Is There a (Valuation) Cost for Inadequate Liquidity?

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Current Debate Surrounding Cash Holdings of US Firms

- Public interest in cash holdings has increased over the past decade as has the levels of cash held by non-financial US firms – over $2T recently

- 25% of the cash is held on the balance sheets of five firms – Apple, Microsoft, Cisco, Google and Oracle

- Activist investors, the media and the current US administration : US economy would be better off if firms reduced cash holdings and invested those funds or returned them to shareholders

- Firms: Cash holdings needed because of uncertainty about the economy, the political environment, taxes, and regulation, in addition to increased volatility in cash flows (precautionary motive); Cash also provides flexibility as it relates to opportunistic acquisitions (optionality); Cash remains trapped overseas due to the repatriation tax;

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Literature on Abnormal Cash Holdings

- Opler, et al. (JFE, 1999) document that cash holdings (cash to assets) are related to firm characteristics – growth opportunities (+), uncertain prospects (+), capital expenditures (-)

- Bates, Kahle and Stulz (JF, 2009) – cash to assets have doubled between the 1980s and 2006; cash holdings have increased because of precautionary motive instead of agency arguments

- Pinkowitz, Stulz and Williamson (RFS, 2016) – between 1998 and 2011, US firms held more cash on average than similar foreign firms (foreign twins); The average difference in cash holdings does not increase after 2008, and is driven by highly R&D-intensive US firms; there are no foreign twins for these highly R&D-intensive US firms that hold large amounts of cash; without these firms, neither US multinational nor purely domestic firms hold more cash than their foreign twins

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Literature on the Impact of the 2007-2008 Crisis

- Almeida et al. (CFR, 2011) show that firms with lumpy long-term debt made larger cuts in their investment spending
- Campello et al. (JFE, 2010) use survey data to document that firms that perceived themselves as being more credit constrained during the last quarter of 2008 reduced their spending more
- Ivashina and Scharfstein (JFE, 2010) show that syndicated lending started to fall in mid-2007 and dropped significantly by end-2008
- Bliss, Cheng and Denis (JFE, 2015) find that firms increase cash in the post-crisis period by reducing the percentage of earnings paid out as dividends, and by reducing share repurchases

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Research Questions in this Study

- Why do some firms hold abnormally low levels of excess cash during normal periods? Why do other firms hold abnormally high levels of excess cash during normal periods?

- Is the change in abnormal cash holdings following a liquidity shock related to the level of abnormal cash holdings pre-crisis? Is the adjustment to a liquidity shock symmetric for firms that hold too much versus too little excess cash pre-crisis?

- Are firms that hold abnormally low levels of cash penalized by the market in the event of a liquidity shock? What is the market's reaction to how they raise liquidity levels during a liquidity crisis?

- What is the likelihood of surviving a liquidity crisis as a public firm if you hold very low levels of excess cash pre-crisis? What factors increase the likelihood of surviving a liquidity crisis as a public firm?

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Sample

- All Compustat firms subject to regulation and all firms with SIC codes between 6000 and 6999 (financial firms) are deleted
- Financial information is collected from Compustat
- Price and return data are from CRSP
- Our sample period is between 2001 and 2011, since we are interested in studying the impact of the financial/liquidity crisis on the cash holdings of firms

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Methodology

- Similar to Bates, et al. (2009), abnormal cash holdings are computed using the following model based on work by Opler et al. (1999)

Cash ratio = α_0 + α_1 Industry cash flow risk + α_2 Market-to-book ratio + α_3 Firm size + α_4 Cash flow to assets + α_5Net working capital to assets + α_6 Capital expenditures to assets + α_7 Leverage + α_8 R&D to sales + α_9 Dividend payout dummy + α_{10} Acquisitions to assets + Industry Dummies + ε

- The abnormal cash ratio is the error term from the regression

- Firms are rank-ordered into quartiles based on their abnormal cash holdings in 2006

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Variable Definition

Variable	Definition
Cash ratio	The ratio of cash and marketable securities to the book value of total assets
Market-to-book ratio	Measured as (book value of total assets - book value of equity + market value of equity)/book value of total assets
Firm size	The natural log of the book value of total assets in 2011 dollars
Cash flow to assets	Measured as (EBITDA - interest - taxes - common dividends)/book value of total assets
Net working capital to assets	The ratio of net working capital (NWC) to the book value of total assets; NWC is calculated as net working capital minus cash and marketable securities
Capital expenditures to assets	The ratio of capital expenditures to the book value of total assets
Leverage	The ratio of total debt to the book value of total assets, where debt includes long-term debt plus debt in current liabilities
Industry cash flow risk	The mean of the standard deviations of cash flow/assets over ten years for firms in the same industry, as defined by the two-digit SIC code
R&D to sales	The ratio of research and development expense (R&D) to sales; R&D is set equal to zero when missing
Dividend payout dummy	One in years in which a firm pays a common dividend, and zero otherwise
Acquisitions to assets	The ratio of expenditures on acquisitions relative to the book value of total assets

Descriptive statistics on information and agency costs, and ability to raise capital externally for firms in Quartiles 1 and 4

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Firm Characteristics

Panel A: Descriptive Statistics of Firms in Quartiles 1 and 4				
Variables	Quartile 1	Quartile 4	Quartile 1 - Quartile 4	
Obs	1199	1199	1199	
Log(Sales)	4.1775	3.8956	0.2819	**
Profitability	-0.1500	-0.1741	0.0241	
Tangibility	0.2372	0.1588	0.0784	***
R&D to Sales	0.7653	0.9176	-0.1523	
Capital Expenditures to Sales	0.7170	2.5134	-1.7964	*
Cash Ratio	0.0646	0.5165	-0.4519	***
Market to Book Ratio	3.1098	3.5741	-0.4644	**
Cash Flow to Assets	-0.2256	-0.2413	0.0157	
Leverage	0.3067	0.2586	0.0481	*

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Long-term and Short-term Credit Ratings

Panel B: Credit Rating of Firms in Quartiles 1 and 4				
	Q1		Q4	
S&P Domestic Long Term Issuer Credit Rating:	Obs	Percent	Obs	Percent
Firms with a credit rating	159	13.3%	116	9.7%
Firms with investment grade rating (BBB- or above)	63	5.3%	44	3.7%
S&P Domestic Short Term Issuer Credit Rating:	Obs	Percent	Obs	Percent
Firms with a credit rating	38	3.2%	25	2.1%
Firms with investment grade rating (A-3 or above)	34	2.8%	20	1.7%
Number of Firms in the Quartile	1199	100%	1199	100%

Is the adjustment to a liquidity shock symmetric for firms in Quartiles 1 and 4?

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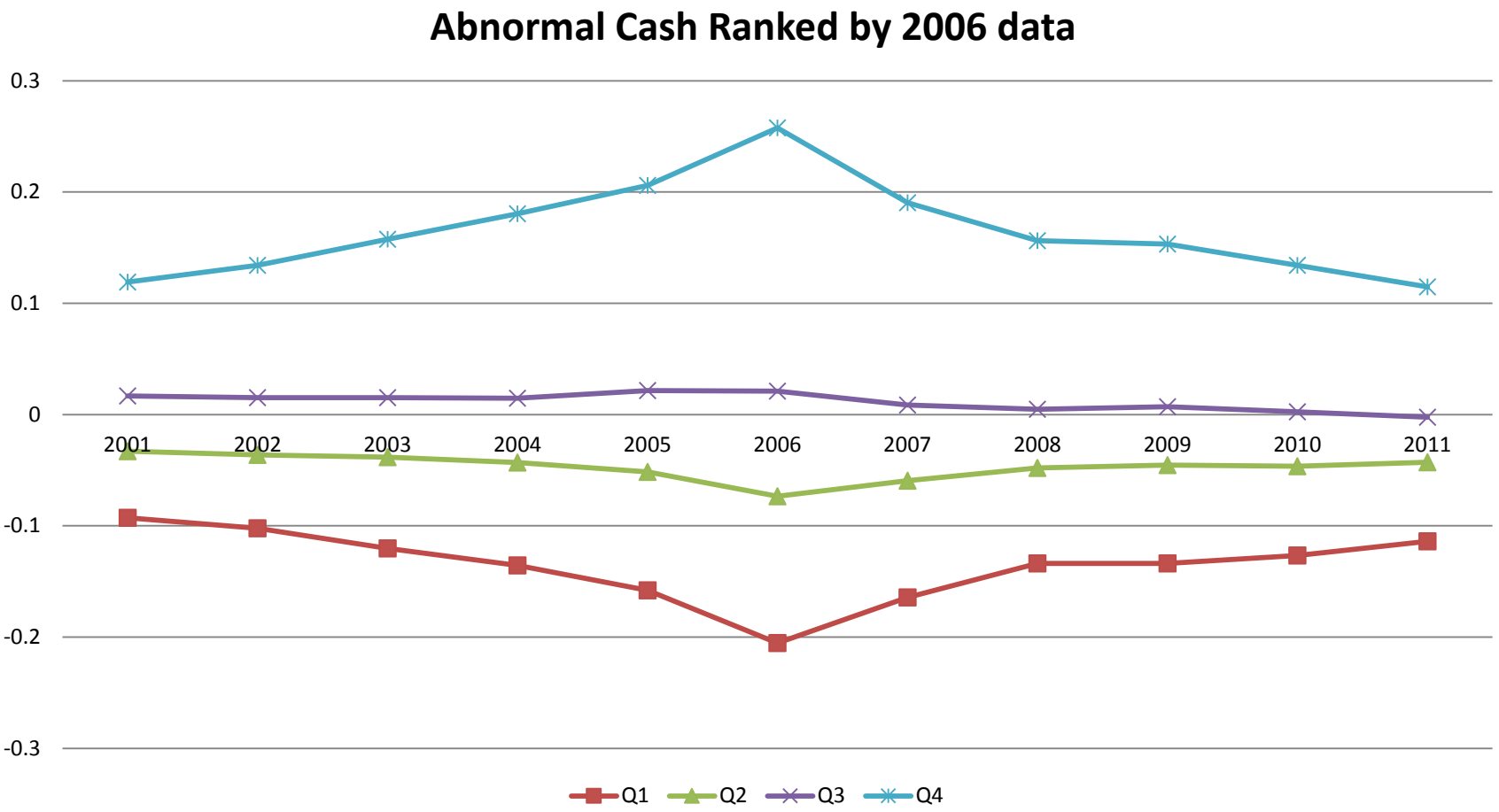
Time-Series Behavior of Abnormal Cash Ratios



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Adjustment in Abnormal Cash Following the Crisis

Dependent Variable = ΔAbnormal Cash Ratio									
Variable	Whole Sample						Subsample		
	Estimate	t-stat		Estimate	t-stat		Estimate	t-stat	
Intercept	-0.007	(-3.52)	***	-0.021	(-3.90)	***	-0.044	(-2.93)	***
Q3Q4				0.020	(3.00)	***			
Q4							0.034	(1.82)	*
Abnormal Cash Ratio$_{pre}$	-0.405	(-33.50)	***	-0.489	(-13.13)	***	-0.593	(-7.87)	***
Q3Q4*Abnormal Cash Ratio$_{pre}$				0.064	(1.51)				
Q4*Abnormal Cash Ratio$_{pre}$							0.194	(2.29)	**
n	3,742			3,742			1,772		
R^2	0.23			0.23			0.30		

How do firms in Quartile 1 raise their abnormal liquidity levels following the liquidity shock?

How do firms in Quartile 4 use up their abnormal cash balances?

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Quartile 1 Firms

- Average net issuance for firms that raise equity increased from 5.25% of existing market value of equity in 2006 to over 7% annually between 2009 and 2011
- Average net issuance for firms that raise debt increased from 16.8% of existing debt in 2006 to 24.2% in 2009, 18.5% in 2010 and 17.6% in 2011
- More firms reduced share repurchases post-crisis than those that did so pre-crisis
- The percent of firms that reduced capital expenditures and R&D expenses post-crisis increased relative to 2006

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Quartile 4 Firms

- Average net issuance of equity declined from 9.3% of existing equity for firms that did issue equity in 2006 to 5.9% in 2009 and 6.8% in 2010
- Average net debt issuance declined from 28.3% of existing debt in 2006 to 18.7% on 2009 and 19.1% in 2010 to 15.2% in 2011
- Average R&D to assets remained at 14% in 2009, similar to the level in 2006; However, this declined to 12% in 2010 and 11.6% in 2011

Is there a cost for inadequate, or excessive, liquidity?

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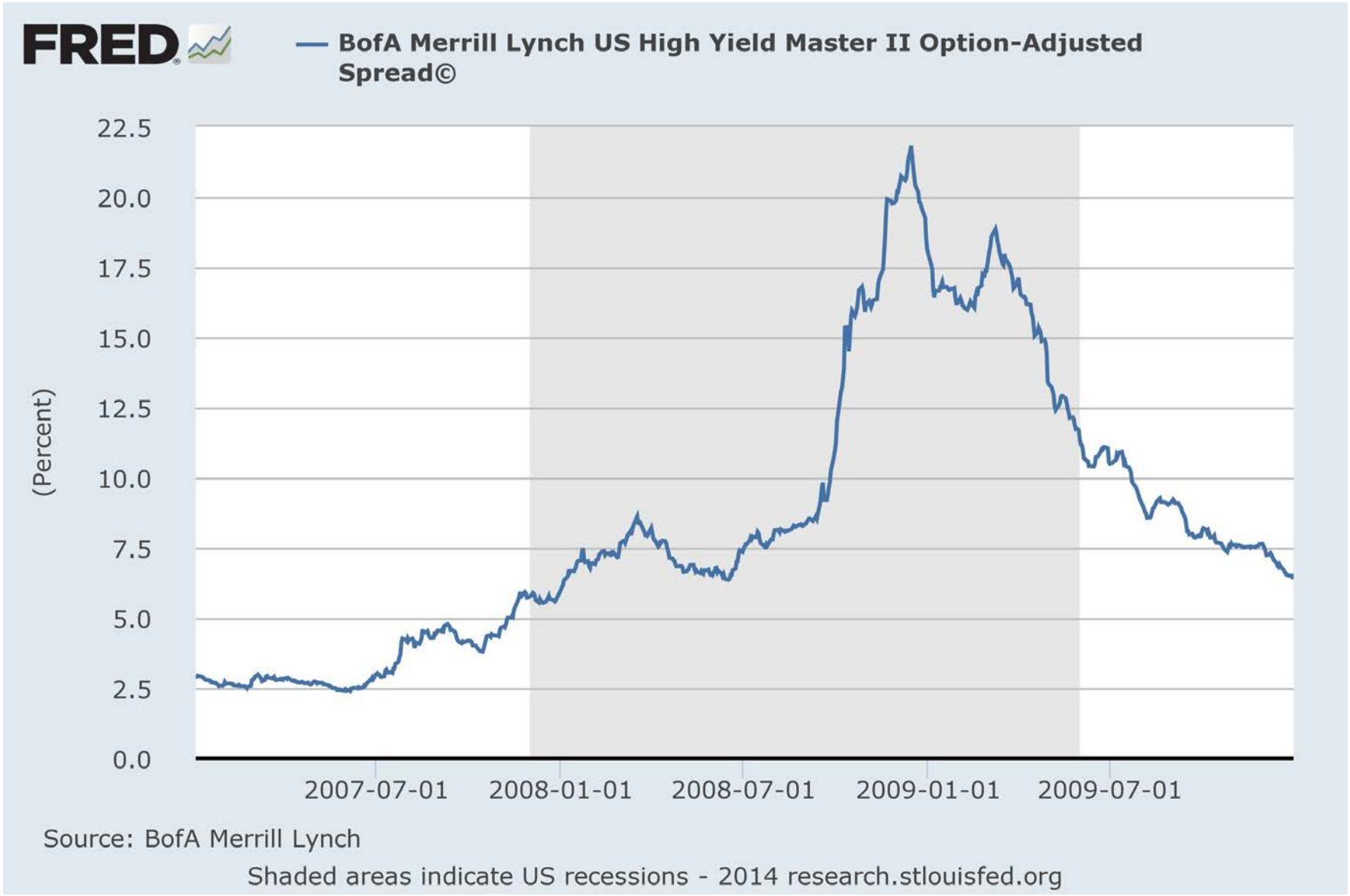
Determining the Financial Crisis for Corporations



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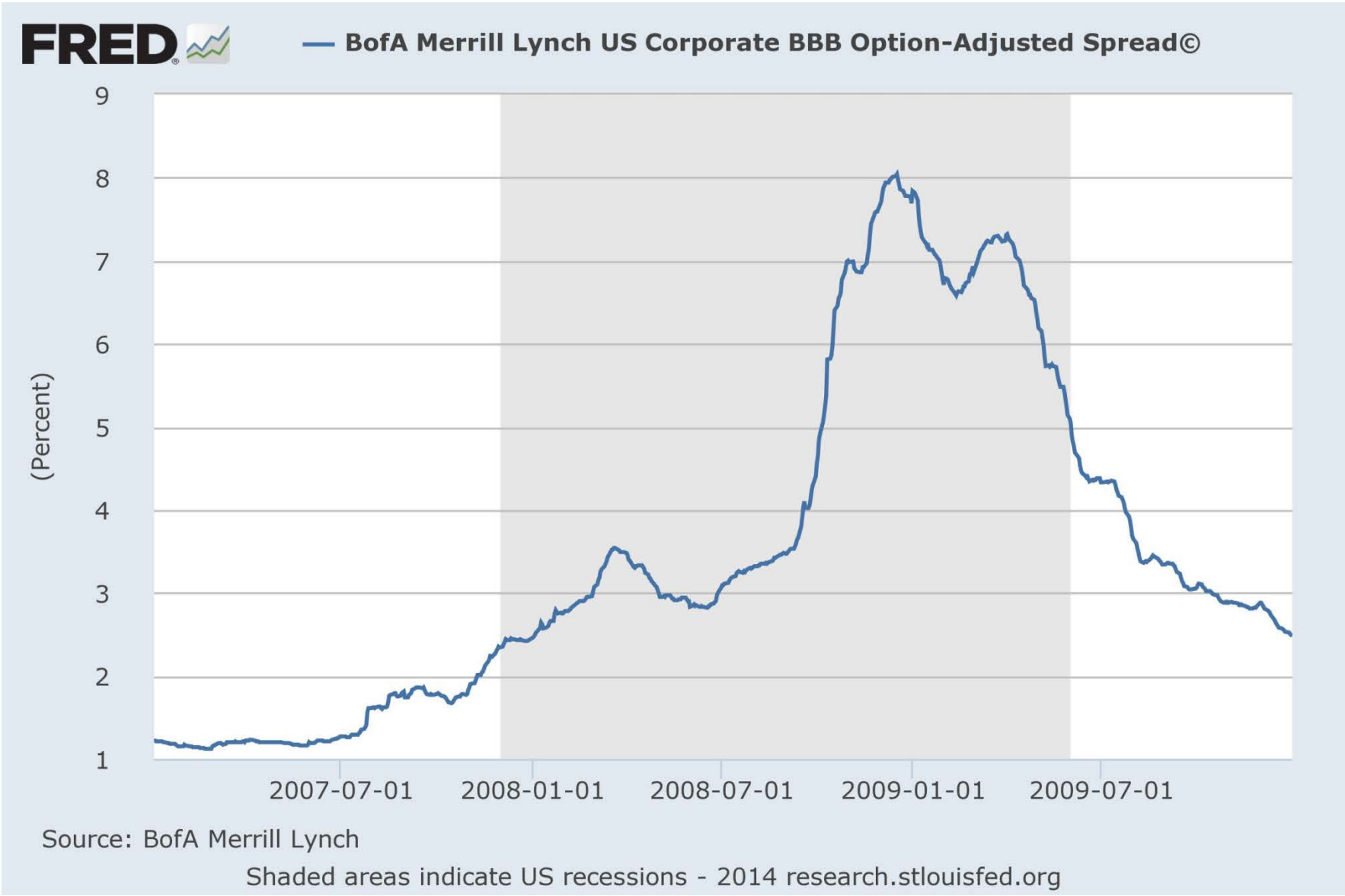

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Market Reaction Surrounding the Crisis (2008 Q3 to 2009 Q2)

Panel A: Six-month market-adjusted returns

	Quartile 1			Quartile 4			Quartile 4 - Quartile 1		
	Pre	Crisis	Post	Pre	Crisis	Post	Pre	Crisis	Post
Obs	518	550	518	693	720	693			
Min	-0.8299	-0.9104	-0.7449	-0.9278	-0.8724	-0.7795			
Max	2.9789	3.2574	10.6400	3.0954	6.2571	12.6579			
Mean	-0.0798***	-0.1915***	0.3368***	-0.1286***	-0.0727***	0.3120***	-0.0488^^	0.1188^^^	-0.0247
Median	-0.1123***	-0.2473***	0.2231***	-0.1501***	-0.1621***	0.1912***	-0.0379^^^	0.0852^^^	-0.0319^
Std Dev	0.3396	0.4159	0.6923	0.3521	0.5343	0.8149			

Panel B: Six-month industry-adjusted returns

	Quartile 1			Quartile 4			Quartile 4 - Quartile 1		
	Pre	Crisis	Post	Pre	Crisis	Post	Pre	Crisis	Post
Obs	516	548	516	690	717	690			
Min	-0.7431	-0.8210	-2.2945	-0.8740	-0.8959	-1.7555			
Max	3.0093	3.1996	9.6930	3.1585	6.2003	12.2155			
Mean	0.0287**	-0.0423**	0.0070	-0.0215	0.0354*	-0.0052	-0.0502^^	0.0777^^^	-0.0123
Median	0.0050	-0.0885***	-0.0768***	-0.0397***	-0.0234	-0.1136***	-0.0448^^^	0.0651^^^	-0.0368
Std Dev	0.3295	0.4006	0.6681	0.3437	0.5215	0.8005			

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Cross-Sectional Regression of Capital Raising Policies

Panel A: Regression Results		Financial Crisis (2008 4th Quarter~ 2009 2nd Quarter)									Post-Crisis (2010 ~ 2011)								
		R&D intensive			Capital intensive			Rest of Sample			R&D intensive			Capital intensive			Rest of Sample		
		Estimate	t-stat		Estimate	t-stat		Estimate	t-stat		Estimate	t-stat		Estimate	t-stat		Estimate	t-stat	
α_0	Intercept	-0.292	-4.05	***	-0.188	-1.10		-0.386	-2.36	**	0.581	3.20	***	1.022	3.42	***	0.152	0.57	
α_1	Operating cash flow to assets	0.229	1.81	*	-0.001	0.00		0.058	0.33		0.351	0.94		1.302	1.90	*	0.027	0.10	
α_2	Net equity issuance	-0.266	-1.01		-0.090	-0.24		0.871	2.32	**	-0.955	-1.29		0.880	1.28		0.131	0.19	
α_3	Net long-term debt issuance	0.525	1.49		0.437	1.04		0.925	1.95	*	-0.629	-0.69		-0.174	-0.25		-0.553	-0.70	
α_4	Capital expenditures to assets	0.628	0.90		-1.057	-2.35	**	0.155	0.22		2.453	1.32		0.551	0.74		-0.469	-0.40	
α_5	R&D to assets	-0.146	-0.63		-18.932	-1.27		-0.228	-0.30		-0.801	-1.38		36.560	1.33		-2.492	-1.94	*
α_6	Dividends to assets	0.076	0.11		0.087	0.81		0.117	1.39		0.049	0.03		-0.258	-1.16		0.372	2.76	***
α_7	Share repurchase	-0.081	-0.18		-0.061	-0.06		0.226	0.62		0.044	0.04		-1.624	-0.91		0.098	0.14	
α_8	Q1	-0.055	-1.36		0.013	0.13		-0.071	-1.92	*	0.348	3.28	***	-0.063	-0.36		0.015	0.24	
α_{11}	Q1*Operating cash flow to assets	-0.079	-0.32		-0.837	-0.66		0.497	1.60		-0.339	-0.52		-1.134	-0.44		-0.263	-0.48	
α_{12}	Q1*Net equity issuance	0.835	1.69	*	-0.012	-0.02		-0.191	-0.36		3.654	2.93	***	-1.377	-1.42		-1.254	-1.31	
α_{13}	Q1*Net long-term debt issuance	-0.639	-1.35		0.970	0.89		-0.720	-1.26		0.166	0.13		-0.392	-0.21		0.544	0.56	
α_{14}	Q1*Capital expenditures to assets	-0.456	-0.39		1.466	1.58		-0.509	-0.45		-5.184	-1.73	*	0.089	0.06		0.704	0.38	
α_{15}	Q1*R&D to assets	0.554	0.93		96.037	0.90		2.466	1.46		4.891	3.32	***	-412.454	-2.38	**	4.847	1.88	*
α_{16}	Q1*Dividends to assets	0.057	0.08		-0.094	-0.35		0.326	0.83		-0.072	-0.04		0.240	0.52		-1.417	-2.36	**
α_{17}	Q1*Share repurchase	0.039	0.05		0.614	0.29		0.021	0.04		1.335	0.68		-0.822	-0.18		-0.320	-0.32	
	Profit_06	0.117	0.77		0.987	1.77	*	0.333	1.69	*	1.084	2.45	**	-0.149	-0.16		0.177	0.50	
	Size_06	-0.002	-0.22		-0.041	-1.93	*	-0.028	-2.39	**	-0.069	-2.58	**	-0.125	-3.43	***	-0.041	-2.05	**
	Operating cash flow to assets_06	0.016	0.09		-0.319	-0.47		0.246	1.12		-0.987	-2.08	**	1.023	0.88		-0.168	-0.43	
	Industry fixed effects	Included			Included			Included			Included			Included			Included		
	R-Square	0.07			0.32			0.13			0.15			0.19			0.12		
	F-value	2.44			3.62			3.23			3.88			2.19			2.76		
	n	487			147			570			421			133			491		

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How Should Q1 Firms Raise Liquidity During the Crisis?

Panel B: Test of joint significance	Financial Crisis (2008 4th Quarter~ 2009 2nd Quarter)			Post-Crisis (2010 ~ 2011)		
	R&D intensive	Capital intensive	Rest of Sample	R&D intensive	Capital	Rest of
Variables	F-value	F-value	F-value	F-value	F-value	F-value
$\alpha_1 + \alpha_{11}$	0.51	0.50	4.63 **	0.00	0.00	0.25
$\alpha_2 + \alpha_{12}$	1.72	0.07	2.94 **	6.37 **	0.57	2.68 *
$\alpha_3 + \alpha_{13}$	0.13	1.90	0.4 *	0.24	0.10	0.00
$\alpha_4 + \alpha_{14}$	0.03	0.25	0.17	1.35	0.22	0.03
$\alpha_5 + \alpha_{15}$	0.55	0.53	2.23	8.78 ***	4.87 **	1.15
$\alpha_6 + \alpha_{16}$	0.38	0.00	1.34	0.00	0.00	3.20 *
$\alpha_7 + \alpha_{17}$	0.00	0.09	0.35	0.82	0.32	0.09

Issue equity during the crisis

Increase R&D during the crisis

Cut R&D during the crisis

Number of Public Firms Surrounding the Crisis

- Of the total sample of Q1 (Q4) firms in 2006 (pre-crisis), 27.3% (21%) are no longer public firms in 2009
  - Q1 firms are less likely to remain public firms following a liquidity crisis
- Of the R&D intensive firms, 22.7% (21%) of Q1 (Q4) firms are no longer public firms in 2009
- Of the capital intensive firms, 30.5% (21.1%) of Q1 (Q4) firms are no longer public firms in 2009

	2006		2009	
	Q1	Q4	Q1	Q4
Rest of Sample	575	589	400	466
Capital intensive	128	171	89	135
R&D intensive	497	438	384	346
Total	1,200	1,198	873	947

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Why Do Firms No Longer Remain Public Post Crisis?

	Panel A: Full Sample				Panel B: R&D intensive firms				Panel C: Capital intensive firms			
Reasons	Q1		Q4		Q1		Q4		Q1		Q4	
	n	%	n	%	n	%	n	%	n	%	n	%
Acquired	189	58%	134	54%	69	61%	57	62%	26	67%	19	53%
Went private	5	2%	13	5%	1	1%	1	1%	1	3%	1	3%
Went bankrupt	66	20%	38	15%	24	21%	8	9%	7	18%	8	22%
Noncompliance with the listing requirements	26	8%	45	18%	10	9%	20	22%	0	0%	6	17%
Voluntarily delisted	12	4%	15	6%	3	3%	6	7%	0	0%	1	3%
Name change	9	3%	0	0%	2	2%	0	0%	3	8%	0	0%
Unknown	19	6%	5	2%	4	4%	0	0%	2	5%	1	3%
Total	326	100%	250	100%	113	100%	92	100%	39	100%	36	100%

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Likelihood of Surviving a Financial Crisis

	Quartile 1			Quartile 4		
Variables	Estimate	chi-square		Estimate	chi-square	
Intercept	1.5249	32.36	***	1.3989	36.16	***
Abnormal cash to assets ratio	2.8087	5.68	**	0.8924	1.13	
Investing cash flow to assets	-0.9422	1.94		-0.0358	0.03	
Operating cash flow to assets	0.0719	0.10		0.5281	8.12	***
Net equity issuance	-1.9681	5.59	**	-2.2828	14.56	***
Net long-term debt issuance	-2.0922	15.16	***	-0.5038	2.15	
Capital expenditures to assets	-13.1036	10.58	***	0.9047	0.16	
Abnormal cash to assets ratio* Capital expenditures to assets	-77.3543	10.75	***	-3.3408	0.13	
R&D to assets	-0.4074	0.22		1.2064	3.82	*
Abnormal cash to assets ratio* R&D to assets	-0.0674	0.00		-5.6916	4.85	**
Dividends to assets	0.3148	1.61		0.0457	0.31	
Share repurchase	0.4070	0.03		-0.2747	0.01	
n	1,025			973		
Likelihood ratio	61.88			54.01		

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Conclusions

- At the extremes (Quartiles 1 and 4), abnormal cash holdings by firms are related to the information and agency costs they face and their ability to access internal and external capital

- The change in abnormal cash holdings following a liquidity shock is related to the level of abnormal cash held by the firm pre-crisis

- Firms with low levels of excess liquidity pre-crisis raise liquidity following a liquidity shock by cutting back on capital expenditures and R&D and by cutting back on dividends and share repurchases; the market rewards them for low excess liquidity pre-crisis, but penalizes them during the crisis

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Conclusions

- Firms with excess liquidity pre-crisis use their cash holdings to maintain R&D expenses following a liquidity shock; based on industry-adjusted annual returns, the market does not penalize them pre-crisis, but rewards them during the crisis

- R&D-Intensive (Capital-intensive) firms should issue equity and not cut (should cut) R&D expenses during the crisis to raise liquidity

- In addition, firms with low levels of excess liquidity pre-crisis are less likely to survive as public firms following a liquidity shock relative to firms with excess liquidity pre-crisis

- Moreover, the likelihood of surviving as a public firm following a liquidity shock increases if a firm maintains financial flexibility on the balance sheet by not raising debt or equity capital pre-crisis