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Intermediary Asset Pricing: New Evidence from Many Asset Classes

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Motivation

- ▶ Traditional view: SDF is marginal value of wealth of agg. household
    - ▶ Requires participation in many asset markets
    - ▶ Complex hard-to-value assets
    - ▶ Requires the ability to frequently re-optimize
    - ▶ But barriers to trading some assets are impenetrable for households

- ▶ Recent theory ties SDF to marginal value of wealth of intermediaries
    - ▶ He-Krishnamurthy, Brunnermeier-Sannikov
    - ▶ Marginal value of wealth tied to intermediary net worth/capital
    - ▶ Low capital ↔ distress ↔ high marginal value of wealth

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Main Results

▶ Measurement: capital ratio of primary dealers of NY Fed

    1. Capital Ratio = Equity/Assets = 1/Leverage
    2. Why primary dealers? Large, sophisticated, active in most markets

▶ Cross-sectional asset pricing tests for each asset class separately:

▶ Equity	▶ Options
▶ Treasuries	▶ CDS
▶ Corporate bonds	▶ Commodities
▶ Foreign sovereign bonds	▶ FX

Key Results:

1. Positive prices of "intermediary capital risk" for all asset classes

    ▶ Intermediary values a dollar more in low capital (high leverage) states
    ▶ Low β on capital shocks asset is hedge, low expected returns

2. Similar price of risk in all markets of about 9% per quarter

    ▶ $\sigma(\beta)$ difference means 6pp difference in annual risk premia
    ▶ Not saying these markets are not segmented ...

Important implications for theoretical models of intermediary frictions

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Important implications for theoretical models of intermediary frictions

Intermediary's Pricing Kernel and Capital Ratio

▶ Pricing kernel is marginal value of wealth for marginal investors:
  ▶ Freely and actively make portfolio decisions on asset side
  ▶ (though may face financing constraints on liability side)

▶ We propose two-factor pricing kernel of intermediaries

$$\Lambda_t \propto (\eta_t W_t)^{-\gamma}, \text{ where } \gamma > 0$$

  ▶ η_t is the intermediary equity capital ratio
  ▶ W_t is the aggregate wealth of the economy; CAPM intuition

▶ Underlying two-dimensional states/shocks
  ▶ Financial shock: affects soundness of the financial intermediary
    sector (e.g., agency/contracting considerations; housing shocks; etc.)
  ▶ Fundamental shock: persistent technology shock driving general
    economic growth; mainly affects W_t

Why Equity Capital Ratio?

▶ Intermediaries value a dollar more when equity is low

$$\frac{\partial \Lambda_t}{\partial \eta_t} < 0$$

▶ A direct implication of macro-finance literature on balance sheet channel (Bernanke-Gertler, Holmstrom-Tirole)

  ▶ Past losses eat the agent's net worth, more constrained as harder to obtain external financing, lower investment, etc
  ▶ He-Krishnamurthy: risk-averse intermediary gets more distressed given smaller equity base (see paper for the model)
  ▶ Other mechanisms: regulatory capital requirement; equity based on compensation; potential layoff; etc

▶ All we need is

  ▶ Intermediaries are marginal
  ▶ Pricing kernel linked to capital ratio

    ▶ MVW inversely related to capital

Intermediary Capital Ratio

- ▶ Intermediaries: Primary Dealers
  - ▶ Compustat/CRSP/Datastream data for publicly-traded holding companies of NY Fed-designated primary dealers (foreign too)
  - ▶ Why these? Large, active in effectively all markets
- ▶ Capital ratio based on market value of equity:

$$\eta_t = \frac{\Sigma_i \text{Market Equity}_{it}}{\Sigma_i \left(\text{Market Equity}_{it} + \text{Book Debt}_{it}\right)}$$

  - ▶ Market equity is shares outstanding times stock price
  - ▶ Book debt is total assets minus common equity: $AT - CEQ$
- ▶ Intermediary capital risk factor: growth rate of η_t

Primary Dealers as of February 11, 2014
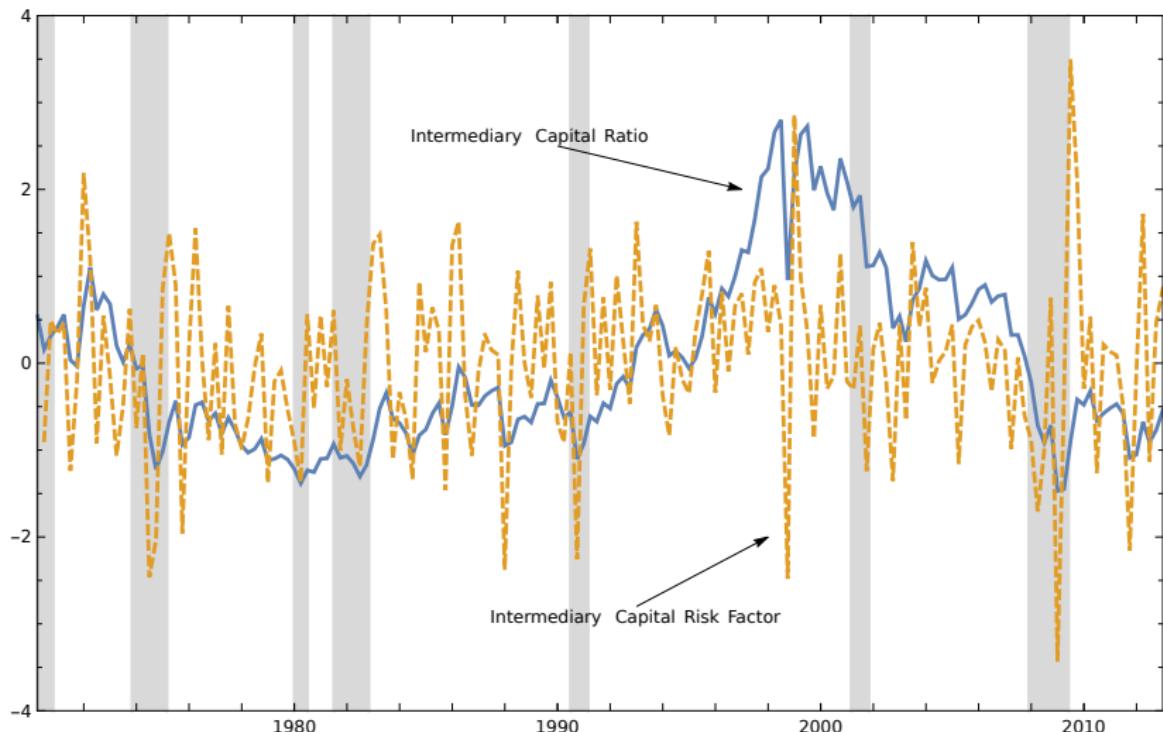
Primary Dealer	Holding Company
Goldman, Sachs & Co.	Goldman Sachs Group, Inc.
Barclays Capital Inc.	Barclays PLC
HSBC Securities (USA) Inc.	HSBC Holdings PLC
BNP Paribas Securities Corp.	BNP Paribas
Deutsche Bank Securities Inc.	Deutsche Bank AG
Mizuho Securities USA Inc.	Mizuho Financial Group, Inc.
Citigroup Global Markets Inc.	Citigroup Inc.
UBS Securities LLC	UBS AG
Credit Suisse Securities (USA) LLC	Credit Suisse Group AG
Cantor Fitzgerald & Co.	Cantor Fitzgerald & Co
RBS Securities Inc.	Royal Bank of Scotland Group
Nomura Securities International,Inc	Nomura Holdings, Inc.
Daiwa Capital Markets America Inc.	Daiwa Securities Group Inc.
J.P. Morgan Securities LLC	JPMorgan Chase & Co.
Merrill Lynch, Pierce, Fenner & Smith	Bank of America Corporation
RBC Capital Markets, LLC	Royal Bank Holding Inc.
SG Americas Securities, LLC	Societe Generale
Morgan Stanley & Co. LLC	Morgan Stanley
Bank of Nova Scotia, NY Agency	Bank of Nova Scotia
BMO Capital Markets Corp.	Bank of Montreal
Jefferies LLC	Jefferies LLC
TD Securities (USA) LLC	Toronto-dominion Bank

Representativeness of Primary Dealers

~20 primary dealers are essentially all of the broker-dealer sector, a substantial share of banking, and even large relative to entire publicly-traded sector

	Total Assets			Book Debt			Market Equity		
	BD	Banks	Cmpust.	BD	Banks	Cmpust.	BD	Banks	Cmpust.
1960-2012	0.959	0.596	0.240	0.960	0.602	0.280	0.911	0.435	0.026
1960-1990	0.997	0.635	0.266	0.998	0.639	0.305	0.961	0.447	0.015
1990-2012	0.914	0.543	0.202	0.916	0.550	0.240	0.848	0.419	0.039

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Capital Ratio (State Variable and Factor)

Correlations with Other Macro Variables

Equity capital ratio is procyclical

	Market Capital Ratio corr(state variable,level)	Market Capital Ratio corr(factor,growth)
Book Capital Ratio	0.50	0.30
Market Excess Return		0.78
E/P	-0.83	-0.75
Unemployment	-0.63	-0.05
GDP	0.18	0.20
Financial Conditions	-0.48	-0.38
Market Volatility	-0.06	-0.49

Test Portfolios

We try to use portfolios that are readily available in the literature

- **Equity**: Fama-French 25 size/value portfolios
- **US Bonds**:
  - Government: Fama 10 maturity sorted portfolios from CRSP
  - Corporate: 10 spread sorted portfolios of Nozawa (2014) who combines TRACE, Lehman, etc
- **Sovereign Bonds:** 6 portfolios of Borri and Verdelhan (2012)
- **Options**: 18 portfolios of S&P 500 index options sorted on moneyness and maturity from Constantinides et al. (2013)
- **CDS**: 20 portfolios sorted on spread using individual name 5-year CDS from Markit beginning in 2001
- **Commodities**: 23 portfolios from CRB, Yang (2013)
- **FX**:
  - 6 portfolios sorted on yield differential (Lettau et al., 2014)
  - 6 portfolios sorted on momentum (Menkhoff et al., 2012)
- **All**: Combines all classes into single large cross section

Empirical Design

- For each asset class k, Fama-MacBeth tests using portfolios i in k
- First-order condition (pricing kernel equation $\mathbb{E}\left[mR_k^i\right] = 1$)

$$\mathbb{E}\left[R_k^i\right] - R_f = \lambda_k^\eta \beta_k^{i,\eta} + \lambda_k^W \beta_k^{i,W} + \nu_k^i$$

  - Risk loadings β_k^i from a first-stage time-series regression
  - Cross-sectional regression to estimate λ_k^η
- Cross-equation restriction: $\lambda_k^\eta = \lambda^\eta$
- Separately estimate risk price λ_k^η within each asset class
- Also estimate λ^η once for all asset classes together
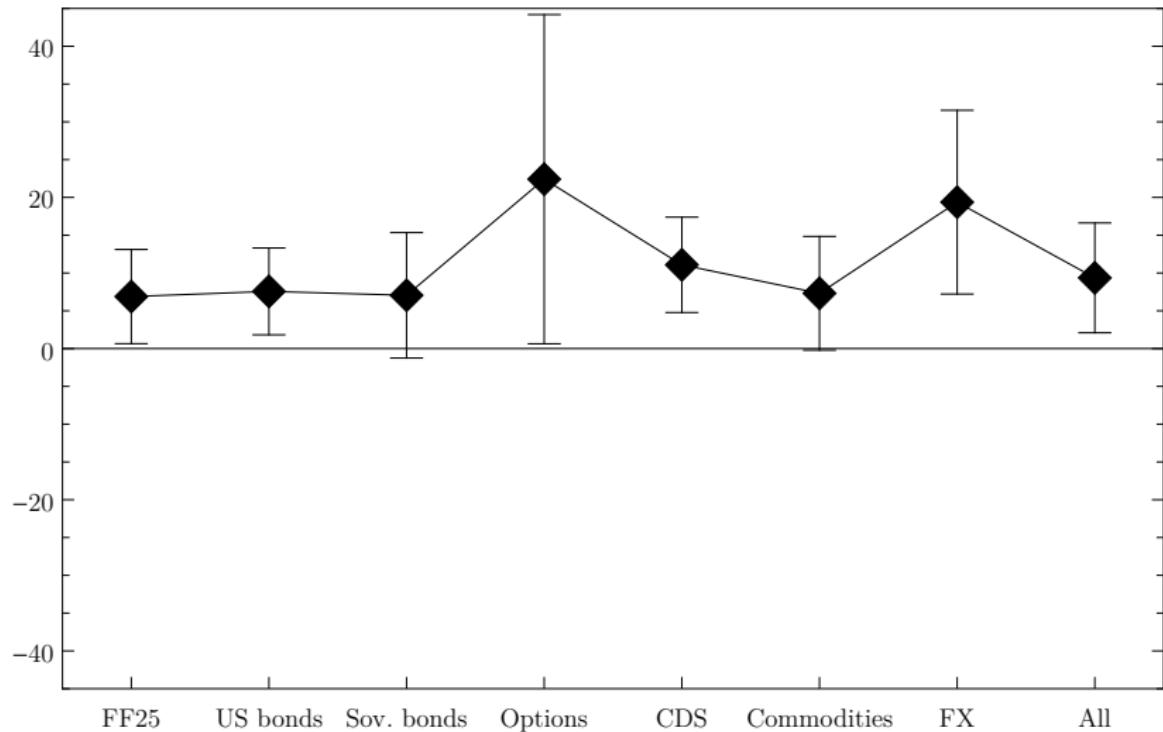
# Intermediary Capital Risk Price $\hat{\lambda}^\eta$ by Asset Class

Cross-sectional Results by Asset Class 1970Q1–2012Q4

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	6.88	7.56	7.04	22.41	11.08	7.31	19.37	9.35
	(2.16)	(2.58)	(1.66)	(2.02)	(3.44)	(1.90)	(3.12)	(2.52)
Market	1.19	1.42	1.24	2.82	1.11	-0.55	10.14	1.49
	(0.78)	(0.82)	(0.32)	(0.67)	(0.41)	(-0.25)	(2.17)	(0.80)
Intercept	0.48	0.41	0.34	-1.11	-0.39	1.15	-0.94	-0.00
	(0.36)	(1.44)	(0.33)	(-0.31)	(-2.77)	(0.83)	(-0.83)	(-0.00)
R^2	0.53	0.84	0.81	0.99	0.67	0.25	0.53	0.71
MAPE, %	0.34	0.13	0.32	0.14	0.18	1.15	0.44	0.63
MAPE-R, %	0.40	0.26	0.45	0.68	0.39	1.40	0.62	0.63
RRA	2.71	3.09	2.52	8.90	3.61	2.88	8.26	3.69
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172

GMM t-stats in parentheses correct for cross-correlation and first-stage estimation error in betas
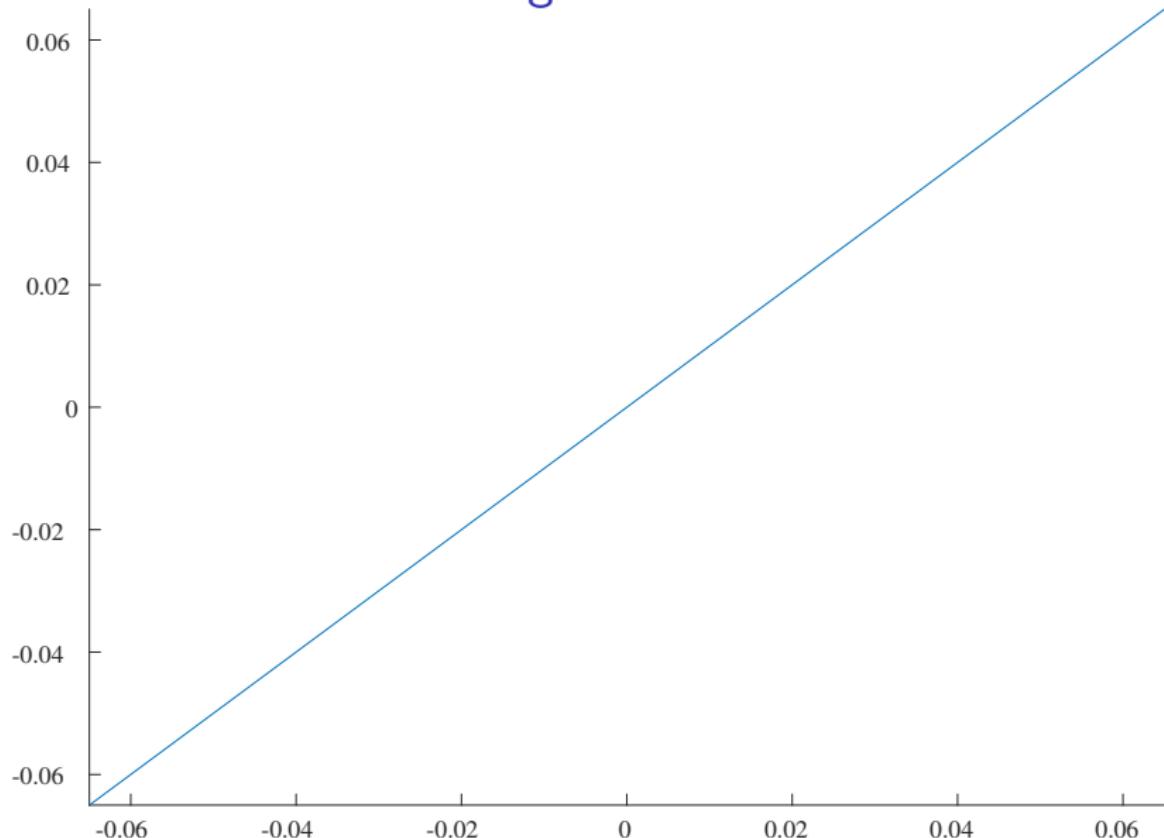
Actual vs. Predicted Average Excess Returns

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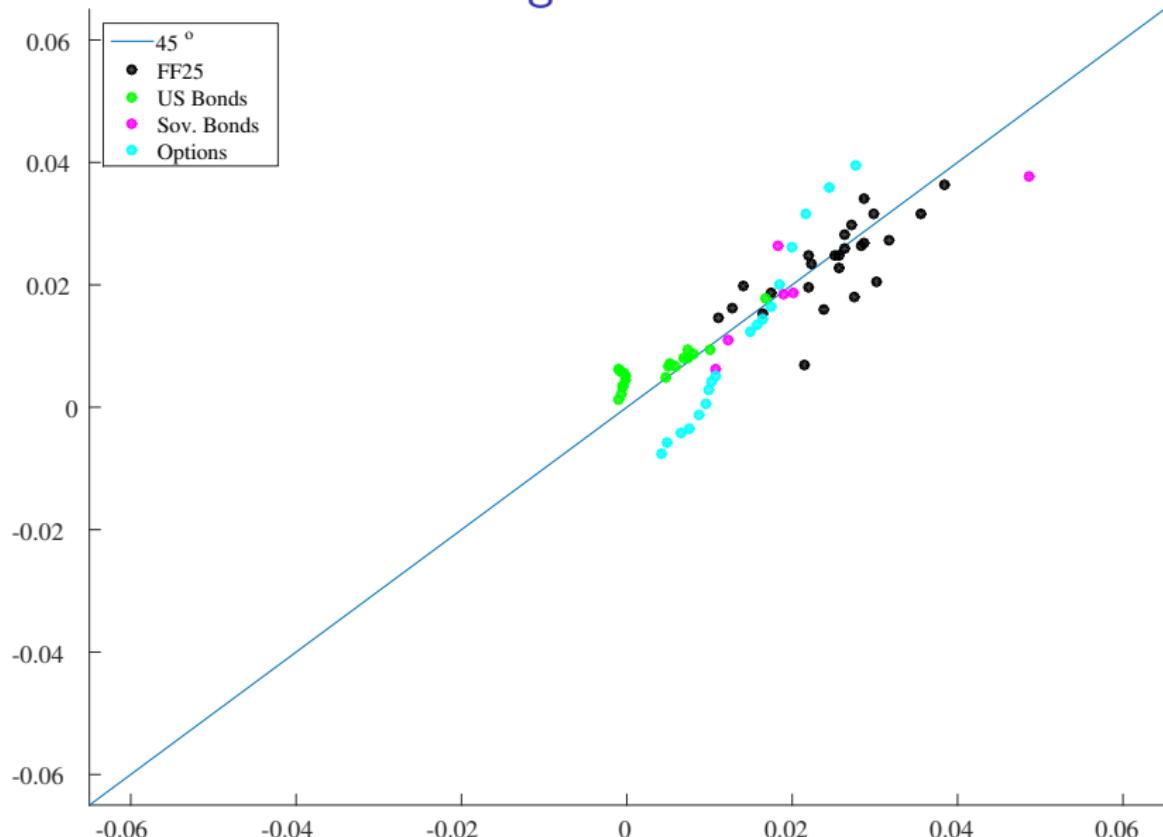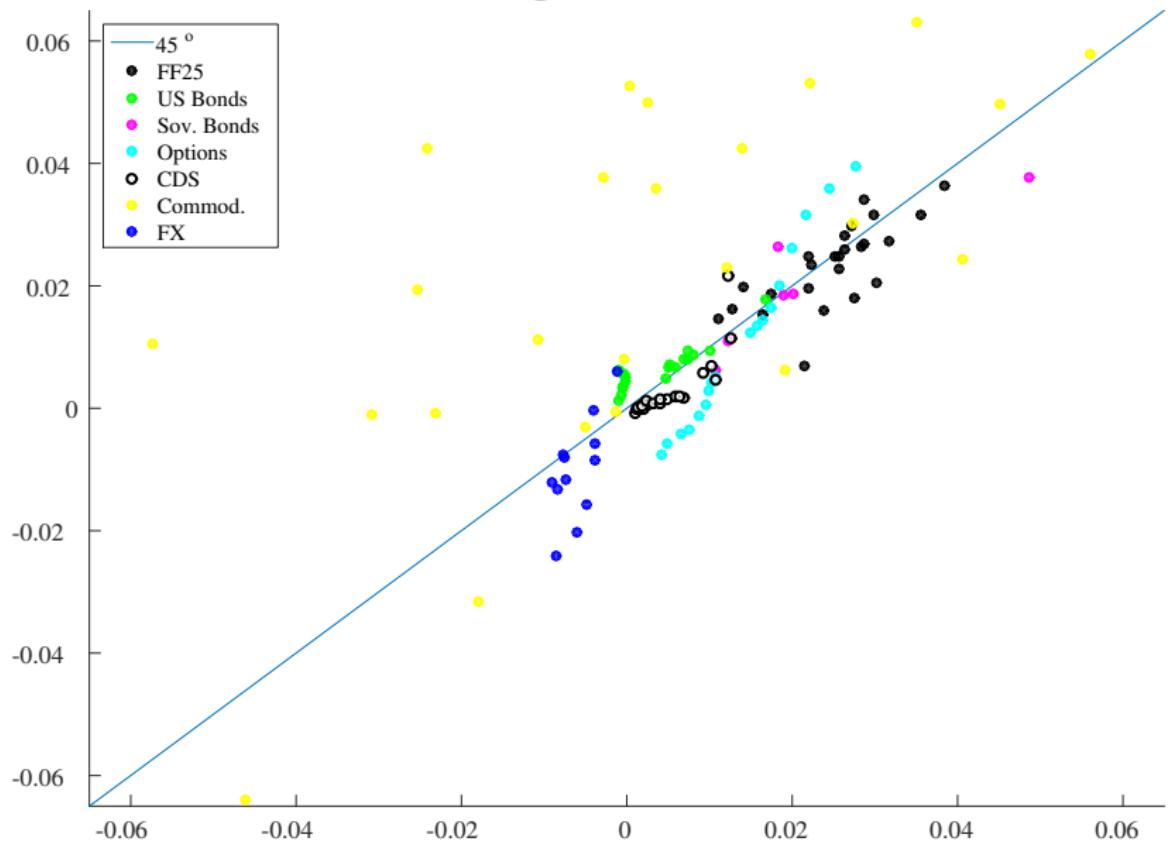
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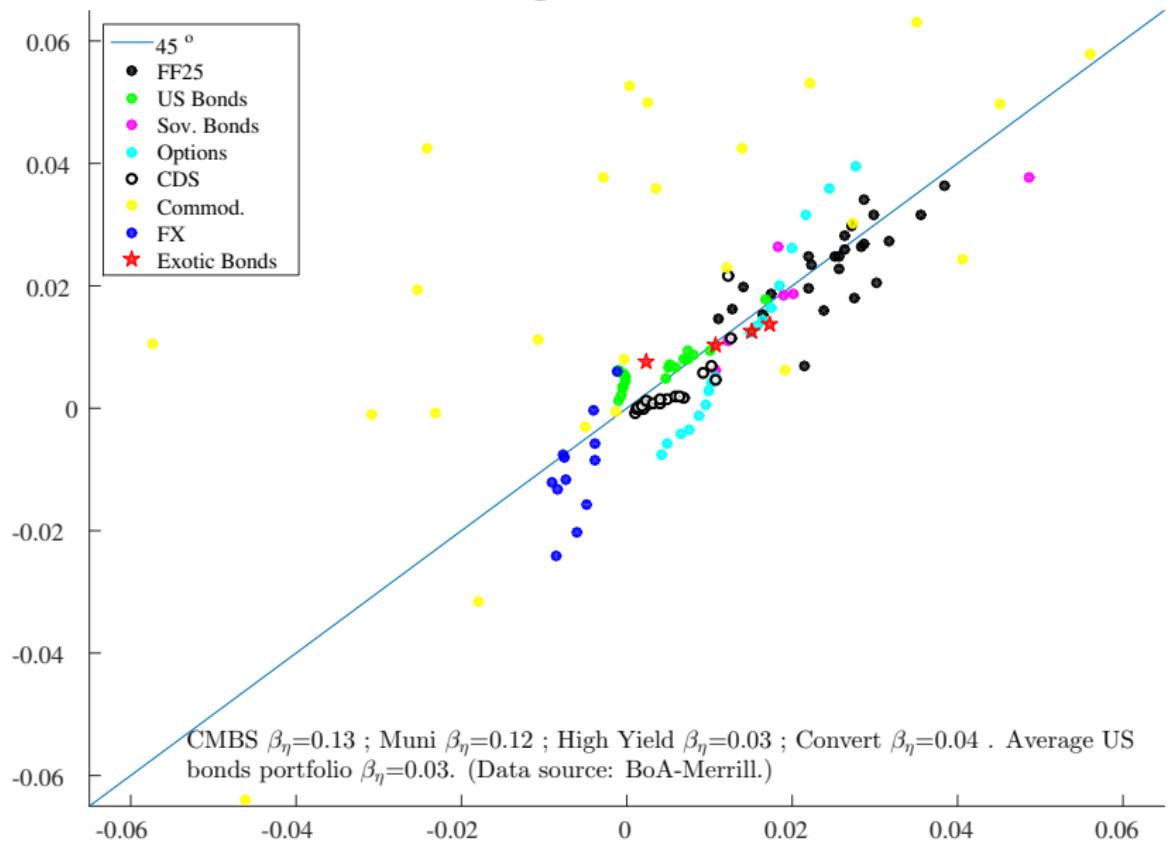
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Actual vs. Predicted Average Excess Returns

Actual vs. Predicted Average Excess Returns

CMBS β_η=0.13 ; Muni β_η=0.12 ; High Yield β_η=0.03 ; Convert β_η=0.04 . Average US bonds portfolio β_η=0.03. (Data source: BoA-Merrill.)

Legend:
- 45°
- FF25
- US Bonds
- Sov. Bonds
- Options
- CDS
- Commod.
- FX
- Exotic Bonds

Capital Ratio vs. Other Pricing Factors

Benchmark:	CAPM	FF3F	FF5F	Momentum	PS-liquidity	LMW
Capital	9.35	9.14	8.81	9.69	7.87	7.56
	(2.52)	(1.98)	(2.46)	(2.84)	(1.75)	(1.76)
Market	1.49	1.62	1.33	1.54	1.21	
	(0.80)	(0.90)	(0.74)	(0.81)	(0.69)	
SMB		0.39	0.59			
		(0.42)	(0.68)			
HML		2.23	2.01			
		(1.36)	(1.46)			
CMA			-0.33			
			(-0.09)			
RMW			0.08			
			(0.04)			
MOM				-1.20		
				(-0.14)		
PS^{nt}					5.71	
					(0.64)	
LMW^{-}						0.77
						(0.58)
LMW						0.63
						(0.31)
Adj. R^2	0.71	0.80	0.69	0.73	0.67	0.70
MAPE, %	0.63	0.65	0.62	0.61	0.59	0.63
RRA	3.69	3.32	3.50	3.74	2.61	2.58
Assets	124	124	124	124	124	124
Quarters	172	172	172	172	172	172
Adj. R^2 w/o Capital	0.32	0.65	0.65	0.27	0.67	0.50
MAPE w/o Capital	0.85	0.86	0.82	0.85	0.83	0.87

Placebo Test: Are Primary Dealers Special?

What if we use capital factor constructed based on non-primary dealers?
Results not there

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	16.25	12.37	43.26	-85.93	66.77	-10.20	-2.61	11.03
	(2.45)	(0.69)	(1.24)	(-2.33)	(2.55)	(-1.52)	(-0.12)	(1.04)
Market	-2.45	3.82	5.56	-6.53	6.86	-0.87	11.76	1.40
	(-1.66)	(2.51)	(1.74)	(-1.20)	(2.99)	(-0.49)	(2.45)	(0.80)
Intercept	4.40	0.38	0.26	7.22	-0.41	-0.38	-2.14	0.25
	(3.36)	(1.49)	(0.22)	(1.48)	(-2.72)	(-0.62)	(-2.14)	(0.95)
R^2	0.54	0.82	0.81	0.97	0.86	0.11	0.50	0.46
MAPE, %	0.36	0.14	0.32	0.23	0.15	1.30	0.45	0.90
MAPE-R, %	0.62	0.30	1.29	1.33	0.34	1.67	1.06	0.90
RRA	1.94	1.49	3.95	-10.95	5.16	-1.33	-0.34	1.32
Assets	25	20	6	18	20	23	12	124
Quarters	165	148	65	103	47	105	135	172

- ► Similar if we use other "intermediary" definitions
  - ► Commercial banks (non-primary)
  - ► Non-financials

Equity Shock vs Debt Shock?

▶ Decompose capital shock into

1. Equity growth shock (ME)
2. Debt growth shock (BD)

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
ME	7.22	4.72	5.03	13.77	5.56	8.72	19.13	9.71
	(1.62)	(1.34)	(0.86)	(1.54)	(1.32)	(1.56)	(4.30)	(2.35)
BD	-2.00	4.09	-6.89	-5.85	-10.19	2.06	-0.18	-0.26
	(-1.51)	(1.53)	(-2.24)	(-0.93)	(-2.12)	(1.14)	(-0.08)	(-0.07)
Market	0.76	4.54	1.85	0.91	-0.52	0.00	8.62	1.68
	(0.46)	(2.01)	(0.48)	(0.19)	(-0.17)	(0.00)	(2.12)	(0.93)
Intercept	0.85	0.22	-0.19	-0.06	-0.42	0.43	-0.79	-0.18
	(0.56)	(1.19)	(-0.12)	(-0.02)	(-3.25)	(0.38)	(-0.76)	(-0.40)
R^2	0.51	0.89	0.90	0.99	0.86	0.28	0.54	0.77
MAPE, %	0.35	0.09	0.29	0.12	0.15	1.21	0.44	0.64
MAPE-R, %	0.44	0.41	0.47	0.68	0.22	1.53	0.52	0.64
RRA	2.39	1.55	1.38	4.20	1.50	2.65	6.57	3.21
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172

▶ Both matter

Intermediary Equity Return as Factor

Primary dealers' equity return as single factor (direct test of HK with log preferences)

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	-0.38	5.31	6.22	14.16	9.32	0.94	18.97	3.41
	(-0.14)	(3.10)	(1.77)	(2.99)	(2.91)	(0.31)	(3.44)	(1.07)
Intercept	2.43	0.35	0.39	-5.19	-0.37	0.29	-1.08	-0.03
	(1.79)	(1.68)	(0.48)	(-2.67)	(-3.73)	(0.46)	(-1.38)	(-0.06)
R^2	0.00	0.84	0.72	0.94	0.63	0.00	0.58	0.40
MAPE, %	0.56	0.13	0.46	0.32	0.20	1.39	0.42	0.78
MAPE-R, %	0.54	0.44	1.14	1.02	0.20	1.41	1.05	0.78
RRA	-0.21	2.99	3.12	7.73	4.15	0.50	11.14	1.92
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	5.97	6.62	6.94	28.50	12.96	6.94	19.26	8.69
	(1.89)	(2.55)	(1.52)	(1.71)	(3.00)	(1.77)	(3.40)	(2.39)
Market	1.38	2.17	2.39	2.92	1.62	0.06	8.63	1.74
	(0.89)	(1.15)	(0.60)	(0.54)	(0.56)	(0.03)	(1.81)	(0.97)
Intercept	0.33	0.29	0.27	-1.08	-0.40	0.65	-0.75	-0.22
	(0.24)	(2.23)	(0.22)	(-0.24)	(-2.60)	(0.57)	(-0.68)	(-0.26)
R^2	0.45	0.85	0.74	0.99	0.68	0.26	0.59	0.68
MAPE, %	0.39	0.12	0.43	0.16	0.19	1.22	0.44	0.61
MAPE-R, %	0.48	0.32	0.47	0.76	0.16	1.37	0.51	0.61
RRA	2.14	2.39	2.26	10.09	3.76	2.43	7.34	3.12
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172

....but significant in two-factor structure with excess market return

Interpretation

Summary of facts:

- ▶ Capital ratio of intermediary sector helps explain differences in average returns across assets
- ▶ Estimated price of risk is positive
- ▶ Consistent risk price estimates across multiple asset classes

Interpretations:

- ▶ Marginal investor prefers assets that pay off in states with low intermediary capital, as in "equity constraint" models (He-Krish, Brunn-Sann)
- ▶ This intermediary (or relatively homogeneous set of intermediaries) is marginal in many asset markets
- ▶ (other interpretations may also be consistent with empirical facts)

Important implications for how we think about intermediation frictions

Variants of "Intermediary Asset Pricing" Models

Key difference between two main variants of these models

1. "Debt constraint" models à la Brunnermeier-Pedersen, Geanakoplos, Adrian-Boyarchenko ...

   ▶ Risk-based funding constraint: risk rises → deleveraging → prices fall
   ▶ High leverage, low capital ratio ↔ low distress
   ▶ Shocks to capital ratio have negative price (shocks to leverage have *positive* price of risk)

2. "Equity constraint" models à la He-Krishnamurthy, Brunnermeier-Sannikov, Holmstrom-Tirole, Bernanke-Gertler ...

   ▶ Capital constraints: negative equity shock → agency exacerbated → risk-bearing capacity falls → prices fall → leverage rises
   ▶ High leverage, low capital ratio ↔ high distress
   ▶ Shocks to capital have positive price of risk (shocks to leverage have *negative* price)

Comparison with Adrian-Etula-Muir (2014)

An important precursor: Adrian-Etula-Muir (JF, 2014, later AEM)
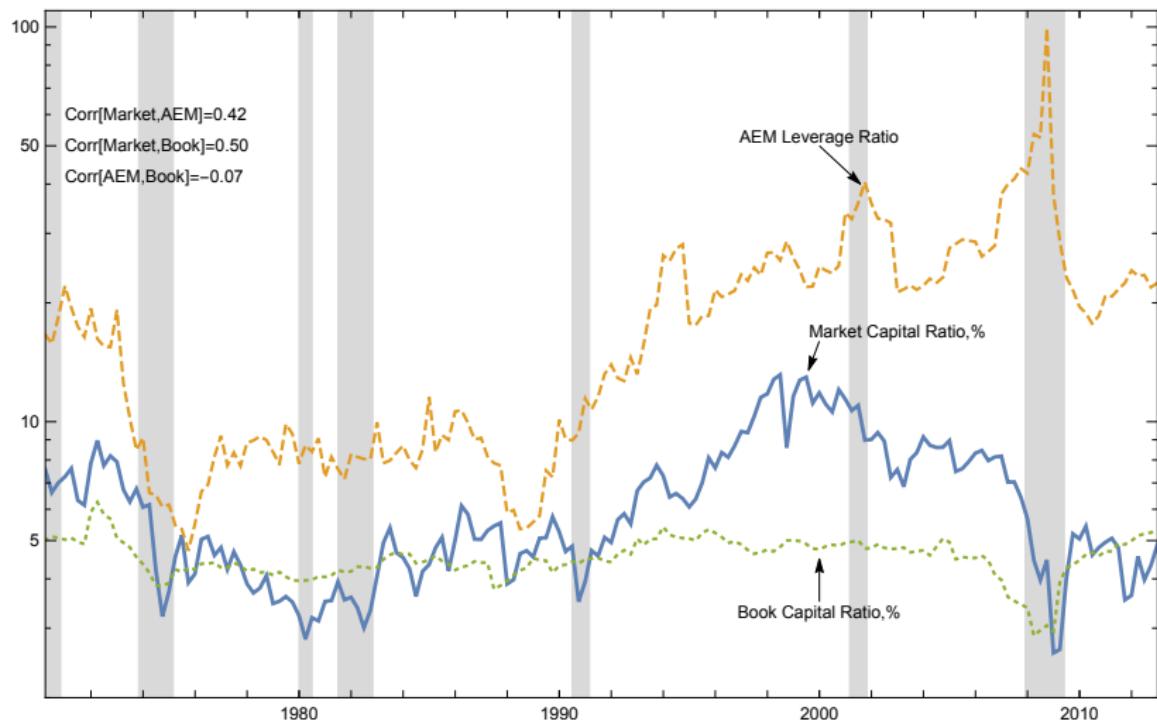
- ▶ Factor: Broker-dealer leverage from Flow of Funds
- ▶ Explains cross-section of equity and bond returns
- ▶ Positive price of risk on leverage factor (negative price on capital factor)
- ▶ Leverage is procyclical (low capital in good times)

Contrast with our results

- ▶ Positive price of risk on capital factor (negative price on leverage factor)
- ▶ Leverage (1/capital ratio) is counter-cyclical
- ▶ Empirically, our factor works in all asset classes in a consistent manner, unlike the AEM factor
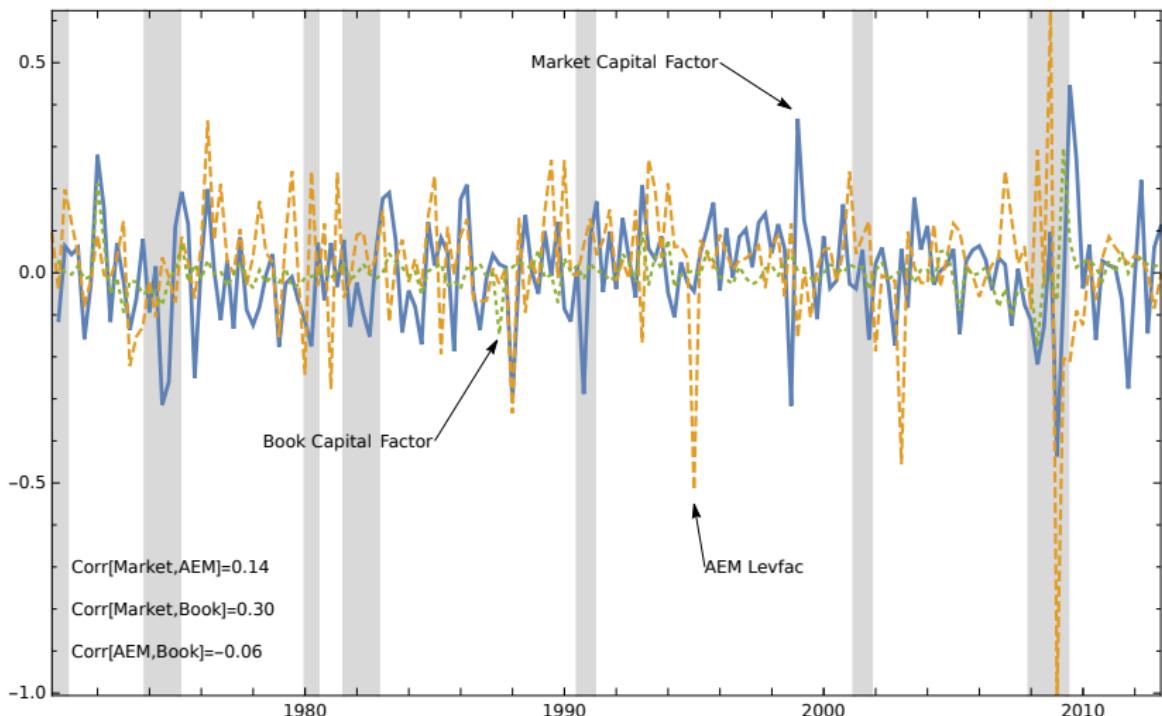
What drives differences?

AEM Leverage and Intermediary Capital Ratio: Level

- Leverage and capital ratio should be negatively correlated...
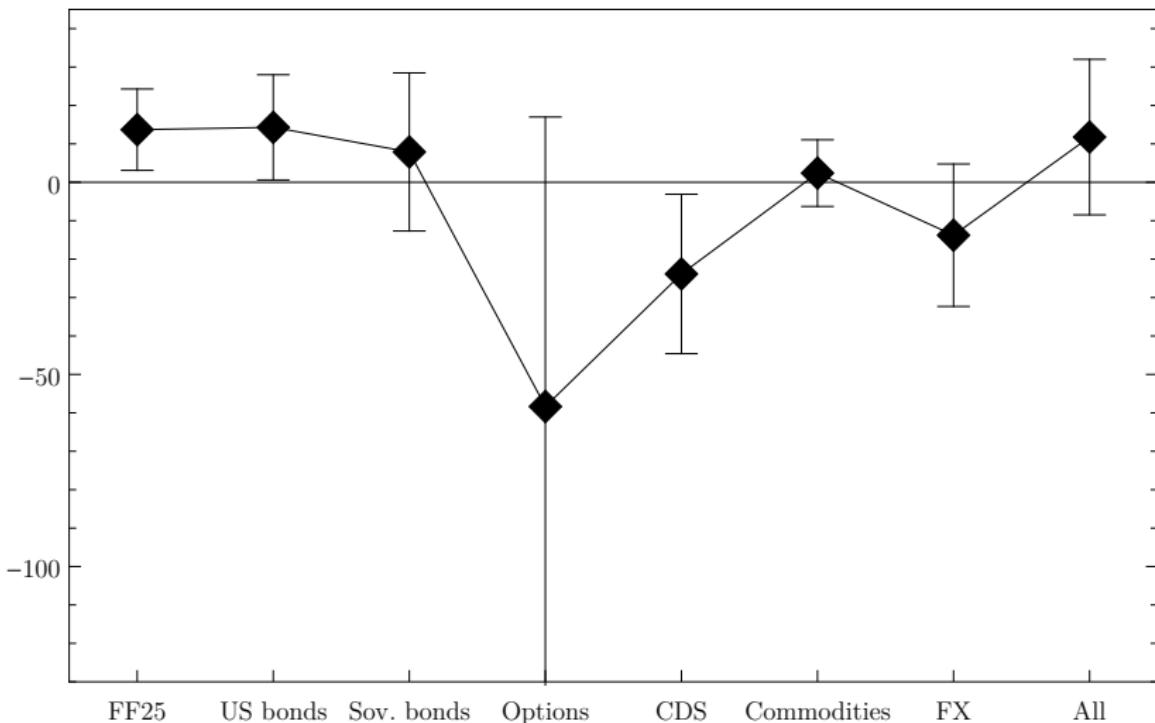
AEM Leverage and Intermediary Capital Ratio: Factor

- Leverage and capital ratio should be negatively correlated...

Intro
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Model
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Data
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Main Results
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Interpretation/Comparisons
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Conclusion
○

AEM Leverage Factor Risk Price by Asset Class

Potential Difference from AEM

- ▶ It is intriguing that we have countercyclical leverage while AEM have procyclical leverage
- ▶ Equilibrium leverage pattern depends on the theory you write (either equity-constraint or debt-constraint)
- ▶ But what differs in our data?

	AEM	HKM
Data Source	Flow of Funds	CRSP/Compustat/Datastream
Universe	Public+Private	Public
Book vs. Market	Book values	Market equity, book debt
Reporting if hold. co.	BD operations only	Holding company

- ▶ Importance of private/public distinction unlikely due to size concentration (can show that even in public universe, all driven by largest 25 firms)

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Book vs Market

- ▶ One common thought: FoF is accounting data (book leverage), while we use market leverage

- ▶ Not the answer. For primary dealers, market and book capital ratios are 50% correlated

- ▶ Mark-to-market accounting for broker-dealers make the difference small
  - ▶ For stand-alone public broker-dealers (SIC 6211,6221), we find a 75% correlation between market leverage and book leverage
  - ▶ For our sample of primary dealers including big banks (mark-to-market?), book and market leverages are also positively correlated

Book Capital Ratio in Our Test

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	2.11	-1.54	6.55	10.11	7.65	2.36	-9.14	2.36
	(1.53)	(-0.33)	(2.07)	(2.18)	(2.59)	(1.62)	(-1.06)	(1.33)
Market	-1.72	4.81	-1.00	2.32	0.54	-1.35	13.26	1.57
	(-1.33)	(1.19)	(-0.34)	(0.91)	(0.19)	(-0.74)	(2.08)	(0.96)
Intercept	3.93	0.32	1.20	-0.44	-0.38	0.78	-2.84	0.15
	(3.39)	(4.36)	(2.15)	(-0.21)	(-3.46)	(1.12)	(-1.90)	(0.23)
R^2	0.10	0.82	0.95	0.97	0.69	0.11	0.72	0.37
MAPE, %	0.52	0.13	0.17	0.18	0.18	1.27	0.37	0.76
MAPE-R, %	0.73	0.24	0.91	0.85	0.36	1.33	1.07	0.76
RRA	8.63	-7.38	20.39	39.31	16.41	9.12	-43.97	9.66
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172

Holding Company vs Subsidiary

- ▶ We include primary dealers' entire balance sheet
  - ▶ Holding company level, not just their trading arms
  - ▶ Say JPMorgran. Losses on JPMorgan's other businesses likely adversely affect the trading arm's risk-return trade-off
  - ▶ We postulate this drives the difference
- ▶ A piece of suggestive evidence
  - ▶ AEM implied capital ratio (i.e., inverse of AEM leverage) has -59% correlation with primary dealers
  - ▶ But, AEM implied capital ratio is 12% correlated with non-primary dealers (smaller with broker-dealer arms only)
- ▶ Which is the right measure?
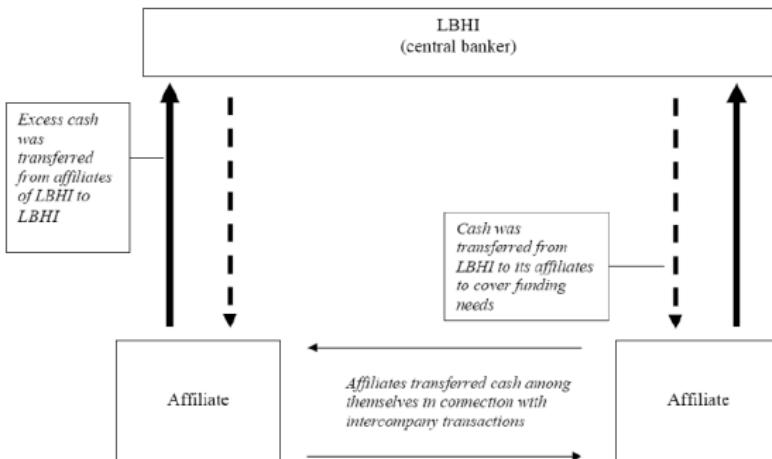
Holding Company or Subsidiary Leverage (1)?

- ▶ Houston, James, and Marcus (1997): bank subsidiary's loan growth is more correlated with holding company's capital position

- ▶ Anecdotal post-mortem evidence suggest capital is fungible within broker-dealer holding companies
  - ▶ Drexel Burnham Lambert Group bankruptcy in 1990 led to the liquidation of its broker-dealer arm
    - ▶ Post-Drexel, the SEC moved toward group-wide risk assessments of BD holdings companies
  - ▶ In 2008, Lehman Brothers' European affiliate took down the holding company and its US broker-dealer with it
    - ▶ Holding company used its liquid assets to guarantee the obligations of its subsidiaries to their clearing banks

Holding Company or Subsidiary Leverage (2)?

Lehman Brothers Holdings acted as a "central banker" for Lehman subsidiaries

Source: Bankruptcy Examiners' Report (Valukas, 2010)

▶ Holding company leverage is the economically meaningful one

Conclusion and What We Learn

▶ Primary dealers' capital ratio has strong explanatory power across financial assets, especially sophisticated ones

  ▶ Interestingly, the implied price of risk across different markets lines up reasonably well
  ▶ Supporting evidence that intermediaries (primary dealers) are marginal investors in many financial assets

▶ Sophisticated asset markets might be segmented, but connected through primary dealers with limited capital

  ▶ Contagion effect: Kyle-Xiong (2001), Kondor-Vayanos (2014)

▶ Intriguing heterogeneity among financial intermediaries

  ▶ Primary dealers vs non-primary dealers
  ▶ Broker-dealer arm vs holding company
  ▶ We propose a simple general equilibrium model with heterogeneous leverage patterns

Broker Dealer Liquidity Positions

- During the week of September 8, LBI lost $2.1 billion of liquidity primarily as a result of

  - Lost repo capacity, which resulted in an increase in the box (most of the lost capacity was absorbed with no impact to liquidity to the repo overfunding policy that maintained repo lines in excess of Lehman's funding requirements)

  - Increase in haircut as repo counterparties became less comfortable with non-Government, non-Agency collateral

- During the week of September 8, LBIE lost $11.0 billion primarily as a result of

  - $4.2 billion decrease in operational cash cushion of its prime broker business (although this cushion is meant to protect its prime broker business, it is commingled with and included in LBIE liquidity)

Change in LBI Liquidity During 9/8 Week ($ Billion)	
Secured funding haircut increase	(1.6)
Box increase	(1.5)
Other	(0.3)
Change in 15c3 reserve formula	1.3
Total	(2.1)
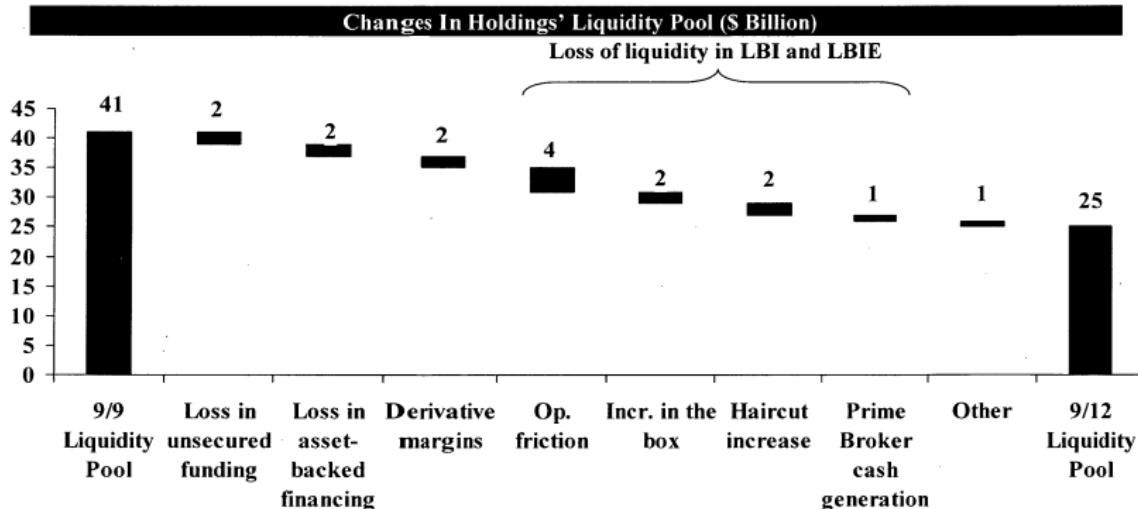
Change in LBIE Liquidity During 9/8 Week ($ Billion)	
Prime Broker	(4.2)
Margin	(0.9)
Secured funding haircut increase	(0.4)
Operational friction & other	(5.5)
Total	(11.0)

Liquidity Situation Post Q3 Earnings Announcement
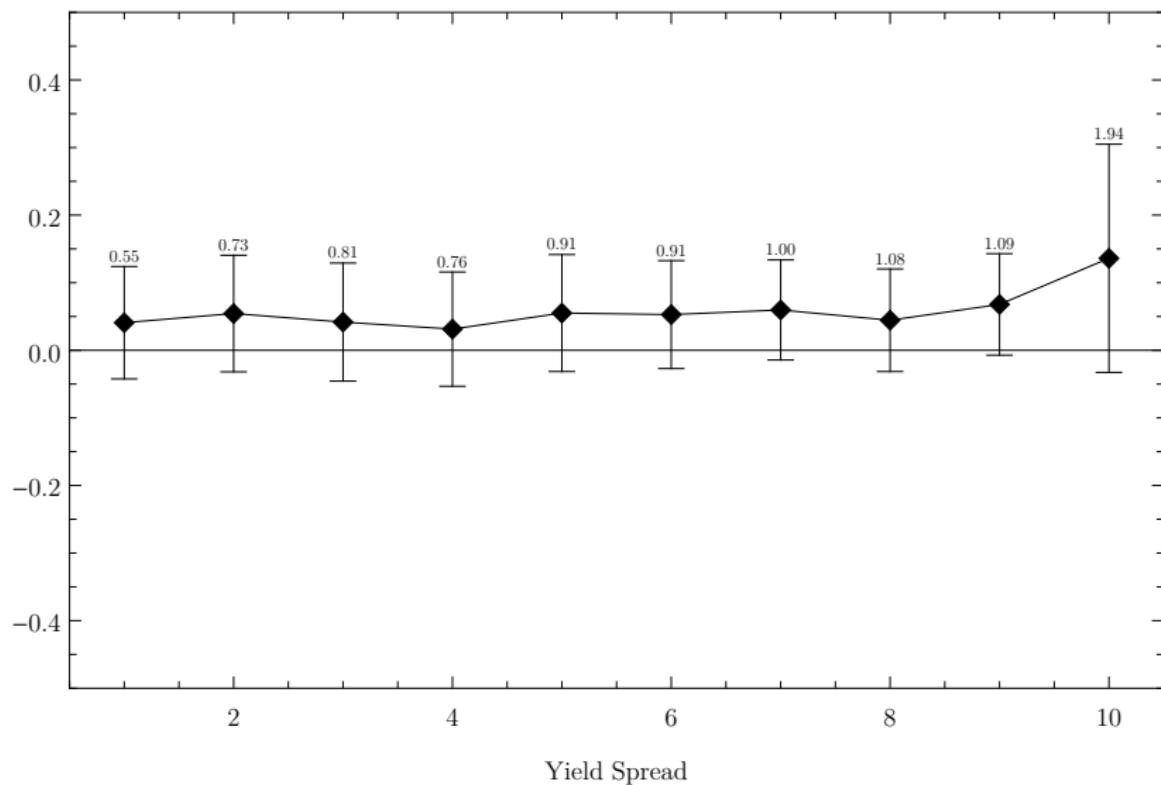
◆ Post earnings announcement on September 9, Holdings' liquidity decreased by $16 billion from $41 billion to $25 billion - $16 billion of which was required by clearing banks at the start of the day and approximately $7 billion of which was in liquid securities that became near impossible to monetize immediately in this extremely stressed market environment – primarily because of a loss of repo capacity.

◆ As a result, the result of "free cash" available intra day was less than $2 billion. With LBIE facing a projected cash shortage of $4.5 billion on September 15, Lehman had no choice but to place LBIE into administration because of potential director liability. This resulted in a cross-default of and triggered the filing on September 15.

Changes In Holdings' Liquidity Pool ($ Billion)

Loss of liquidity in LBI and LBIE

Bar chart values: 9/9 Liquidity Pool = 41; Loss in unsecured funding = 2; Loss in asset-backed financing = 2; Derivative margins = 2; Op. friction = 4; Incr. in the box = 2; Haircut increase = 2; Prime Broker cash generation = 1; Other = 1; 9/12 Liquidity Pool = 25
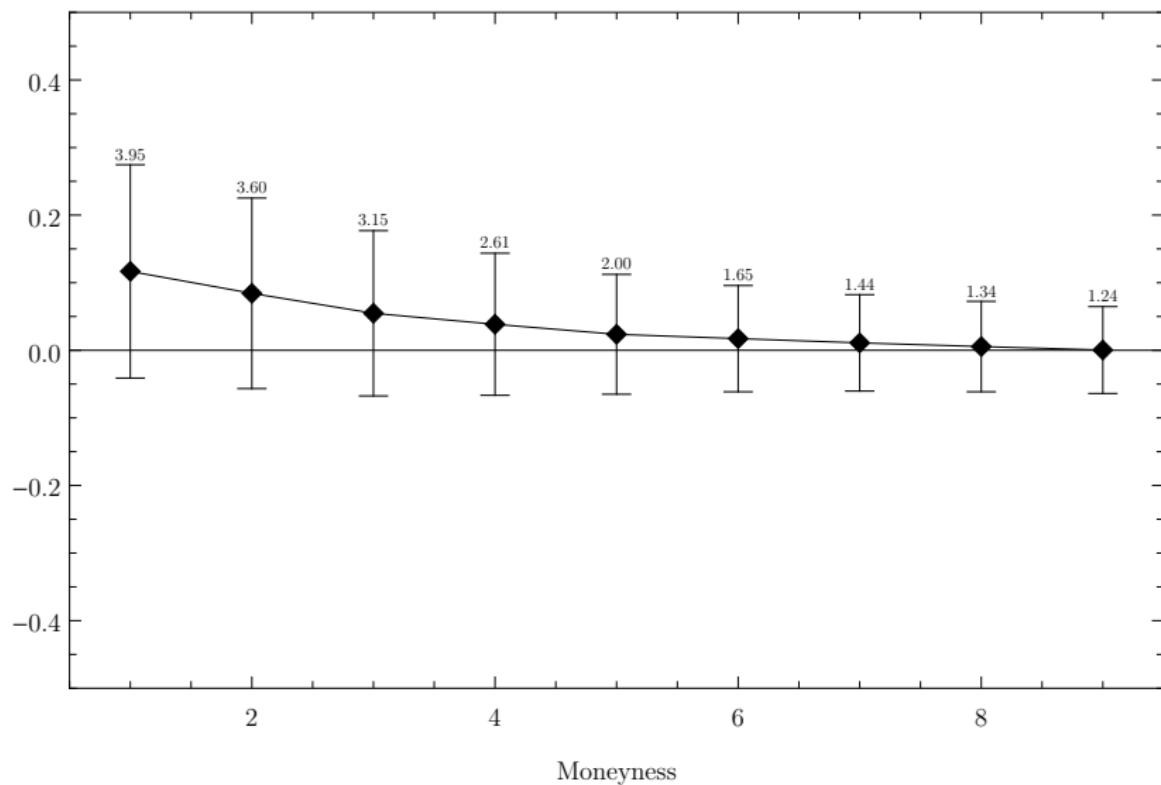
Expected Returns and Betas by Asset Class

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Mean($\mu_i - r_f$)	2.18	0.72	1.97	1.11	0.28	0.37	-1.01	0.82
Std($\mu_i - r_f$)	0.70	0.39	1.13	1.47	0.52	1.70	0.82	1.40
Mean($\beta_{i,\eta}$)	0.07	0.03	0.22	-0.01	0.06	-0.09	-0.08	0.01
Std($\beta_{i,\eta}$)	0.11	0.04	0.14	0.05	0.04	0.10	0.03	0.11
Mean($\beta_{i,W}$)	1.02	0.06	0.09	0.83	0.04	0.27	0.15	0.41
Std($\beta_{i,W}$)	0.30	0.07	0.12	0.11	0.03	0.26	0.04	0.44
Mean(R^2)	0.78	0.09	0.30	0.79	0.63	0.04	0.04	0.42
$p(\chi^2(\beta = 0))$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172
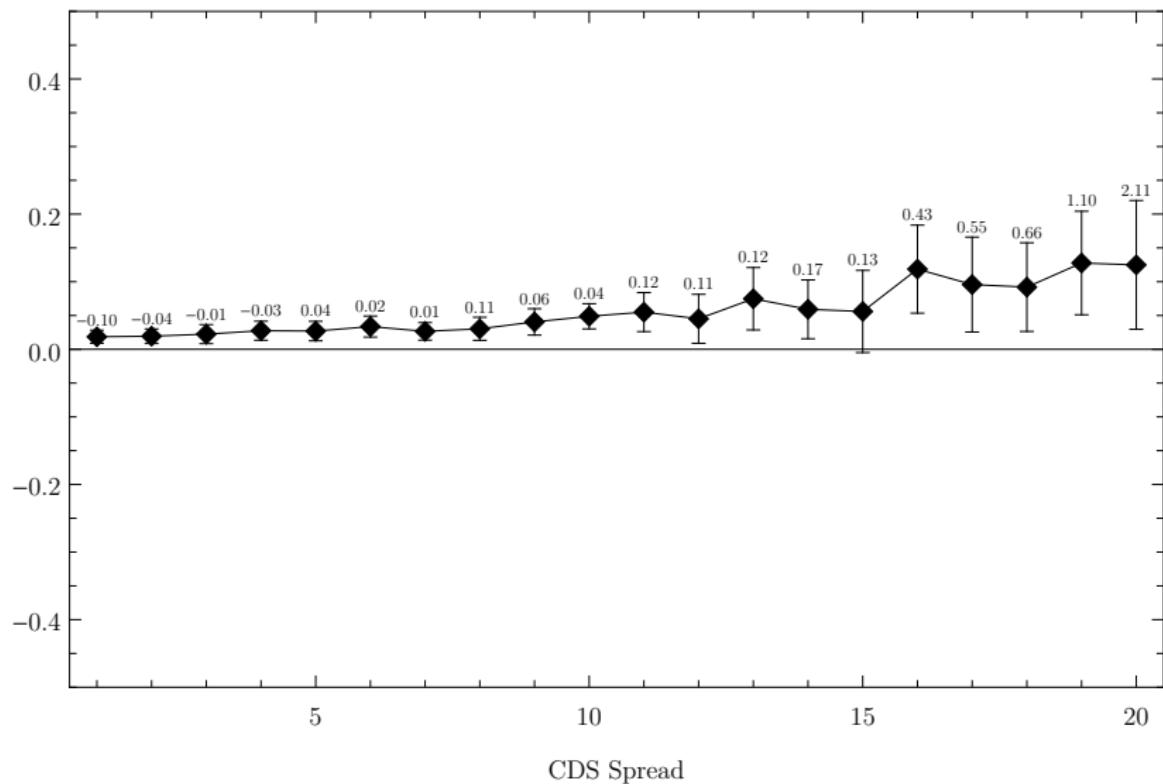
Capital Risk Beta's for US Corporate Bond Portfolios

Yield Spread

Capital Risk Beta's for Put Options Portfolios

Moneyness

Capital Risk Beta's for CDS portfolios

Cross-sectional Tests at the Monthly Frequency

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	1.38	1.30	1.80	22.67	5.51	-0.51	6.85	3.10
	(1.16)	(0.71)	(1.35)	(0.80)	(3.09)	(-0.39)	(3.51)	(2.10)
Market	0.07	1.44	1.75	2.08	-0.14	0.43	3.03	0.78
	(0.17)	(1.71)	(2.16)	(0.74)	(-0.16)	(0.60)	(1.76)	(1.52)
Intercept	0.59	0.12	0.02	-2.26	-0.16	-0.04	-0.34	-0.19
	(1.68)	(4.39)	(0.06)	(-0.77)	(-3.90)	(-0.21)	(-1.30)	(-1.06)
R^2	0.27	0.78	0.71	0.96	0.72	0.04	0.32	0.70
MAPE, %	0.16	0.05	0.17	0.07	0.07	0.40	0.16	0.28
MAPE-R, %	0.17	0.24	0.40	0.37	0.11	0.55	0.17	0.28
RRA	1.92	1.79	2.39	31.15	7.74	-0.71	10.03	4.30
Assets	25	20	6	18	20	23	12	124
Quarters	516	449	196	310	143	316	407	516

Dealer Heterogeneity

- Should we expect to find the same price of risk in each asset class?
- Question of how similar marginal investors. Our setting essentially assumes dealers are homogeneous marginal investors
- Correlation of capital ratios within our intermediary group
  - US vs. foreign: 86% correlation
  - Large primary vs. small primary: 61% correlation
  - Median pairwise correlation among primary dealers: 47%
  - Non-primary dealers vs. primary: 38% correlation