Funding Liquidity and the Cross-Section of Stock Returns

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Funding Liquidity

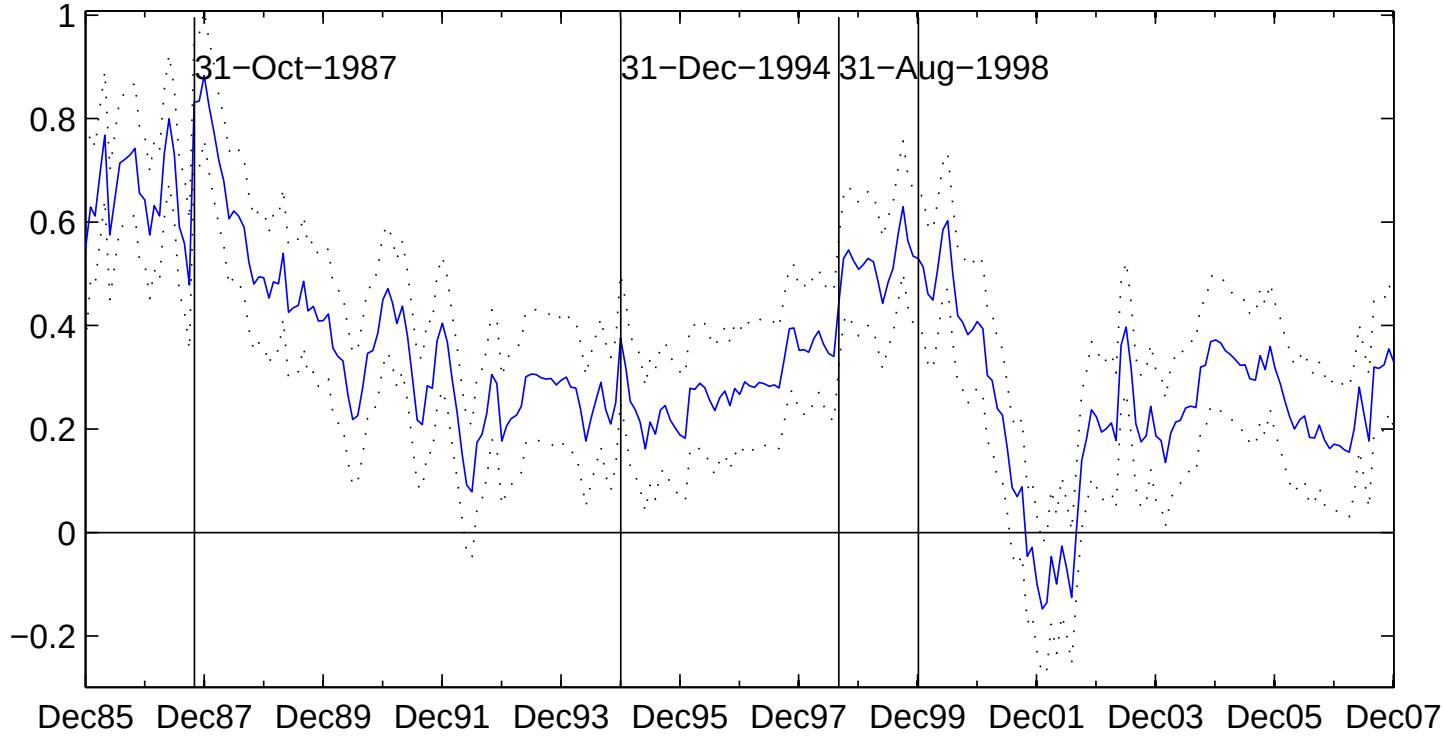
- Funding Liquidity is the ease with which traders obtain funding, while Market Liquidity is the ease with which an asset is traded.
- In Brunnermeier and Pedersen (2009) ”Market Liquidity and Funding Liquidity”, speculators finance their trades through collateralized borrowing from financiers who set the margins to control their value-at-risk.
- An adverse shock to speculators’ funding liquidity (through for example higher margins) forces them to reduce their leverage and provide less liquidity to the markets, which decreases assets’ market liquidity.
- Conversely, traders’ funding (their capital and the margins they are charged) depend on the assets’ market liquidity.
- Under certain conditions, margins are destabilizing and market liquidity and funding liquidity are mutually reinforcing, leading to liquidity spirals that affect all asset markets.

Measurement of Funding Liquidity

- A prominent example that liquidity affects asset prices is the on-the-run liquidity premium — the most recently issued (on-the-run) bonds sell at a premium relative to seasoned (off-the-run) bonds with similar coupons and maturities.
- To measure this liquidity premium, Fontaine and Garcia ("Bond Liquidity Premia", forthcoming *Review of Financial Studies*) extract a latent factor by estimating a term structure model from a panel of pairs of U.S. Treasury securities, where each pair has similar cash flows but different ages.
- This strategy is consistent with the existence of an on-the-run premium in the short-run but also with the evidence that older bonds are less liquid (Warga, 1992).

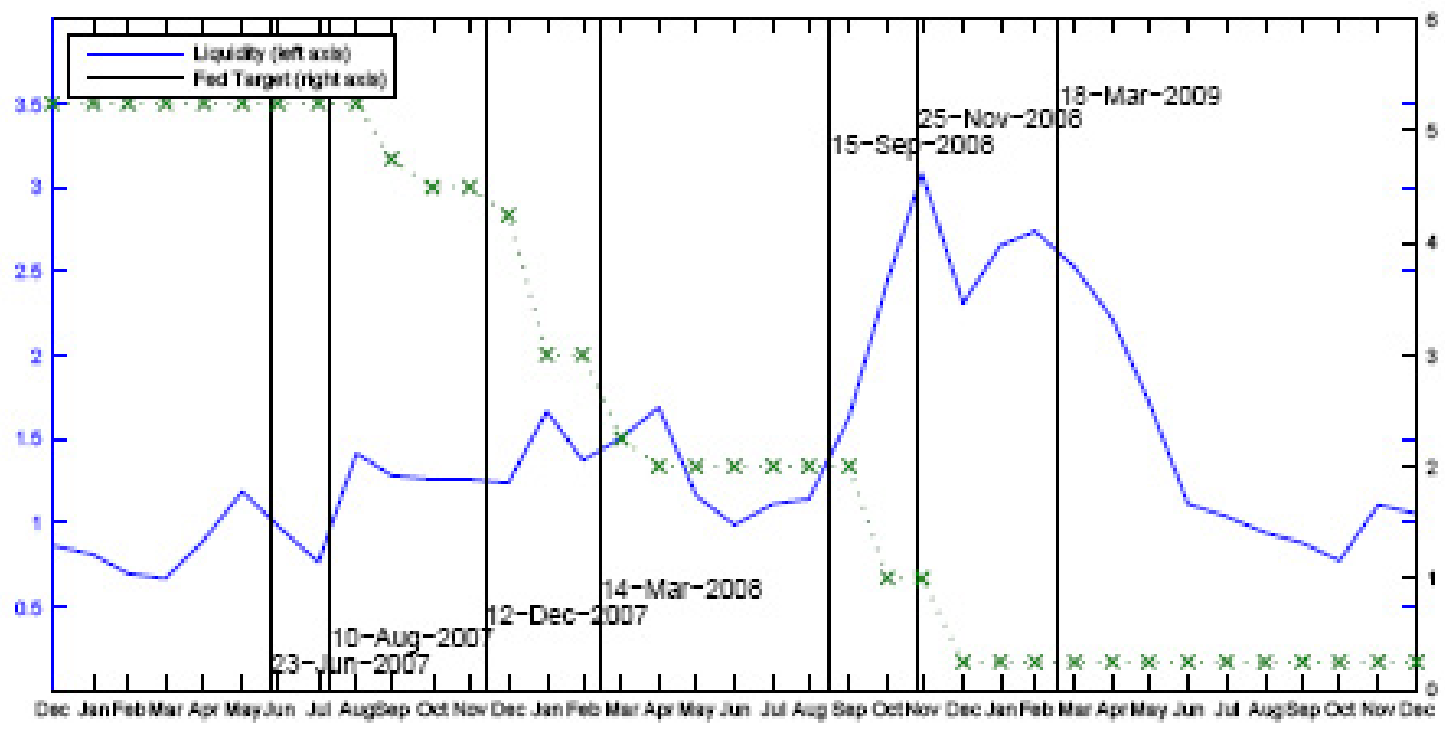
Estimation of the TS Model with Liquidity

Liquidity Factor: the value of liquidity to investors



Liquidity Factor during the Crisis

Prediction of the TS Model with Liquidity



(a) Liquidity Factor

Evidence for funding liquidity - 1

The core of the paper aims at demonstrating that our age-based measure of the value of liquidity can be explicitly linked to funding conditions.

- We relate the liquidity value to the expected benefits of holding a more liquid security. We measure these benefits by a common component in repo spreads.
- We document the price-quantity relationship between the value of liquidity and the quantity of funding liquidity supplied by shadow banks.
- We study the relationship between the value of liquidity and broader measures of funding conditions (non-borrowed reserves, growth of M2).

Evidence for funding liquidity - 2

We test whether tightness of funding conditions affects risk premia across several fixed-income securities. We find that:

1. an increase in the value of liquidity predicts lower expected excess returns, and thus higher current prices, for Treasury bonds at all maturities.
2. variations of LIBOR rolling excess returns are positively linked to variations of funding liquidity.
3. for corporate bond spreads, the impact of liquidity is significant and follows a flight-to-quality pattern across ratings. For bonds of the highest credit quality, spreads decrease, on average, following a shock to funding liquidity value. In contrast, spreads increase for bonds with lower ratings.

Funding liquidity and Other Markets

We explore the relevance of funding liquidity in:

1. Pricing the cross-section of stock returns
2. Explaining hedge fund returns

Funding Liquidity and the Cross Section of Stock Returns

Liquidity and Stock Returns

- The relationship between expected returns and liquidity of the stock market has been investigated by several studies.
- Amihud (2002) use a measure of stock illiquidity based on the average across stocks of the daily ratio of absolute stock return to dollar volume. He shows that expected market illiquidity positively affects ex-ante stock excess return, especially for small firm stocks.
- Pastor and Stambaugh (2003) use a measure of liquidity based on a cross-sectional average of individual-stock liquidity measures based on volumes. They show that stocks whose returns are more exposed to marketwide liquidity fluctuations command higher expected returns.
- We explore the effect of **funding liquidity** on the cross-section of stock returns.

Method Overview

1. Run single time-series regression for each test asset over the relevant time period, regressing excess returns on factors to obtain beta estimates. For example, for the Fama-French model with three factors:

$$r_{it} - r_{ft} = \beta_{i0} + \beta_{im}(r_{mt} - r_{ft}) + \beta_{is} SMB_t + \beta_{iv} HML_t + \varepsilon_{it} \ , t = 1, 2, T$$

2. Conduct T cross-sectional regressions of quarterly returns on betas obtained in 1. from which Fama-Macbeth t statistics can be calculated.
3. Obtain R-squared and adjusted R-squared from a single regression of mean returns on estimated betas.

Table 1: Pricing the Cross-Section of 25 Size and Book to Market Portfolios (Q3/1986-Q4/2009)

	CAPM	3-Factor Benchmark	Liq. Level and 3-Factor Benchmark	Liquidity and 3-Factor benchmark	3-Factor benchmark + liq. level+liq. changes
Constant	1.609	0.325	0.397	0.512	0.451
FM t-stat	2.315	1.325	1.640	2.156	1.890
Liquidity Level			-1.430		-1.399
FM t-stat			-3.202		-3.140
Liquidity Changes				-0.982	-0.695
FM t-stat				-2.835	-2.124
Market	0.145	1.192	1.226	0.992	1.155
FM t-stat	0.133	1.276	1.312	1.065	1.239
SMB		0.219	0.350	0.298	0.360
FM t-stat		0.362	0.577	0.494	0.595
HML		1.363	0.700	0.825	0.601
FM t-stat		1.501	0.808	0.947	0.699
R-Squared	0.004	0.290	0.507	0.396	0.516
Adj. R-Squared	-0.034	0.201	0.421	0.291	0.405

Table 2: Pricing the Cross-Section of 25 Size and Book to Market Portfolios (Q3/1986-Q4/2006) Precrisis

	CAPM	3-Factor Benchmark	Liq. Level and 3-Factor Benchmark	Liquidity and 3-Factor benchmark	3-Factor benchmark + liq. level+liq. changes
Constant	2.090	0.261	-0.020	0.270	0.001
FM t-stat	3.037	1.365	-0.096	1.415	0.003
Liquidity Level			-1.595		-1.612
FM t-stat			-3.338		-3.332
Liquidity Changes				-0.783	-0.588
FM t-stat				-2.087	-1.643
Market	0.069	1.511	1.970	1.413	1.909
FM t-stat	0.062	1.600	2.074	1.498	2.021
SMB		0.332	0.771	0.549	0.812
FM t-stat		0.508	1.163	0.838	1.224
HML		1.542	1.305	1.208	1.213
FM t-stat		1.794	1.546	1.447	1.452
R-Squared	0.001	0.396	0.576	0.445	0.580
Adj. R-Squared	-0.038	0.320	0.502	0.348	0.485

Financial Intermediaries and the Cross-Section of Stock Returns

Based on the growing theoretical literature on the links between financial institutions and asset prices, Adrian, Etula and Muir (2010) show that:

- Broker-Dealer leverage (ratio of Total financial assets over the difference bewtween total financial assets and total financial liabilities) is a good empirical proxy for the marginal value of wealth of financial intermediaries;
- Shocks to leverage are priced in the cross-section;
- Investors require higher compensation for holding assets that exhibit greater comovement with broker-dealer leverage shocks.

Broker-Dealer Leverage, Funding Liquidity, and the Cross-Section of Stock Returns

- We first verify that we obtain same results over the 1968-2009 period selected in their study.
- We determine whether the level of funding liquidity and changes in liquidity are still priced factors once leverage shocks are taken into account.
- We verify whether results are robust to the exclusion of the recent crisis.

Table 5: Pricing the Cross-Section of 25 Size and Book to Market Portfolios (Q1/1968-Q4/2009)
Broker-Dealer Leverage

	CAPM	FF	BDLev	FF+BDLev
Constant	1.645	-0.022	0.132	0.520
FM t-stat	3.633	-0.152	0.418	2.829
Broker-Dealer Leverage Changes			0.155	0.202
FM t-stat			3.130	4.053
Market	0.070	1.260		0.549
FM t-stat	0.086	1.780		0.771
SMB		0.529		0.332
FM t-stat		1.114		0.689
HML		1.793		0.644
FM t-stat		3.039		1.090
R-Squared	0.001	0.591	0.488	0.743
Adj. R-Squared	-0.037	0.540	0.469	0.698

Table 4: Pricing the Cross-Section of 25 Size and Book to Market Portfolios (Q3/1986-Q4/2009)
Liquidity and Broker-Dealer Leverage

	CAPM	FF	Liq +BD Lev
Constant	1.609	0.325	0.786
FM t-stat	2.315	1.325	2.533
Broker-Dealer Leverage Changes			0.151
FM t-stat			2.474
Liquidity Level			-0.588
FM t-stat			-1.863
Liquidity Changes			-1.344
FM t-stat			-3.069
Market	0.145	1.192	0.735
FM t-stat	0.133	1.276	0.774
SMB		0.219	0.168
FM t-stat		0.362	0.269
HML		1.363	-0.015
FM t-stat		1.501	-0.017
R-Squared	0.004	0.290	0.554
Adj. R-Squared	-0.034	0.201	0.452

Table 5: Pricing the Cross-Section of 25 Size and Book to Market Portfolios (Q3/1986-Q4/2006)-Precrisis
Liquidity and Broker-Dealer Leverage

	CAPM	FF	Liq +BD Lev
Constant	2.090	0.261	0.048
FM t-stat	3.037	1.365	0.218
Broker-Dealer Leverage Changes			0.056
FM t-stat			0.933
Liquidity Level			-0.581
FM t-stat			-1.638
Liquidity Changes			-1.651
FM t-stat			-3.270
Market	0.069	1.511	1.843
FM t-stat	0.062	1.600	1.943
SMB		0.332	0.811
FM t-stat		0.508	1.221
HML		1.542	1.112
FM t-stat		1.794	1.342
R-Squared	0.001	0.396	0.579
Adj. R-Squared	-0.038	0.320	0.483

Future work

- We need to further the analysis by constructing portfolios of stocks that are sensitive to funding liquidity: stocks in capital-intensive industries, firms that rely on markets for their source of capital and operating funds and firms that rely more on internal financing.
- We need to check the robustness of results to time-variation in risk.
- We need to include other measures of liquidity (market or funding).

Funding Liquidity and Hedge Fund Returns

Liquidity and Hedge Fund Contagion

- Hedge funds are particularly relevant in terms of contagion, since they often argue that they offer downside protection by having a low correlation with fundamental factors.
- However, many hedge funds rely on leverage and contagion can be created by tight funding conditions.
- Contagion is defined as correlation over and above that expected from economic fundamentals (see Bekaert, Harvey, and Ng (2005).
- Using this concept of contagion, Boyson, Stahel, and Stulz (2010, 2011) study contagion among indices of hedge fund styles created by liquidity shocks.
- Using individual hedge funds, we use a different methodology to study correlation among individual hedge funds within each style and relate it to market liquidity (Pastor and Stambaugh) and funding liquidity.

Implied correlations in Hedge Fund Returns

- To obtain a measure of a common correlation between individual hedge fund returns, we use measures of variances of index and individual hedge fund returns that are based on a GARCH(1,1) model.
- We construct an equally-weighted measure:

$$IC(t) = \frac{\sigma_I^2(t) - \sum_{i=1}^{N_t} \frac{1}{N_t^2} \sigma_i^2(t)}{\sum_{i=1}^{N_t} \sum_{j \neq i} \frac{1}{N_t^2} \sqrt{\sigma_i^2(t)} \sqrt{\sigma_j^2(t)}}$$

- We can apply this measure to raw returns, but we can also break it down into a common exposure to risk factors and a residual correlation.

Factor-Induced Correlation and Idiosyncratic Correlation

- We regress the returns of individual hedge funds on risk factors and compute the implied correlation based on the explained part (common correlation) and the implied correlation based on the unexplained part (residual or idiosyncratic correlation).
- We use the seven-factor model of Fung and Hsieh (2001) to describe hedge fund returns:

$$\begin{aligned} rexc_{i,t} &= \alpha_i + \beta_i^1 SNPexc_t + \beta_i^2 SML_t + \beta_i^3 RBD10_t \\ &+ \beta_i^4 BAAMBD10_t + \beta_i^5 PTFSBD_t \\ &+ beta_i^6 PTFSFX_t + \beta_i^7 PTFSCOM_t + \varepsilon_{i,t} \end{aligned}$$

SNPexc: Monthly return on S&P 500 minus 1-month T-bill

SML: Wilshire small cap minus large cap

RBD10: change in constant maturity yield 10-year Treasury

BAAMBD10: change in spread Moody's BAA minus 10-year Treasury

PTFS: Primitive trend following strategy for bonds (BD), currency (FX) and commodities (COM)

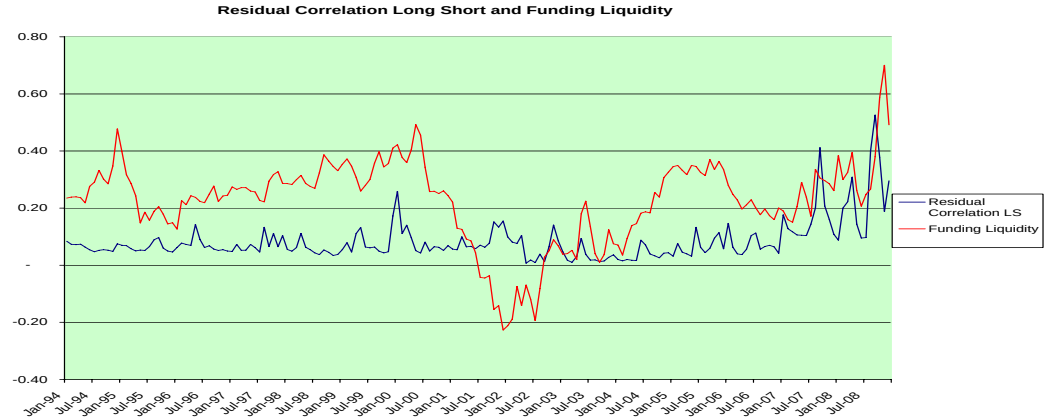
Liquidity Factors

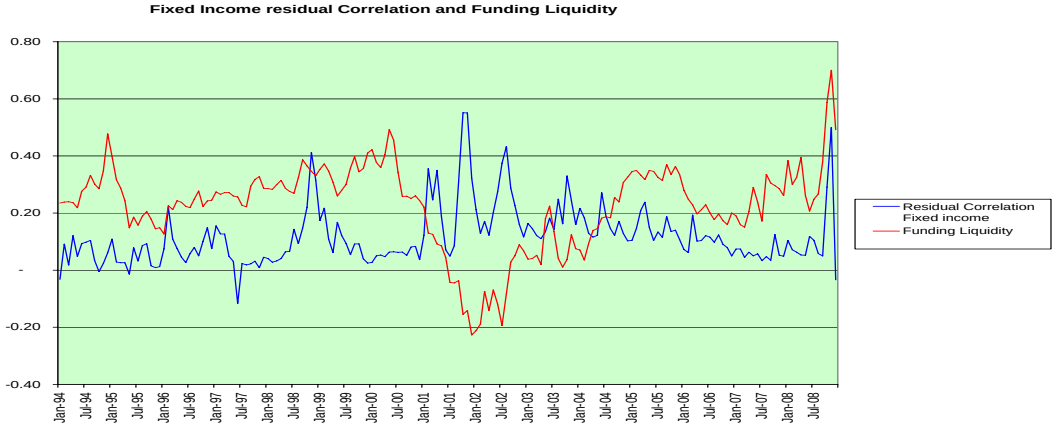
- Since hedge funds use leverage, a prime suspect for explaining residual correlation is liquidity.
  - Pastor and Stambaugh (2003) Liquidity Factor: priced systematic liquidity factor in equity returns, based on lagged dollar volume for each stock.
  - Funding Liquidity Factor (Fontaine and Garcia, 2008): extracted for on-the-run and off-the-run pairs of Treasuries at all maturities.

Liquidity Factors and Residual Correlations for HF Categories

	Global	LS	FF	FI
PS Liq	-0.14	-0.14	-0.17	-0.12
Funding Liq	0.08	0.27	-0.39	-0.37

Funding Liquidity and Residual Correlation - LS and FI





Regression of IC on liquidity for HF Categories

		Liquidity		TS Volatility		CS Volatility	
	Intercept	PS	FG	Res	Mkt	Res	Mkt
Global	0.04	-0.03	0.02	20.58	-0.85	-4.83	0.74
	[3.10]	[-1.34]	[1.86]	[12.27]	[-2.52]	[-20.52]	[3.00]
Convertibles	-0.02	0.16	-0.30	83.07	-13.03	-3.82	-10.39
	[-0.57]	[0.95]	[-3.37]	[29.38]	[-5.75]	[-1.50]	[-4.97]
Short Bias	0.19	-0.20	-0.05	8.79	-1.37	-2.53	-0.27
	[5.87]	[-2.94]	[-1.41]	[4.66]	[-4.33]	[-5.27]	[-0.78]
Emerging Markets	0.26	-0.13	0.21	5.89	-0.68	-2.61	0.29
	[8.82]	[-1.59]	[4.74]	[4.88]	[-1.48]	[-5.20]	[0.57]
Equity Neutral	-0.03	-0.09	0.01	24.32	9.80	-3.53	-0.43
	[-1.89]	[-1.90]	[0.32]	[9.92]	[4.72]	[-7.26]	[-0.64]
Event Driven	0.00	-0.02	-0.03	29.98	0.56	-4.66	-0.18
	[-0.20]	[-0.42]	[-1.53]	[11.62]	[1.14]	[-6.47]	[-0.38]
Fixed Income	0.00	0.12	-0.17	28.95	0.63	-2.53	0.06
	[-0.02]	[1.30]	[-3.38]	[13.67]	[0.46]	[-2.29]	[0.07]
Funds of Funds	0.35	-0.12	-0.38	17.31	5.33	-11.45	1.31
	[9.91]	[-1.57]	[-8.32]	[3.44]	[3.88]	[-8.30]	[1.05]
Global Macro	-0.02	-0.02	-0.03	11.81	5.81	-1.44	-0.17
	[-1.12]	[-1.18]	[-3.21]	[20.12]	[3.07]	[-6.87]	[-1.22]
Long Short	-0.02	-0.03	0.05	20.77	-1.35	-2.77	0.08
	[-1.81]	[-0.89]	[3.10]	[24.24]	[-5.00]	[-11.26]	[0.31]
Managed Futures	0.32	0.05	0.12	9.70	-25.40	-1.02	1.02
	[4.91]	[0.84]	[4.03]	[6.97]	[-6.53]	[-2.10]	[2.95]
Multi Strategy	0.00	-0.02	-0.05	28.23	0.48	-4.15	-0.29
	[-0.27]	[-0.43]	[-2.56]	[13.38]	[0.82]	[-8.66]	[-0.63]
Others	0.72	0.20	-2.60	36.45	4.48	-12.33	1.37
	[1.21]	[0.12]	[-2.75]	[1.16]	[0.30]	[-0.82]	[0.13]

Conclusion

- These results provide evidence that effects of funding liquidity and funding liquidity shocks are pervasive across markets: fixed-income, stock markets, and hedge funds.
- The effects of tight funding conditions are exacerbated during crises but they are pervasive in normal times.
- This evidence points toward the importance of the funding market for the intermediation mechanism.
- Further support needs to be built by looking at individual stocks and construct liquidity-sensitive portfolios.