Funding Liquidity, Market Liquidity, and TED Spread: A Two-Regime Model

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Summary

We study empirically how market liquidity affects funding liquidity, controlling for volatility and a measure of credit risk. Specifically, we verify stabilizing and destabilizing regimes as posited in Brunnermeier and Pedersen (2009).

We also find that the TED spread, the yield spread between Eurodollars and T-bills, allows us to distinguish these two regimes.

When the TED spread is below 151 bp:

- *financiers tend to act in a stabilizing manner;*

When the TED spread is above 151 bp:

- *financiers tend to act in a destabilizing manner;*

This suggests policy makers should watch the TED spread and consider acting to provide funding liquidity before the TED spread reaches 151 bp. This action has the potential to stave off financial distress.

Funding and Market Liquidity

Funding liquidity: ease of borrowing money from financiers.

- consider financing collateralized by risky securities.
- allows intermediaries to provide market liquidity.
- affects terms for repo, margin buys, short sales.

Market liquidity: ease of trading securities in the market.

- use market liquidity measure related to cost of trading.
- cost affects ease of liquidating loan collateral.

Prior Work

Previous studies examined this theory from other angles:

- Drehmann and Nikolau (2009): funding liquidity.
  - Negatively related to market liquidity (Aug–Dec 07).
- Hameed *et al* (2010): market liquidity vs. equity values.
  - Market liquidity affected by changes in equity values.
  - Indicates tighter funding when equity values fall.
  - Economic value to stabilizing market liquidity.
- Mancini-Griffoli and Ranaldo (2010): secured loans.
  - Use unsecured borrowing, financial crisis as controls.
  - Confirm funding liquidity affects market liquidity.

Balke (2000): credit conditions may affect market regime.

Working Hypotheses

We examine four hypotheses:

$H1$: *The rate on a collateralized loan is set given the expected future value of equity collateral. This expectation is influenced by (i) market liquidity, (ii) volatility of collateral value, and (iii) TED spread (indicating market stability).*
$H1$ is mostly just mean-variance utility and is a sanity check.

$H2$: *We can identify two regimes, tranquil and jittery, which occur when the TED spread is below or above some threshold.*
$H2$ (and $H1$): new idea; applies Balke (2000) to identify regimes.

$H3$: *In tranquil markets, brokers' loan rates decrease in market illiquidity. This is stabilizing for market liquidity.*

$H4$: *In jittery markets, brokers' loan rates increase in market illiquidity. This is destabilizing for market liquidity.*
$H3$ and $H4$ follow from Brunnermeier and Pedersen (2009).

These hypotheses have implications for modeling:

- Include a liquidity measure, volatility, and TED spread.
  - Also: test if these belong in the model.
- Compare a single regime model to a two-regime model.
- Opposite-sign market liquidity betas in two regimes.
- Handle endogeneity of funding and market liquidity.

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Models

Model 1: Single-Regime OLS The model of Drehmann and Nikolau (2009).

$$fundilliq_t = \beta_0 + \beta_1 mktilliq_t + \beta_2 vol_t + \beta_3 vol_t^2 + \beta_4 ted_t + \varepsilon_t \quad (1)$$

Model 2: Single-Regime IV Adds instrumentation of $mktilliq$ to the first model.

$$\begin{aligned} mktilliq_t = \alpha_0 + \alpha_1 vol_t + \alpha_2 volsq_t + \alpha_3 ted_t \\ + \alpha_4 decdummy_t + \alpha_5 durtrend_t + \alpha_6 aaaliq_t + \eta_t \end{aligned} \quad (2)$$

Model 3: Two-Regime OLS Adds $stress$: interactions with ted threshold.

$$\begin{aligned} fundilliq_t = \beta_0 + \beta_1 mktilliq_t + \beta_2 vol_t + \beta_3 volsq_t + \beta_4 ted_t \\ + \beta_5 stressmktilliq_t + \beta_6 stressvol_t + \beta_7 stressted_t + \varepsilon_t \end{aligned} \quad (3)$$

Model 4: Two-Regime IV Adds instrumentation of $mktilliq$ to the third model.

$$\begin{aligned} mktilliq_t = \alpha_0 + \alpha_1 vol_t + \alpha_2 volsq_t + \alpha_2 ted_t + \alpha_4 stressvol_t + \alpha_5 stressted_t \\ + \alpha_6 decdummy_t + \alpha_7 durtrend_t + \alpha_8 aaaliq_t + \eta_t \end{aligned} \quad (4)$$

$$\begin{aligned} stressmktilliq_t = \alpha_0^s + \alpha_1^s vol_t + \alpha_2^s volsq_t + \alpha_3^s ted_t + \alpha_4^s stressvol_t + \alpha_5^s stressted_t \\ + \alpha_6^s decdummy_t + \alpha_7^s durtrend_t + \alpha_8^s aaaliq_t + \eta_t^s \end{aligned} \quad (5)$$

Fitted Models

	Linear models		Two-regime models	
Model	Model 1	Model 2	Model 3	Model 4
Estimator	OLS, (1)	IV, (1)+(2)	OLS, (3)	IV, (3)+(4)+(5)
$(intercept)$	**1.304**	**1.481**	**1.456**	-2.651
	(0.092)	(0.113)	(0.099)	(1.759)
	[1.12;1.48]	[1.26;1.70]	[0.94;1.80]	[-7.00;0.89]
$mktilliq$	-0.010	0.012	0.013	**-0.299**
	(0.011)	(0.014)	(0.011)	(0.144)
	[-0.03;0.01]	[-0.01;0.04]	[-0.04;0.05]	[-0.64;-0.01]
vol	**2.939**	**2.796**	**3.151**	**20.861**
	(0.160)	(0.169)	(0.213)	(6.984)
	[2.27;3.25]	[2.47;3.13]	[2.20;3.98]	[6.54;39.01]
$volsq$	**-5.442**	**-5.275**	**-6.096**	**-42.546**
	(0.244)	(0.251)	(0.389)	(14.273)
	[-5.92;-4.97]	[-5.77;-4.78]	[-7.55;-4.25]	[-80.08;-13.25]
ted	**0.588**	**0.577**	**0.560**	**0.727**
	(0.011)	(0.011)	(0.015)	(0.094)
	[0.57;0.61]	[0.56;0.60]	[0.50;0.67]	[0.53;0.94]
$stressmktilliq$			**-0.112**	**1.517**
			(0.009)	(0.630)
			[-0.16;-0.07]	[0.24;3.06]
$stressvol$			**1.132**	**16.320**
			(0.189)	(5.940)
			[0.13;1.90]	[4.20;31.40]
$stressted$			**-0.435**	**2.018**
			(0.032)	(0.944)
			[-0.62;-0.22]	[-7.14;-6.97]
Threshold κ			**1.511**	**1.511**
			[1.40;2.00]	[1.47;1.55]

- Variables significant at: **95% level**, *90% level*.
- Threshold estimated via Hansen (2000), Caner and Hansen (2004).
- 95% CIs may be asymmetric for two-regime models.

Commentary

- Correcting for vol, ted: $mktilliq$ is not significant in models 1–3.
- Model 1: Negative $mktilliq$ beta, like Drehmann and Nikolau.
- Model 2: Positive $mktilliq$ beta (opposes model 1).
- Model 3: Opposite-sign $mktilliq$ betas in-/ex-crisis (non-sensical in-crisis behavior).
- Model 4: Confirms Brunnermeier and Pedersen; $mktilliq$ affects $fundilliq$.
  - Opposite-sign coefficient for $mktilliq$ in-/ex-crisis; and,
  - Correcting for vol, ted: $mktilliq$ is significant.

First-Stage Regressions All first-stages have significant instruments.

	Linear Model	Two-regime Model	
Model	IV, (2)	IV, (4)	IV, (5)
Response	$mktilliq$	$mktilliq$	$mktilliq$
		$(ted < \kappa)$	$(ted \geq \kappa)$
$(intercept)$	**-7.065**	**-7.052**	**1.086**
	(0.035)	(0.040)	(0.081)
vol	**2.964**	**2.973**	**-10.451**
	(0.145)	(0.183)	(0.374)
$volsq$	**-1.710**	**-1.678**	**22.260**
	(0.309)	(0.336)	(0.687)
ted	**0.309**	**0.296**	-0.044
	(0.011)	(0.014)	(0.029)
$stressvol$		0.059	**-9.343**
		(0.173)	(0.353)
$stressted$		-0.024	**-1.501**
		(0.030)	(0.061)
$decdummy$	**-0.732**	**-0.728**	-0.051
	(0.026)	(0.027)	(0.055)
$durtrend$	1.621	1.569	**12.257**
	(2.774)	(2.791)	(5.709)
$aaaliq$	**0.057**	-0.053	*-0.190*
	(0.014)	(0.052)	(0.107)

Data Definitions

Daily data on seven variables; Mar 1998–Oct 2010 (N=3182).

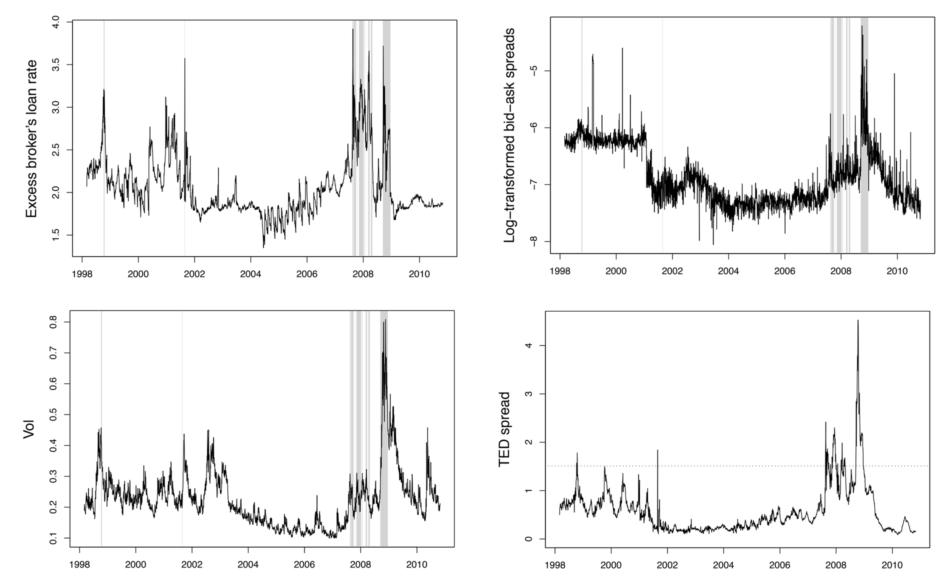
1. $fundilliq$: Broker collateralized loan rate − T-bills.
   - The "Call Money Rate" published in the *WSJ*.
2. $mktilliq$: Mean bid-ask spread for S&P 500 (from CBOE).
3. vol: CBOE volatility index (VIX).
4. ted: Yields of Eurodollars (LIBOR) vs T-bills.
   - Credit spread; less liquidity-driven than bond spreads.
5. $decdummy$: IV, decimalization dummy (29 Jan 2001).
   - Control for more liquid market post-decimalization.
6. $durtrend$: IV, trend: monthly mean time b/w Nasdaq trades.
   - Control for trend of increasing market liquidity.
   - Likely driven by Reg NMS, increasing automation.
7. $aaaliq$: IV, Δ short-term AAA bond yields vs LIBOR.
   - Control for flight to liquidity within AAA credits.

Data Summary

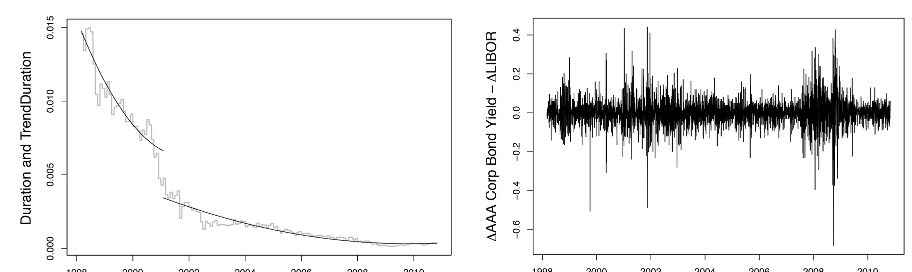
	Full sample		TED spread $\leq$ 151 bp				TED spread > 151 bp			
	med	mean	min	med	mean	max	min	med	mean	max
$fundilliq$	1.94	2.05	1.35	1.92	2.01	3.30	1.95	2.91	2.90	3.92
$mktilliq$	-7.02	-6.87	-8.06	-7.04	-6.89	-4.60	-7.32	-6.48	-6.34	-4.21
vol	0.22	0.23	0.10	0.21	0.22	0.57	0.17	0.30	0.38	0.81
ted	0.44	0.58	0.09	0.42	0.50	1.51	1.51	1.98	2.14	4.53
$durtrend$	1	3	0.3	1	3	15	4	4	8	12
$aaaliq$	0.00	0.00	-0.51	0.00	0.00	0.44	-0.68	0.02	0.02	0.43

- Yield spreads (ted, $aaaliq$) in percent, "0.5" = 0.5%.
- $durtrend$ in years/1000; "1" = 0.001 years.
- Regime means/medians differ at 0.1% level (exc. $aaaliq$).
- $aaaliq \Rightarrow$ bonds (less liquid), LIBOR diverge in crisis.

Covariate Plots



Instrument Plots $decdummy$ plot not shown.



Conclusion

- Empirical support for Brunnermeier and Pedersen (2009).
  - Shows two regimes, market liquidity affects funding.
- All models confirm vol and ted are informative ($H1$).
- Model 4 confirms $mktilliq$ affects $fundilliq$ ($H1$).
- Estimate significant 151 bp threshold ($H2$).
- TED spread < 151 bp $\Rightarrow$ stable markets ($H3$):
  - Bid-ask spreads $1\% \uparrow \Rightarrow$ loan rates $0.3\% \downarrow$.
- TED spread > 151 bp $\Rightarrow$ unstable markets ($H4$):
  - Bid-ask spreads $1\% \uparrow \Rightarrow$ loan rates $1.5\% \uparrow$.
- Asymmetric financing response since crises are tail events.
- Credit conditions (TED spread) help identify market regime.
- Instrument TED spread to handle flights to quality?
- Traders, monetary policy makers should watch TED spread.
- BP also predict flights to quality. Model $aaaliq$?
- Is 151 bp right number? Krugman, others say 100 bp.
- Would we see similar behavior in Europe, esp. recently?

References

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