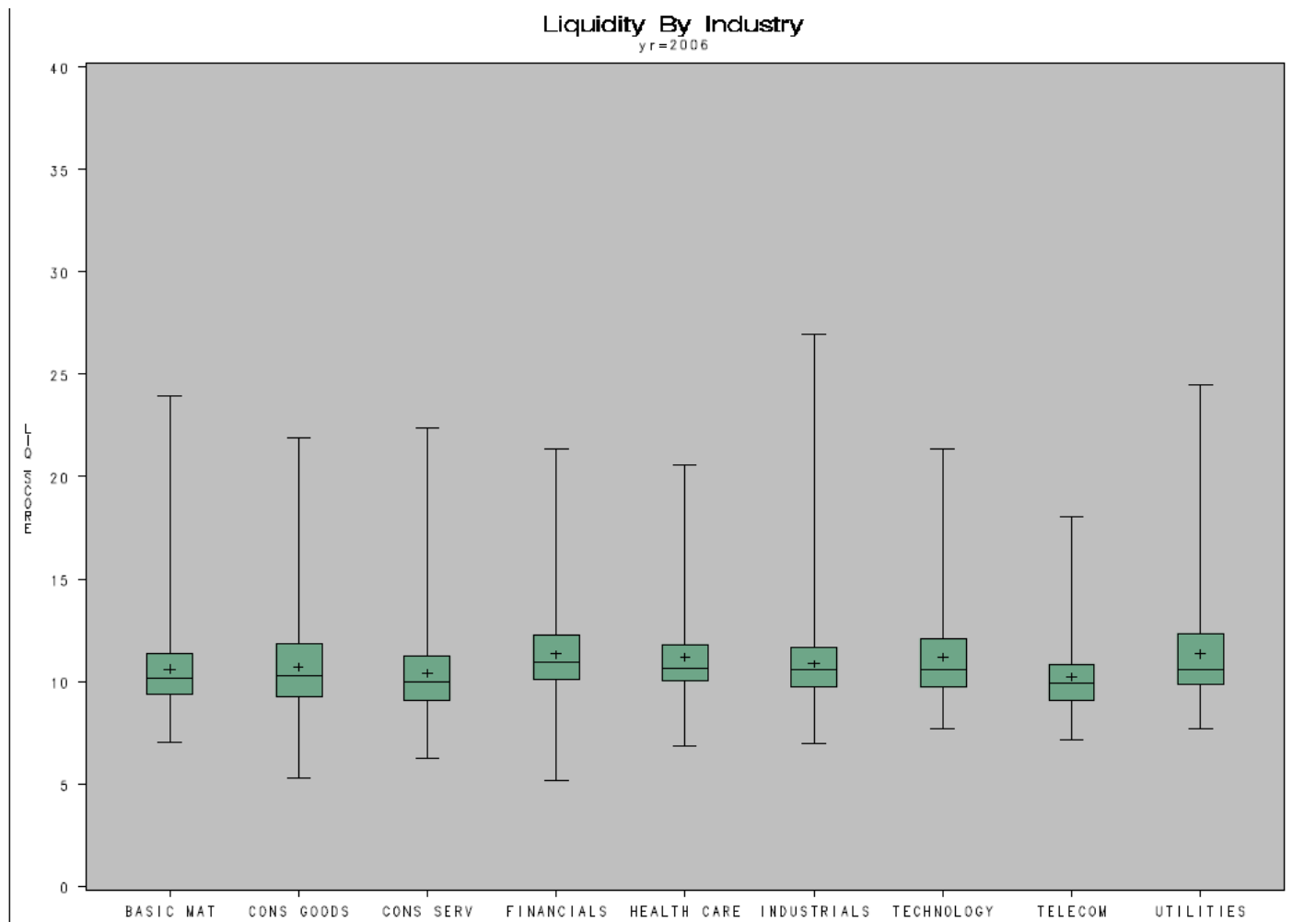
Liquidity Vs. Credit Over Time



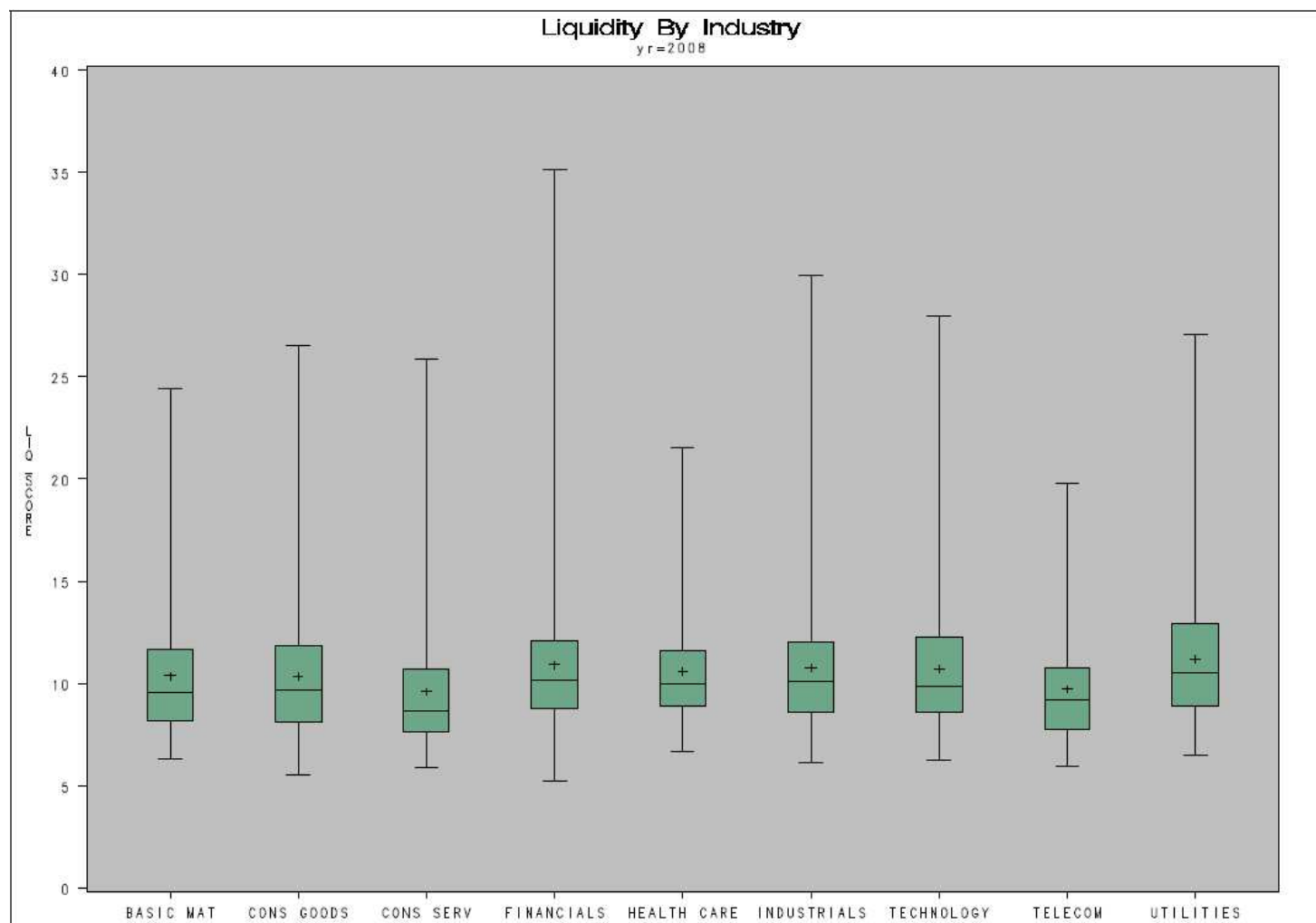
Liquidity vs. Credit Over Time, By Region



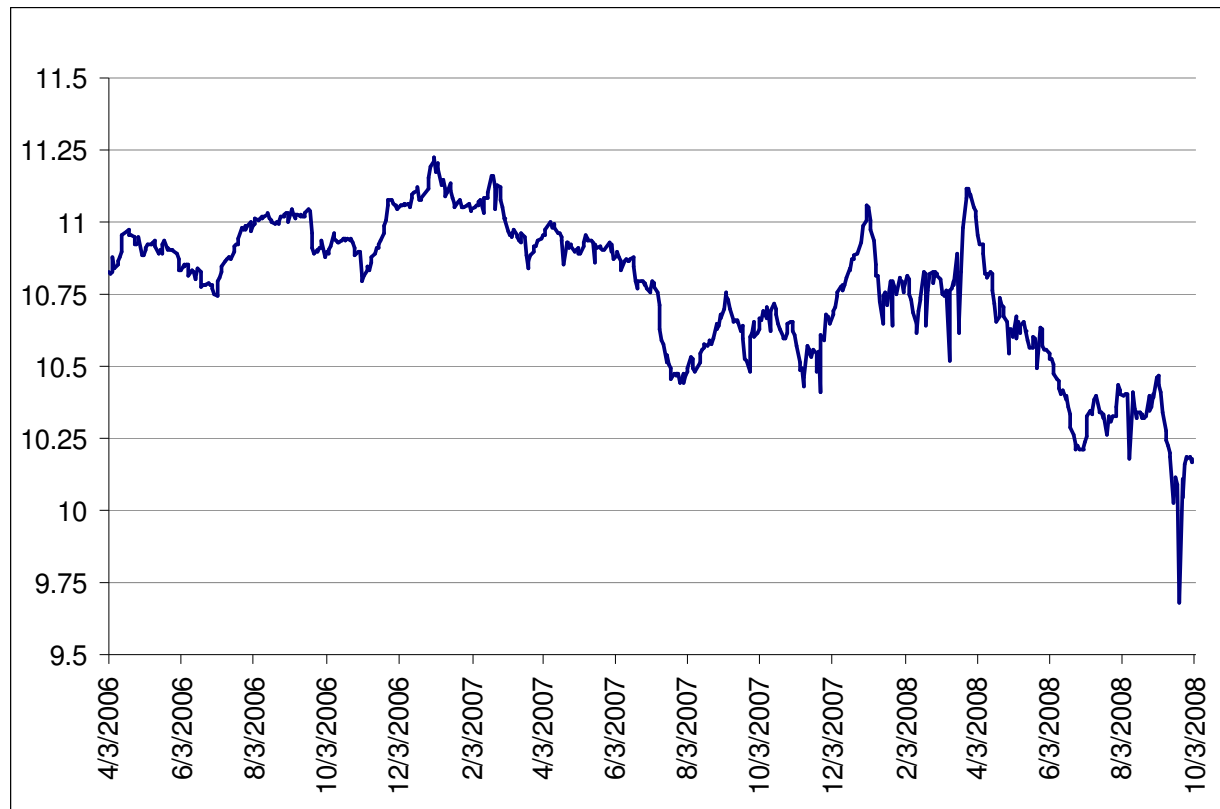
Analysis By Sector (2006)



Analysis By Sector (2008)

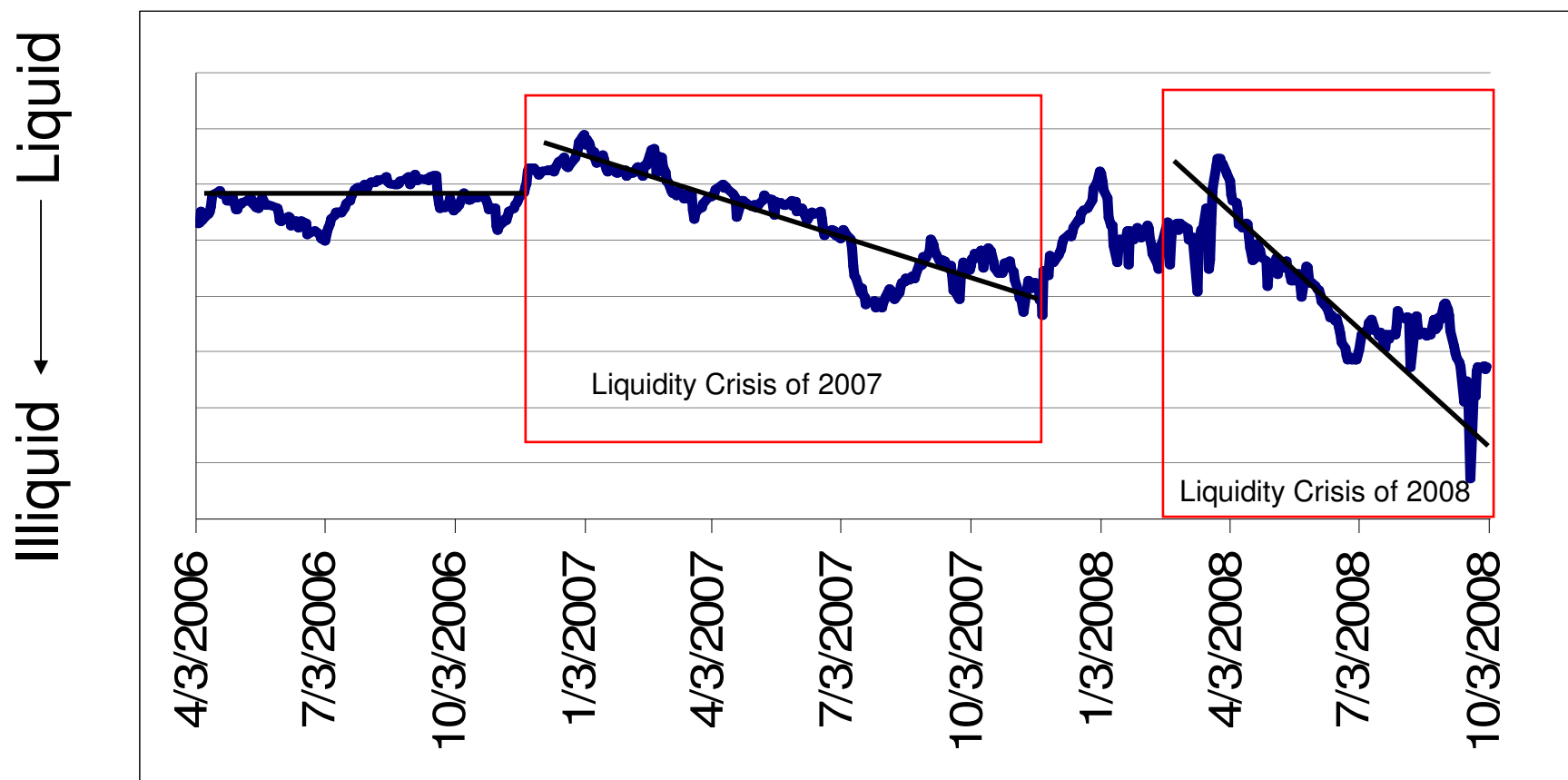


Dynamics of market liquidity: market average



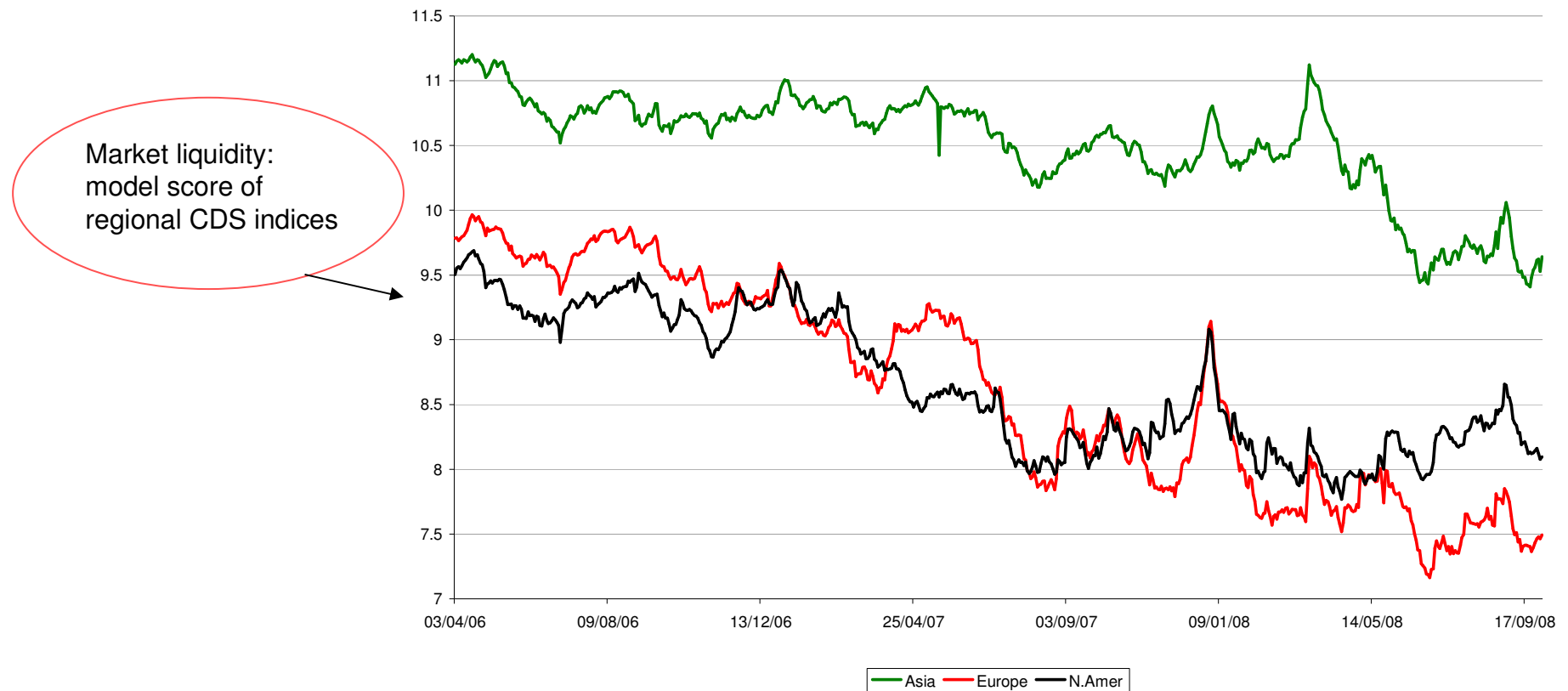
Market liquidity:
average model
score across
reference entities

Behavior of Liquidity over time



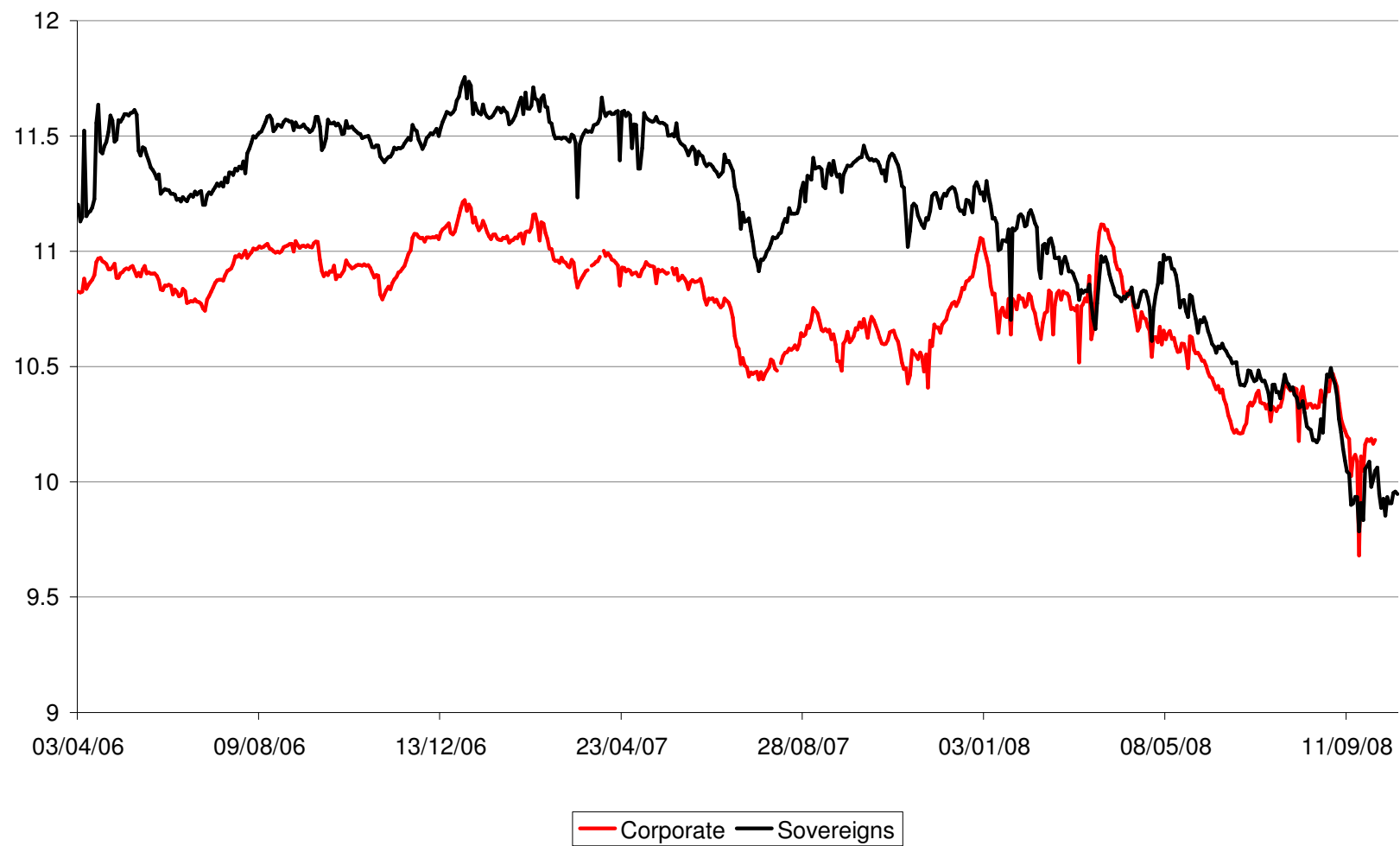
Source: Fitch CDS Liquidity Score

Dynamics of market liquidity: CDS indices

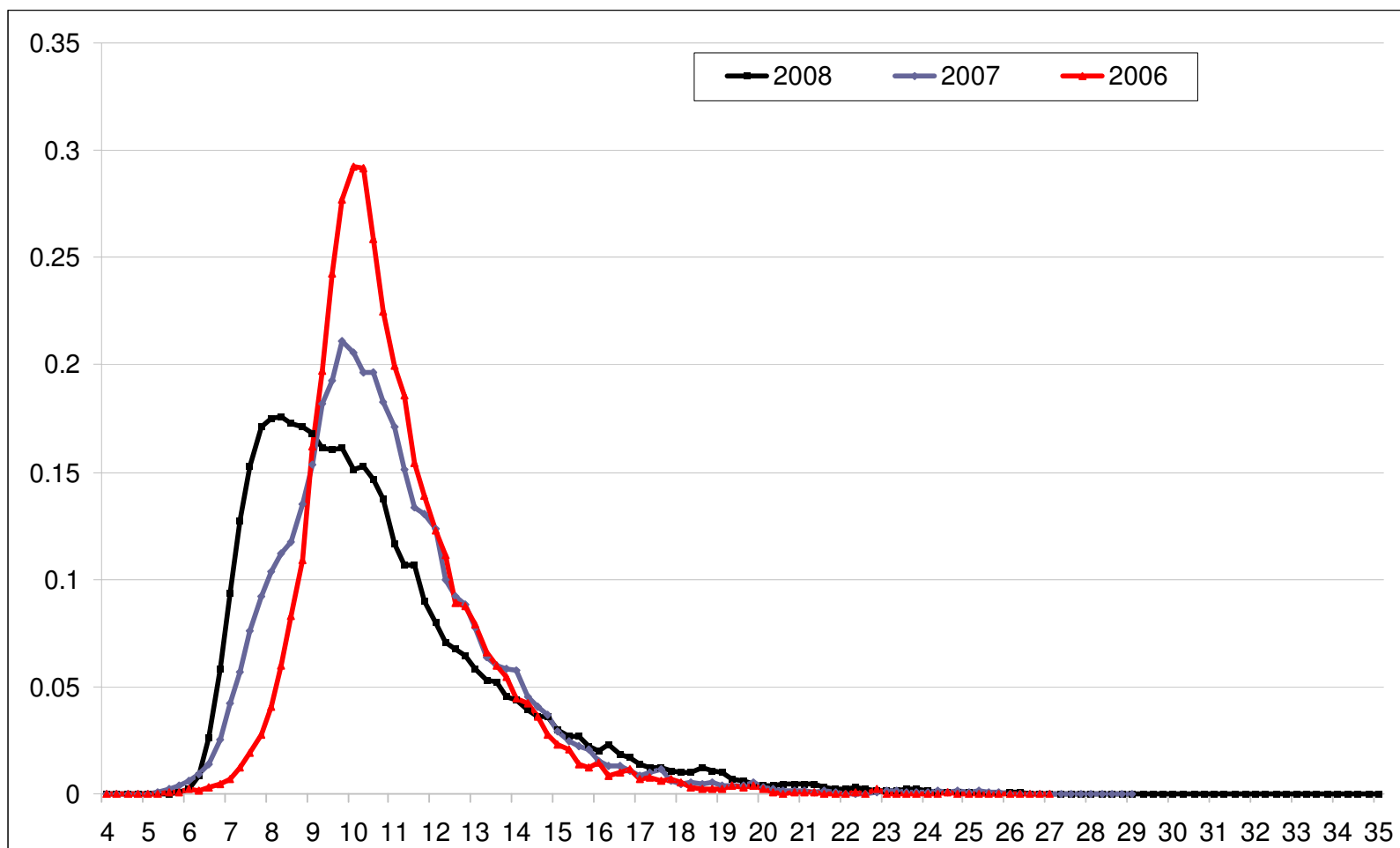


> CDS Indices: iTraxx Europe and CDX closer together (in 2007) than iTraxx Asia

Corporates and Sovereigns Liquidity

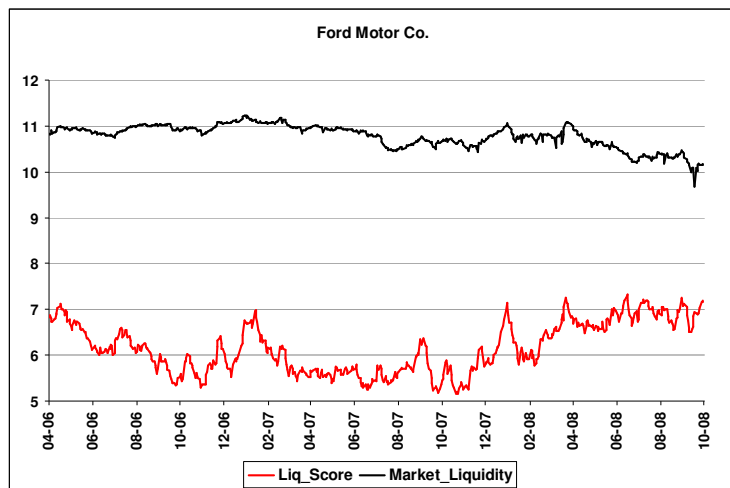


Liquidity Distribution Over Time



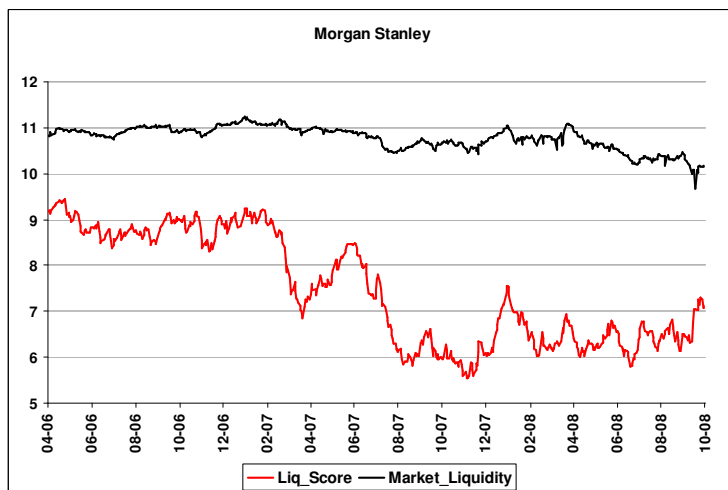
Dynamics of individual scores vs. the market

Ford Motor
(1/1/3)

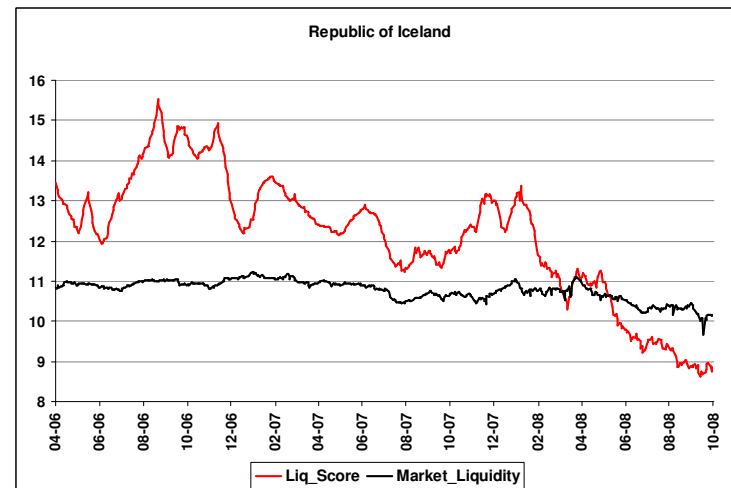


North American names

Morgan Stanley
(10/5/2)

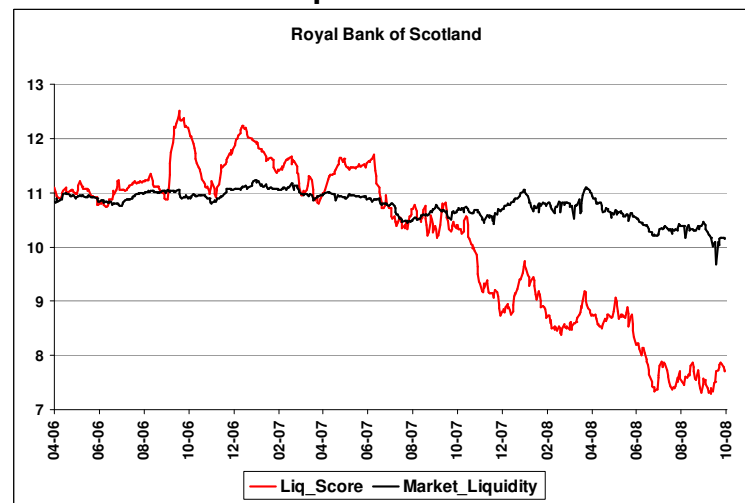


Iceland
(89/78/54)



European names

RBS
(67/55/24)



Top 10 Liquid Names

	Namefull	Region	Industry	Fitch CDS Implied Rating	Liquidity Score	Global Market Liquidity	Global % Rank
Sep-06	Ford Motor Credit Company LLC	N.Amer	Financials	B-	5.50	11.07	1
	Ford Motor Company	N.Amer	Consumer Goods	C/CCC	5.66	11.07	1
	Republic of Brazil	South America	Sovereign	BB	6.28	11.07	1
	General Motors Corporation	N.Amer	Consumer Goods	C/CCC	6.36	11.07	1
	GMAC LLC	N.Amer	Financials	B	6.81	11.07	1
	Turkey (Republic of) - Bond	Asia	Sovereign	BB	6.84	11.07	1
	Lear Corporation	N.Amer	Consumer Goods	C/CCC	6.88	11.07	1
	Colombia (Republic of)	South America	Sovereign	BB	6.95	11.07	1
	Visteon Corporation	N.Amer	Consumer Goods	C/CCC	6.99	11.07	1
	Arvinmeritor, Inc.	N.Amer	Consumer Goods	B-	7.04	11.07	1
Sep-08	Turkey (Republic of) - Bond	Asia	Sovereign	BB	5.50	10.26	1
	Republic of Brazil	South America	Sovereign	BBB-	5.54	10.26	1
	Republic of Argentina (Internationa	South America	Sovereign	B-	5.66	10.26	1
	Federation of Russian States	Asia	Sovereign	BBB	5.75	10.26	1
	Venezuela (Republic of)	South America	Sovereign	B	5.95	10.26	1
	Colombia (Republic of)	South America	Sovereign	BBB-	6.00	10.26	1
	Kazakhstan	Asia	Sovereign	BB+	6.07	10.26	1
	Thailand (Kingdom of)	Asia	Sovereign	BBB	6.11	10.26	1
	Merrill Lynch & Co., Inc.	N.Amer	Financials	BB	6.13	10.26	1
	Indonesia - Republic of (Bond)	Asia	Sovereign	BB	6.17	10.26	1

Top 10 Illiquid Names

	Namefull	Region	Industry	Fitch CDS Implied Rating	Illiq Score	Global Market Liquidity	Global % Rank
Sep-06	Parmalat SpA	Europe	Consumer Goods	C/CCC	19.41	11.07	100
	Alberto-Culver Company	N.Amer	Consumer Goods	A	19.49	11.07	100
	Northwest Airlines Corporation	N.Amer	Consumer Services	C/CCC	19.68	11.07	100
	Collins & Aikman Products Co.	N.Amer	Consumer Goods	C/CCC	19.74	11.07	100
	Futaba Industrial Co., Ltd	Asia	Consumer Goods	A	19.98	11.07	100
	Tembec Industries Inc.	N.Amer	Basic Materials	C/CCC	20.09	11.07	100
	Kreditanstalt fur Wiederaufbau	Europe	Financials	AA+	21.37	11.07	100
	Delta Air Lines Inc.	N.Amer	Consumer Services	C/CCC	22.20	11.07	100
	Calpine Corporation	N.Amer	Utilities	C/CCC	22.75	11.07	100
	British Energy plc	Europe	Utilities	C/CCC	24.52	11.07	100
Sep-08	Japan Pulp and Paper Co., Ltd.	Asia	Basic Materials	AA-	20.82	10.26	100
	Dana Corporation	N.Amer	Consumer Goods	B	20.95	10.26	100
	Snap-on Incorporated	N.Amer	Consumer Goods	BBB+	21.20	10.26	100
	Toronto Dominion Bank	N.Amer	Financials	A+	21.42	10.26	100
	Northwest Airlines Corporation	N.Amer	Consumer Services	B-	21.54	10.26	100
	KeyCorp	N.Amer	Financials	BBB-	22.29	10.26	100
	Belluna Co Ltd	Asia	Consumer Services	BB	22.42	10.26	100
	Nan Ya Plastics Corporation	Asia	Basic Materials	A+	22.42	10.26	100
	DekaBank Deutsche Girozentrale	Europe	Financials	AA+	22.76	10.26	100
	Delphi Corporation	N.Amer	Consumer Goods	B+	23.65	10.26	100

Interpretational issues

> Best used as ordinal model

- Compare rankings across names at any point in time
- Avoid comparing *percentage changes* in CDS illiquidity scores across reference entities with % changes in liquidity premia
 - > e.g. “Ford’s liquidity changed by 7% last week whereas Deutsche Telekom’s changed by only 3% so Ford’s liquidity premia must also have jumped by 4% more”
 - > Stronger claim than the model strictly allows
 - > Analogous to ordinality inherent in credit ratings



Summary

> CDS Liquidity Measure

- > Liquidity score and associated percentile ranking with analysis:
 - > by Credit Quality
 - > by Sector
 - > by Region
- > Liquidity measure *net of* credit
- > Market liquidity score
 - > Benchmark for users
- > Changes in percentile rankings reveal liquidity dynamics