Financial Intermediaries and the Cross-Section of Asset Returns

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May, 2012

[1] The views expressed in this presentation are not necessarily those of the Federal Reserve Bank of New York or the Federal Reserve System.

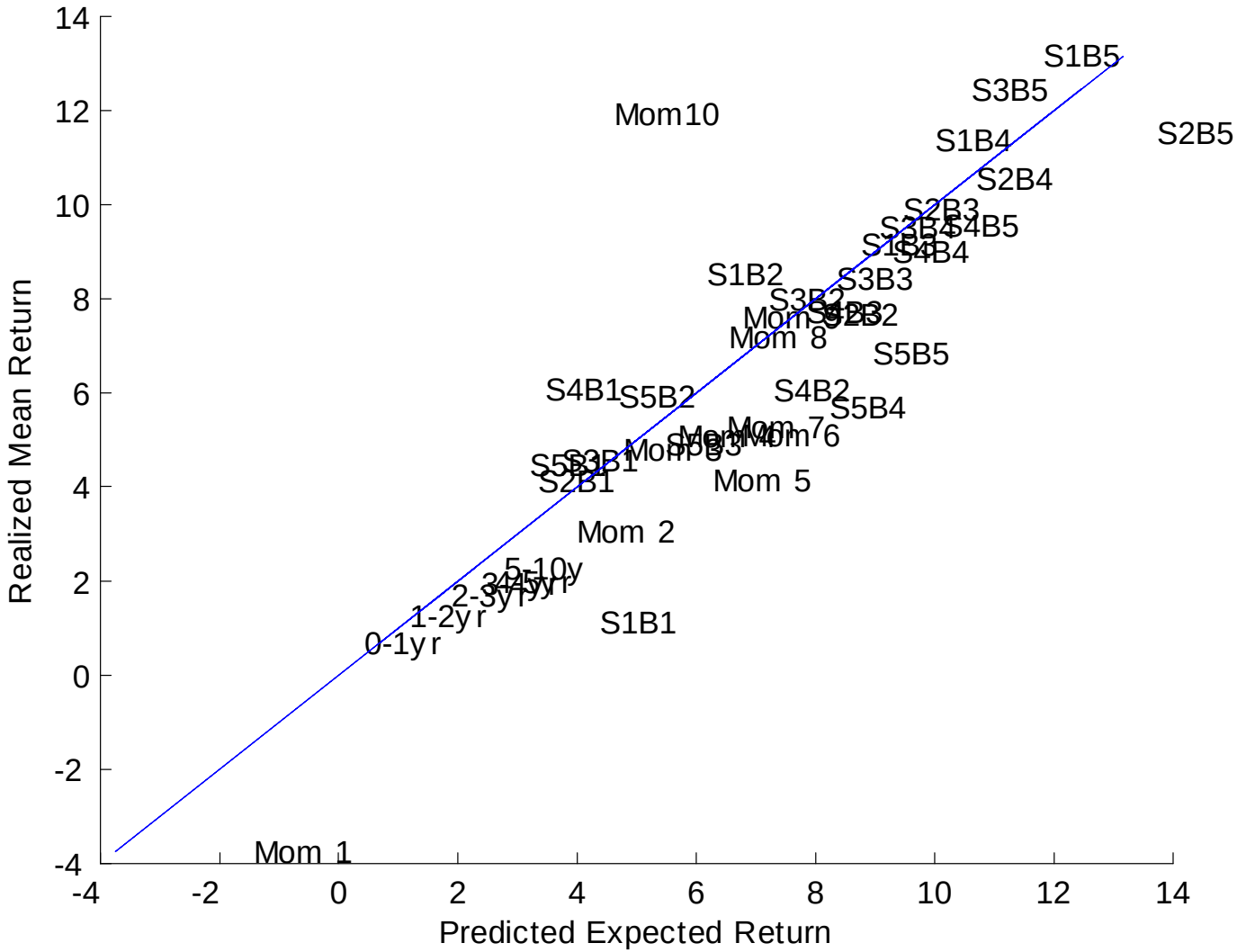
What do we find?

Factor Pricing Model: Cross-Section of Expected Returns

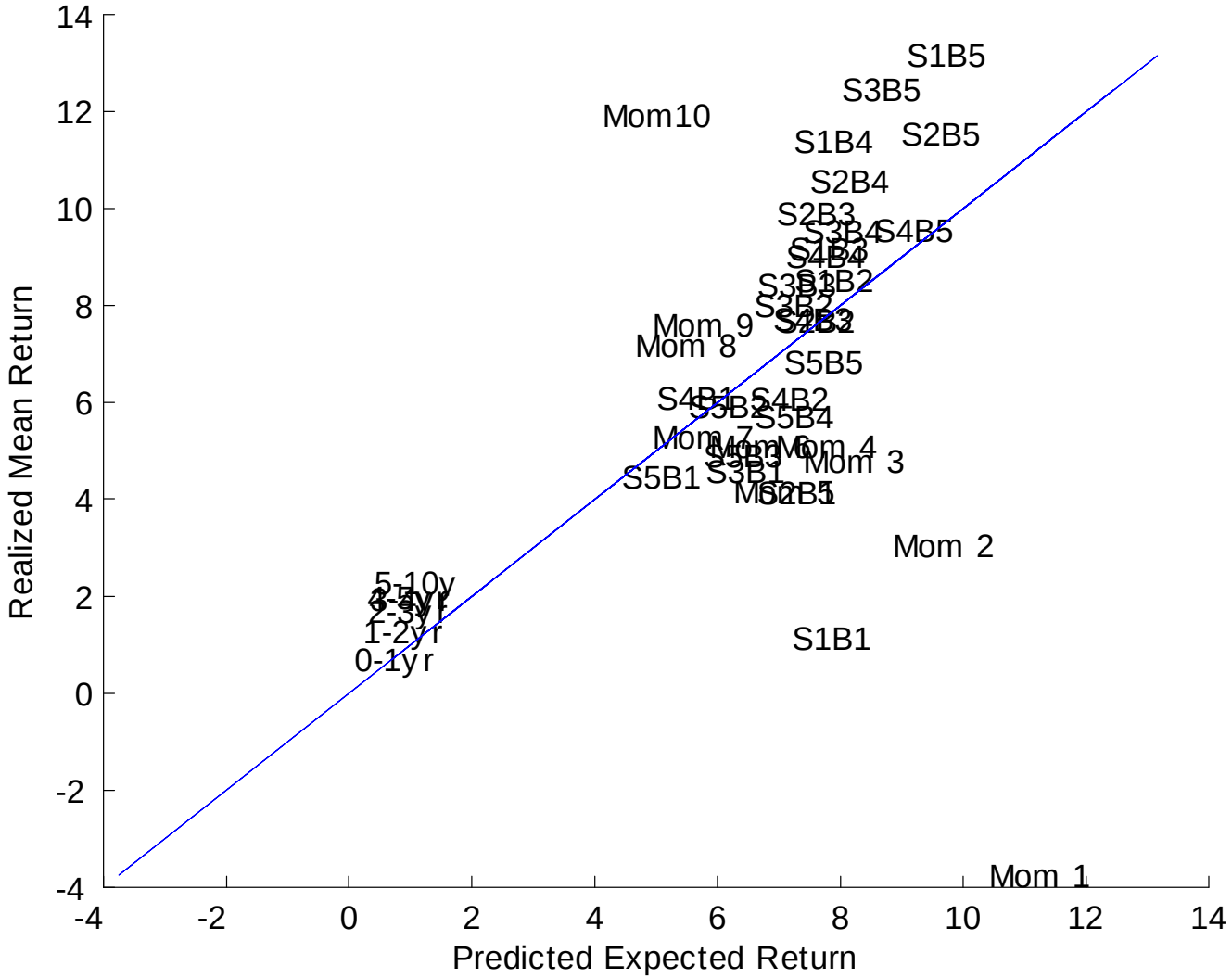
- $E[R^i] - r = \beta_{i,f}\lambda_f = \textit{risk} \times \textit{risk premium}$
- *Single* factor, broker-dealer leverage, explains expected returns across assets
- Factor prices size, book-to-market, momentum, bonds, as well / better than Fama-French + momentum
- Motivation: theories of intermediaries and asset pricing
- De-leveraging measures "bad times" for intermediaries

Single leverage factor and the cross-section of returns

Size & Book-to-Market, Momentum, Bonds, estimated simultaneously



Fama-French Three Factors (Mkt, SMB, HML)



Traditional Asset Pricing:

Prices determined by risk faced by representative household

- Classic theory: SDF is proportional to aggregate consumption risk (CCAPM) or aggregate market risk (CAPM)
- Assumptions: everyone participates in all markets, no transactions costs, agents can compute dynamic portfolio strategies, optimize continuously, know return moments
- But:
  - there is lots of evidence of frictions in trading; market segmentation; inefficient household behavior

This Paper: *Intermediaries* fit classic assumptions

Prices determined by risk faced by representative *intermediary*

- Assumptions about intermediaries: participate in all markets, no transactions costs, can follow dynamic complicated strategy, optimize continuously, know return moments
- Expect focusing on intermediaries will price large class of assets (He and Krishnamurthy (2010))
- Leverage of broker-dealers measures risk faced by intermediary: consistent w/ theory of intermediaries and asset prices

Intermediary Asset Pricing

Leverage of broker-dealers measures risk faced by intermediary: High leverage = good times for intermediary

- Brunnermeier Pedersen (2009)
  - Intermediaries face funding constraints
  - $E_t[R_{t+1}] - R_f = -cov_t(\phi_{t+1}, R_{t+1})$, where ϕ =funding / margin constraint. "Funding liquidity risk."
  - ϕ is inversely related to leverage: High leverage implies low ϕ
  - Leverage measures marginal value of wealth
- Literature: Gromb Vayanos (2002), Brunnermeier Pedersen (2009), Geanakoplos (2010), He and Krishnamurthy (2010), Garleanu Pedersen (2010), Danielson, Shin, Zigrand (2010)

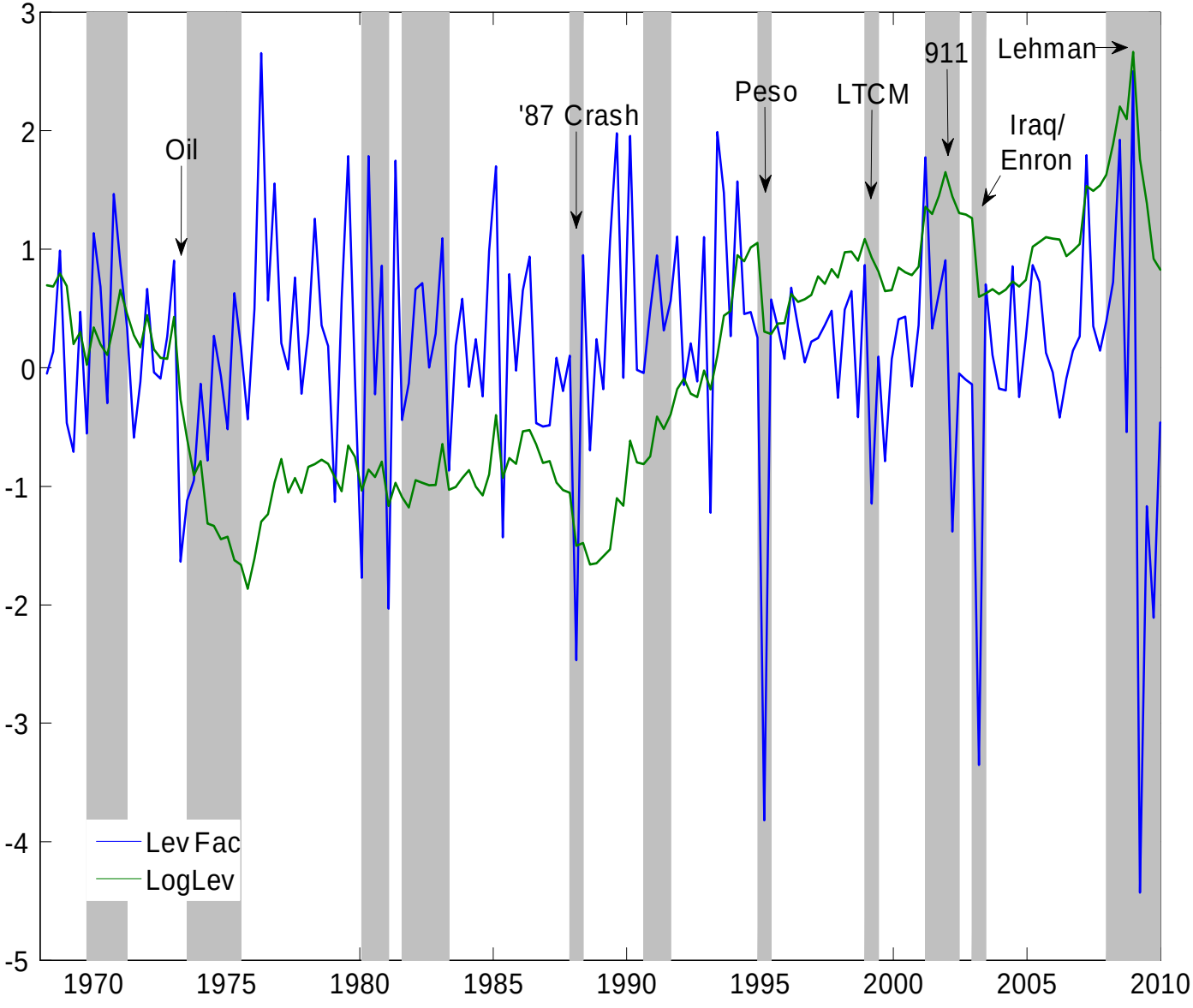
Data (Q1/1968 - Q4/2009)

Flow of Funds (Quarterly)

- Total assets, Total liabilities of U.S. securities broker-dealers
- Lev=(Total Assets)/(Total assets -Total liabilities)

Leverage factor: "shocks" to log leverage (seasonally adjusted)

Broker-Dealer Leverage and Leverage Factor

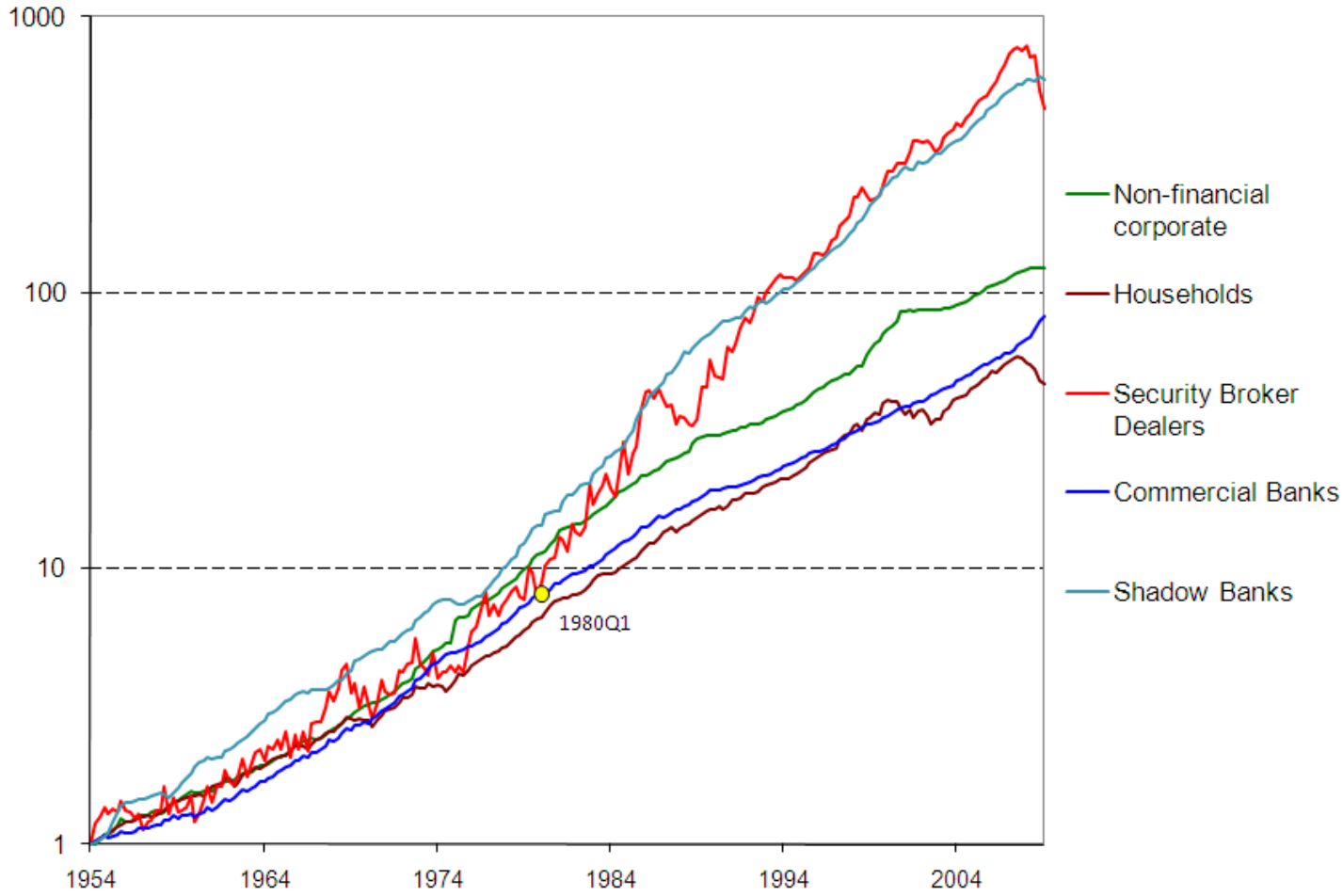


The Flow of Funds

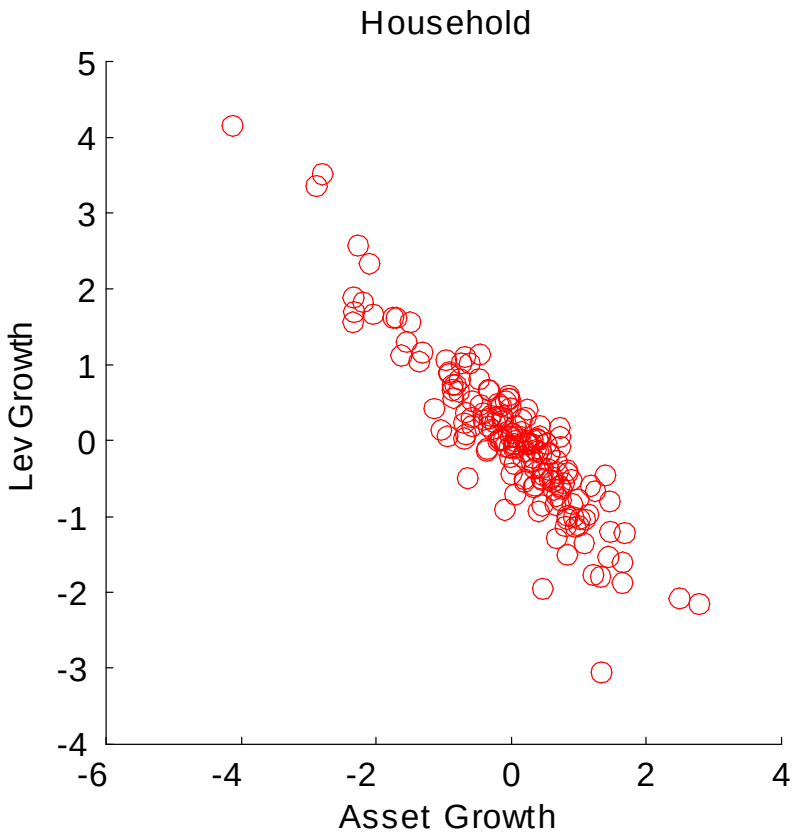
Assets from Flow of Funds (billions)		Liabilities from Flow of Funds (billions)	
Cash (including segregated cash)	$96.9	Net repo	$404.7
Credit market instruments	$557.6	Corporate and foreign bonds	$129.7
Commercial paper	$36.2	Trade payables	$18.1
Treasury securities (net of shorts)	$94.5	Security credit	$936.6
Agencies	$149.8	Taxes payable	$3.6
Municipal securities	$40.0	Miscellaneous liabilities*	$480.7
Corporate and foreign bonds	$185.6	Payables to brokers and dealers	
Other (syndicated loans etc)	$51.4	Securities sold not yet purchased	
Corporate Equities	$117.2	Payables	
Security credit	$278.2	Subordinated liabilities	
Miscellaneous assets*	$1,025.3		
Receivables			
Reverse repos			
Property, furniture, equipment, etc.			
TOTAL	$2,075.1	TOTAL	$1,973.4

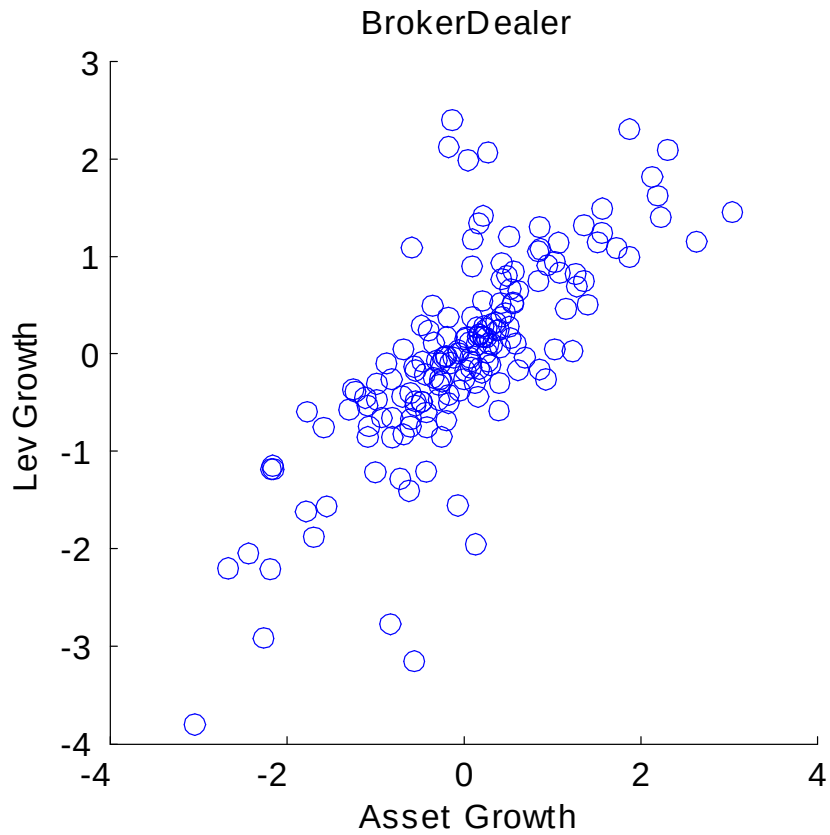
*Sub-categories implicit in FOCUS Reports

Growth of Broker-Dealer Balance Sheets



Procyclical Leverage of Dealers





Correlation of Broker-Dealer Leverage Factor with Aggregate Variables

Correlation of Broker-Dealer Leverage Factor with:				
	Log Broker-Dealer Asset Growth	Market Volatility	Baa-Aaa Spread	Financials Stock Return
ρ	0.73	-0.37	-0.16	0.18
p-value	0.00	0.00	0.03	0.02

Asset Pricing Test

Cross-Section of Expected Returns:

- **Time-series** regression ($\beta_{i,lev}$ exposure to risk):

$$R^e_{i,t} = a_i + \beta_{i,lev} Lev_t + \eta^i_t \qquad t = 1, ..., T, \quad i = 1, .., N$$

- **Cross-sectional** regression (λ_{lev} price of risk):

$$E[R^e_i] = \alpha + \beta_{i,lev}\lambda_{lev} + \epsilon_i, \qquad i = 1, ..., N$$

- **Intuition/Theory**: $\lambda_{lev} > 0$, significant
- **Want**: $\alpha = 0$, R^2 high
- Report the results from the **cross-sectional** regression

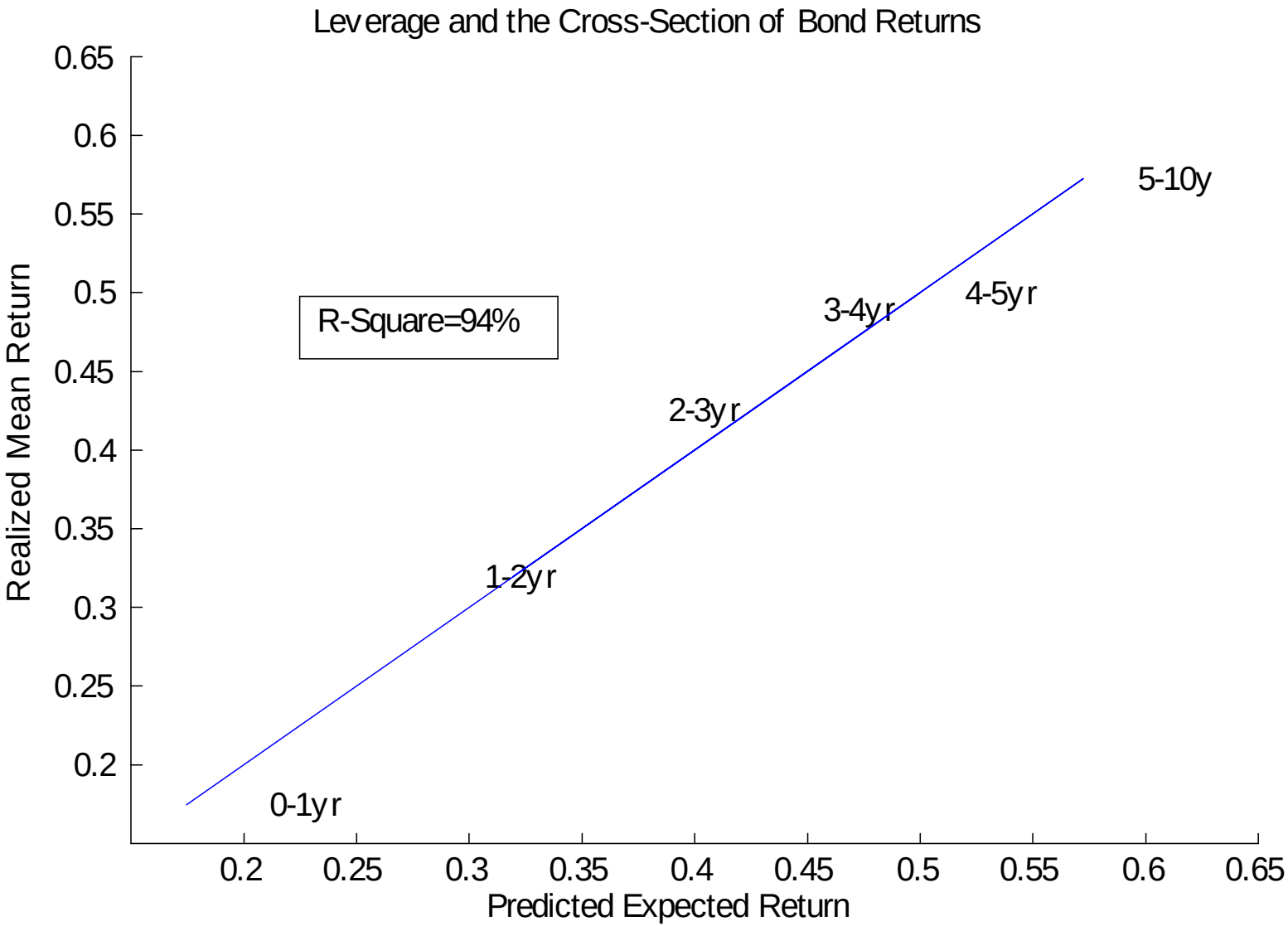
25 Size and Book/Market , 10 Momentum, 6 Treasury Portfolios

Panel A: Prices of Risk					
	CAPM	FF	FF,Mom	FF,Mom,PC1	LevFac
Intercept	3.39	3.16	1.06	0.66	0.12
t-Shanken	3.54	4.03	1.34	1.01	0.04
LevFac					62.21
t-Shanken					3.12
Mkt	3.06	2.30	4.54	4.89	
t-Shanken	0.99	0.80	1.58	1.70	
SMB		1.76	1.57	1.63	
t-Shanken		0.93	0.82	0.86	
HML		3.33	4.37	4.34	
t-Shanken		1.45	1.86	1.85	
MOM			7.82	7.75	
t-Shanken			2.92	2.89	
PC1				14.99	
t-Shanken				0.93	

25 Size and Book/Market , 10 Momentum, 6 Treasury Portfolios

		Panel B: Test Diagnostics				
MAPE	$E[R^E]$	CAPM	FF	FF,Mom	FF,Mom,PC1	LevFac
Size B/M	7.86	2.62	1.81	1.05	1.01	1.16
MOM	5.80	3.05	3.75	1.47	1.48	1.79
Bond	1.65	1.83	1.59	0.17	0.17	0.37
Intercept		3.39	3.16	1.06	0.66	0.12
Total	6.45	6.00	5.41	2.08	1.66	1.31
AdjR2		0.10	0.16	0.81	0.81	0.77
C.I.AdjR2		[0.02, 0.30]	[0.02, 0.36]	[0.74, 0.88]	[0.72, 0.88]	[0.82, 1]
Chi-2		174.48	167.46	111.45	110.19	67.87
P-Value		0.0%	0.0%	0.0%	0.0%	0.3%

Treasury Bonds by Maturity



Robustness Checks:

- We show pricing results for the individual cross sections: 25 size and book-to-market, 25 size and momentum, and Treasury bonds
  - Prices of risk are very stable, pricing better than the benchmark models in each of the cross sections
- The findings are robust to varying the starting date
- Works well excluding financial crisis

Simulation

Randomly draw from leverage factor and attempt to price large cross section of returns
This factor is purely "noise" – should have no power

- Alpha: prob of absolute pricing error as low as we find
- R^2: prob of R^2 as high as we find

	P-value	Number of Occurrences	Replications
Alpha	0.00010	10	100,000
R^2	0.00016	16	100,000
Alpha, R^2 Jointly	0.00001	1	100,000

Leverage Sorted Portfolios

- Rank all CRSP stocks by leverage betas and decile sort.
- Large spread in returns increase mechanically in beta.

Leverage Sorted Portfolios				
	Low	Medium	High	High-Low
$E[R^e]$	4.89	6.20	8.06	3.17
$\sigma[R^e]$	19.86	16.99	21.12	13.75
$E[R^e]/\sigma[R^e]$	0.25	0.37	0.38	0.23
Leverage Beta	3.13	7.71	11.90	8.76

The "Leverage Mimicking Portfolio"

Project factor onto 6 FF Benchmarks & Momentum

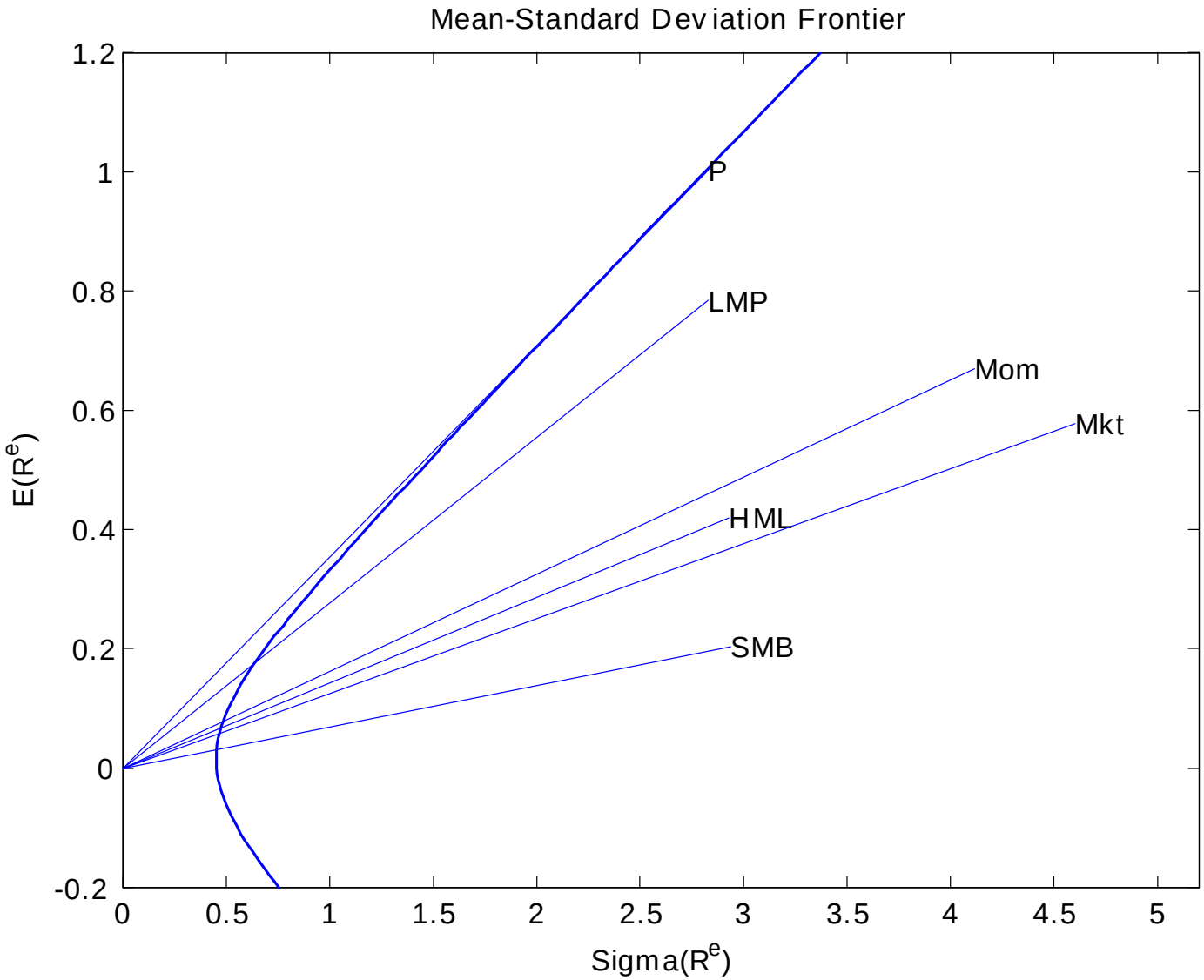
Traded return: allows new tests/insights

Panel A: Time-Series Alphas				
MAPE	Mean	LMP	FF,MOM	FF
SBM	7.86	1.15	1.04	1.57
MOM	5.80	1.66	1.46	4.36
Bond	3.04	0.59	0.93	1.47
Total	6.33	1.19	1.13	2.24

Model Fit	LMP	FF,MOM	FF
GRS	2.57	2.28	4.48
P-value	0	0	0

Mean-Variance Analysis

P=max(Sharpe($\mathbf{a}mkt + \mathbf{b}smb + \mathbf{c}hml + \mathbf{d}mom$))



Mean-Variance Analysis

	$E[R^e]$	$\sigma[R^e]$	Sharpe Ratio	Annualized Sharpe
Market	0.57	4.30	0.13	0.46
SMB	0.15	2.86	0.05	0.18
HML	0.40	2.75	0.15	0.50
Mom	1.32	6.48	0.20	0.70
LMP	1.92	3.23	0.29	0.99
Max Sharpe			0.35	1.20

Betting Against Beta

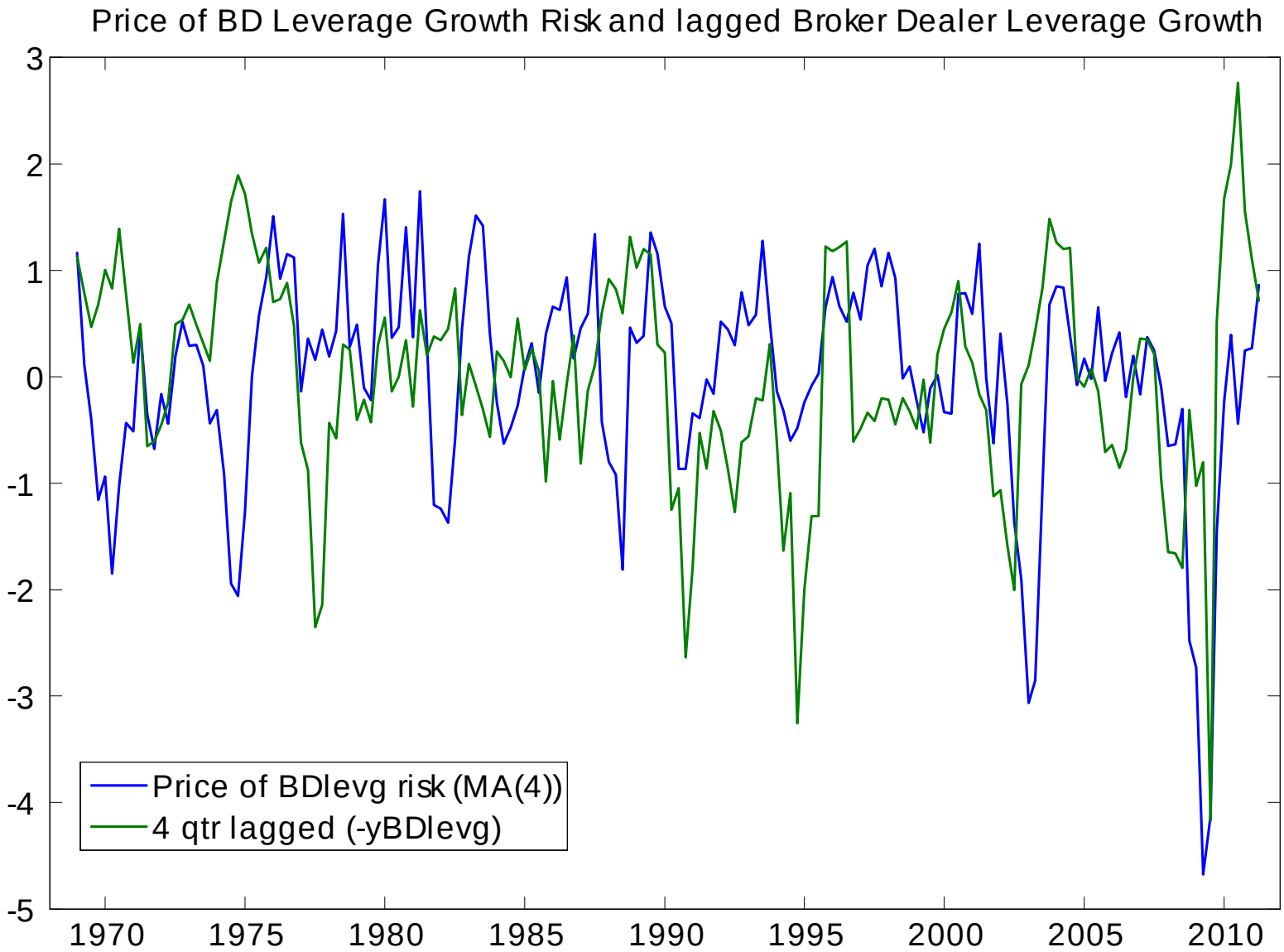
BAB1-10 portfolios sorted by betas, scaled to have unit beta, following Frazzini and Pedersen (2011)

	Time-Series Regressions: $R^e_{i,t} = c_i + \beta_{Lev,i} LevFac_t + \epsilon_{i,t}$				
	$E[R^E]$	Sharpe	Leverage Betas ($x10^{-2}$)	T-stat	R^2
BAB1	10.98	0.46	19.45	2.93	4.90%
BAB2	8.94	0.40	21.71	3.50	6.88%
BAB3	7.29	0.36	16.41	2.91	4.84%
BAB4	6.87	0.35	11.33	2.01	2.38%
BAB5	6.68	0.34	11.67	2.11	2.60%
BAB6	4.67	0.25	12.91	2.41	3.38%
BAB7	5.68	0.30	10.19	1.89	2.10%
BAB8	4.68	0.25	8.90	1.67	1.66%
BAB9	4.29	0.22	3.97	0.72	0.31%
BAB10	3.99	0.20	3.51	0.62	0.23%
1 – 10	6.99	0.36	15.94	2.90	4.82%

Adrian, Moench, Shin (2010): Dynamic Asset Pricing

	λ_0	yBDlevg	qSBag	CAY	dy	CP	W_{Λ_1}	R^2_{xs}
BD Leverage Growth								
yBDlevg	27.78							0.59
	(7.12)							
Intermediary Model								
yBDlevg	31.60	-0.58	-0.15				28.64	0.59
	(6.38)	(-5.31)	(-0.63)				(0.00)	
Benchmark Factor Model								
yBDlevg	29.82			15.69	10.24	-10.83	37.82	0.62
	(7.54)			(5.33)	(3.88)	(-3.57)	(0.00)	
Combined Model								
yBDlevg	32.37	-0.71	-6.64	21.84	7.91	-10.23	57.94	0.62
	(7.87)	(-6.16)	(-2.50)	(6.49)	(3.07)	(-3.42)	(0.00)	

Adrian, Moench, Shin (2010): Broker-Dealer Leverage and Fama-MacBeth Price of Risk



Conclusion

A single factor, broker-dealer leverage, can explain a large set of asset returns

- *Single* factor competes with leading 4 factor equity pricing model and bond pricing model
- *Economically* meaningful: measures intermediary risk
- Think about risks faced by intermediaries for asset pricing. Lot more to do here!