Size is not Everything

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Effects of Too-Big-To-Fail

- Comptroller of Currency Sep 1984: 11 largest BHCs TBTF

- Pure externality: distribution from households to largest firms
  - Largest firms have lower funding costs (Basset (2014); Santos (2014)) or lower sensitivity to risk (Acharya, Anginer, Warburton 2016)

- Internalized in market prices: distribution from smaller firms to largest firms
  - Risk-adjusted returns of TBTF firms are low in normal times in anticipation of bailouts (Gandhi and Lustig (2015), Kelly, Lustig and Van Nieuwerburgh (2016))
  - Kelly et al (2016): out-of-money index put options on bank stocks were relatively cheap in crisis
  - Gandhi, Lustig and Plazzi (2016): increase in small bank returns, wrt large banks, forecast lower GDP and stock returns
  - Acquirer stocks appreciate if merger puts combined firm above a certain threshold (Kane, 2000 and Brewer and Jagtiani, 2013)

Factor Pricing Approach

- TBTF factors using equity returns: based on size threshold, interconnectedness, complexity, leverage, liquidity
- Do stock returns load on TBTF factors in time series of equity returns?
- Are factors priced in cross-section of equity returns?
- Advantages of asset pricing approach:
  - Quantify TBTF discount/premium to cost of capital
  - Whether TBTF risk is priced
  - Easy to implement for broad cross-section of countries and asset classes

Outline

- Construct size threshold (SIFI) factor using large firm returns above and below SIFI threshold

- Fama-Macbeth regressions
  - SIFI subsidy (tax) for TBTF (non-TBTF) firms

- Relate SIFI loadings to systemic risk:
  - Most SIFI subsidies accrue to large financial firms
  - SIFI loadings relate to probability of government support
  - Change in SIFI loadings around TBTF events
  - SIFI loadings in normal times predict systemic risk in crisis

- Factors related to interconnectedness, complexity, leverage, liquidity

Methodology: SIFI (Size Threshold) Factor

- Start with DFA cutoff for SIFI designation of $50B BVA
  - Equal to 92 percentile of distribution of BVE in 2010
  - Use 92 percentile of MVE as threshold
  - Robust to alternative cut-offs from 3% ($300B BVA in 2010) to 10% and using BVE

- SIFI factor construction: similar to SMB (Fama-French 1993)
  - Long-short portfolio accounting for book-to-market (BM)
  - Differences:
    - Size groups 8% and 8-16% instead of above and below median of market cap
    - Use only financial firms

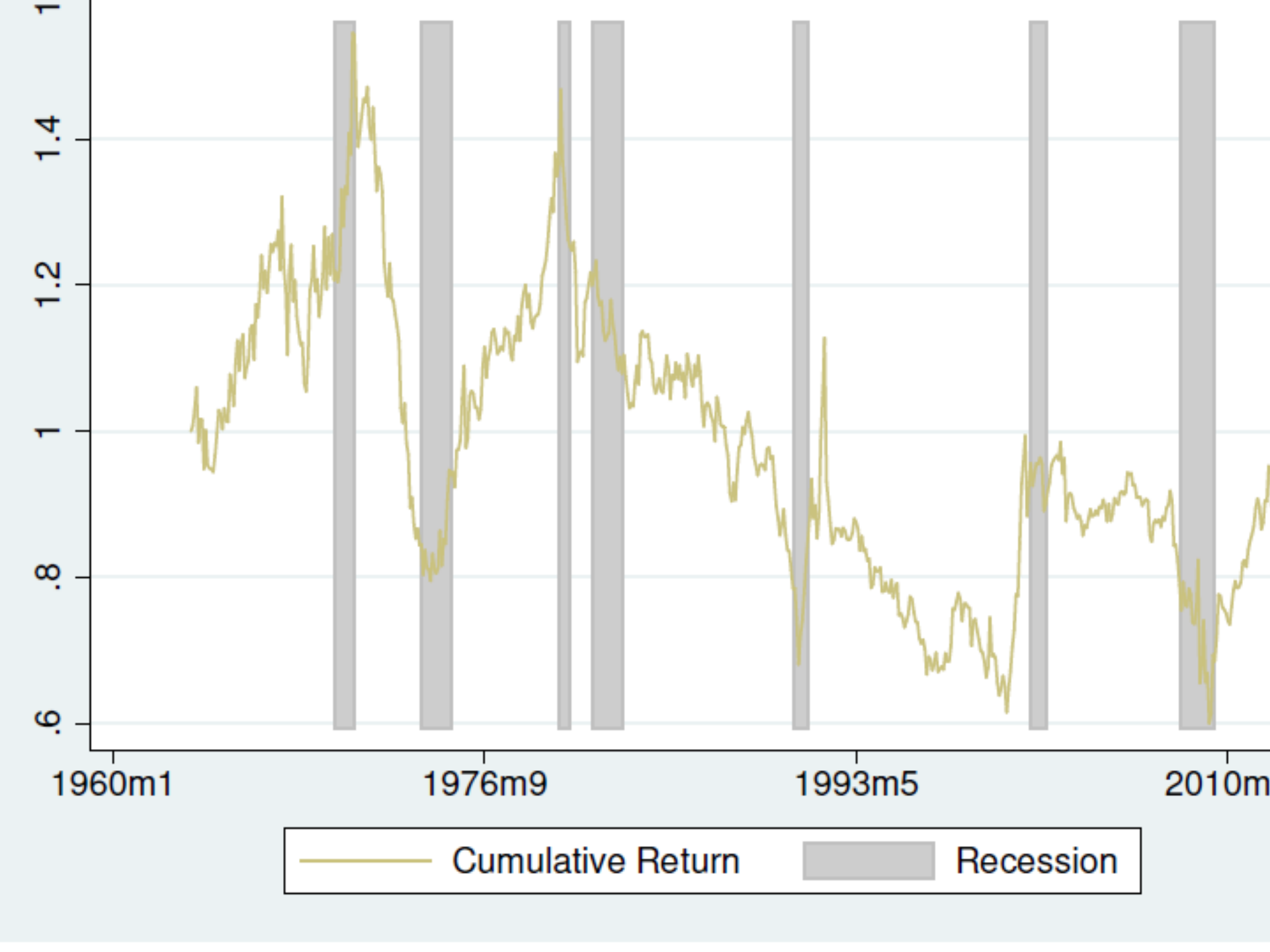
- Orthogonalize SMB by limiting to firms in bottom 84% of firms

Other Factors and Test Portfolios

- FF 5 factor model: Mktrf, HML, SMB, PROFIT, INV
- Carhart momentum factor MOM
- Bond market excess return factors: CORP, GOV

- Gandhi and Lustig bank-size factor: GL
  - Construct portfolios using authors' code
  - Apply weight in Gandhi and Lustig (2014)

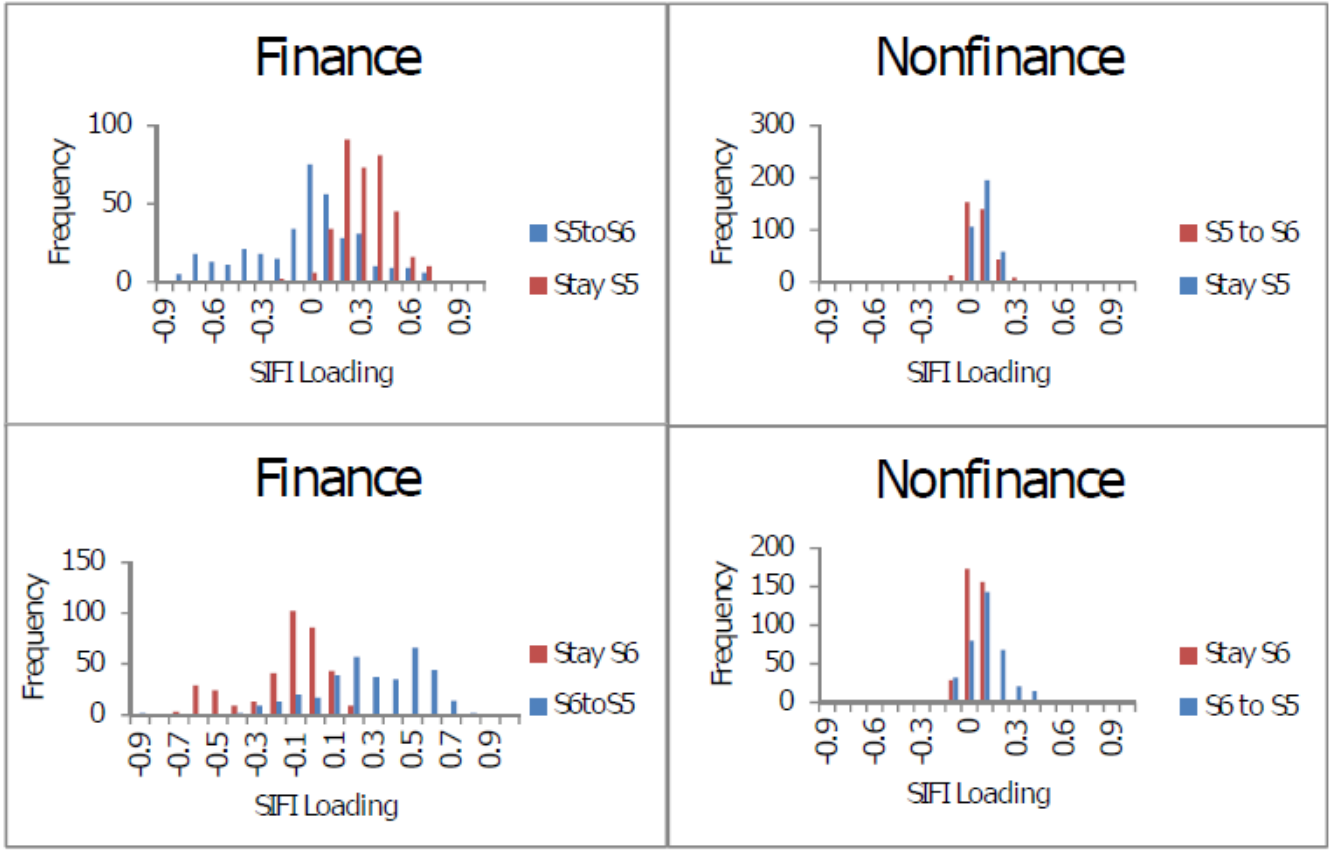
- 30 test portfolios:
  - Largest decile portfolio split into two, to better capture threshold effect
  - Sector portfolios: sub-sectors of finance


1.4
1.2
1
.8
.6
1960m1
1976m9
1993m5
2010m
Cumulative Return
Recession

SIFI Loadings for Financial and Nonfinancial Firms

	Low	2	3	4	High
Panel A: Financial Test Portfolios					
Smallest	-.07	.22***	-.04	.09	.06
2	-.08	.12	.14**	.11**	.11
3	.14*	.11	.17**	.14**	.18
4	.07	.17**	.13**	.11	.04
5	.15*	.38***	.27***	.35***	.48***
Largest	-.31***	-.32***	-.23***	-.33**	-.51***
Panel B: Non-Financial Test Portfolios					
Smallest	.02	.08***	.1***	.09***	.05**
2	.11***	.13***	.13***	.1***	.07**
3	.06*	.1***	.08***	.12***	.1***
4	.05*	.08***	.09***	.07**	.14***
5	.04*	.08***	.08***	.08***	.03
Largest	-.04**	-.03	-.1**	.04	-.07

SIFI Loadings: Transitions Between Two Largest Size Deciles



This figure shows histograms of estimates of loadings on the $SIFI$ factor for firms that remained in the largest 10% size bin S6 and the second-largest 10% size bin S5 (denoted "stay S6" and "stay S5", respectively) and firms that switched between S5 and S6 ("S6 to S5" and "S5 to S6") in consecutive 5-year periods. The size bins are formed every 5 years corresponding to the 20th, 40th, 60th, 80th, and 90th percentiles. The loadings are calculated each month using 60 month rolling regressions of

SIFI Tax/Subsidy for Financial and Nonfinancial Firms

	Low	2	3	4	High	Average
Panel A: Average Annual premium and discount (%), Finance Portfolios						
Smallest	0	0.1	0	0	0	0.02
2	0	0	0.06	0.05	0	0.02
3	0.06	0	0.08	0.06	0	0.04
4	0	0.08	0.06	0	0	0.03
5	0.07	0.17	0.12	0.16	0.22	0.15
Largest	-0.14	-0.14	-0.1	-0.15	-0.23	-0.15
Largest -5	-0.21	-0.32	-0.23	-0.31	-0.45	-0.3
Panel B: Average Annual premium and discount (%), Nonfinance Portfolios						
Smallest	0	0.04	0.05	0.04	0.02	0.03
2	0.05	0.06	0.06	0.05	0.03	0.05
3	0.03	0.05	0.04	0.05	0.05	0.04
4	0.02	0.04	0.04	0.03	0.06	0.04
5	0.02	0.04	0.04	0.04	0	0.03
Largest	-0.02	0	-0.05	0	0	-0.01
Largest -5	-0.04	-0.04	-0.08	-0.04	0	-0.04

Multiply SIFI loadings by average annualized returns on SIFI factor to get subsidy per firm per year

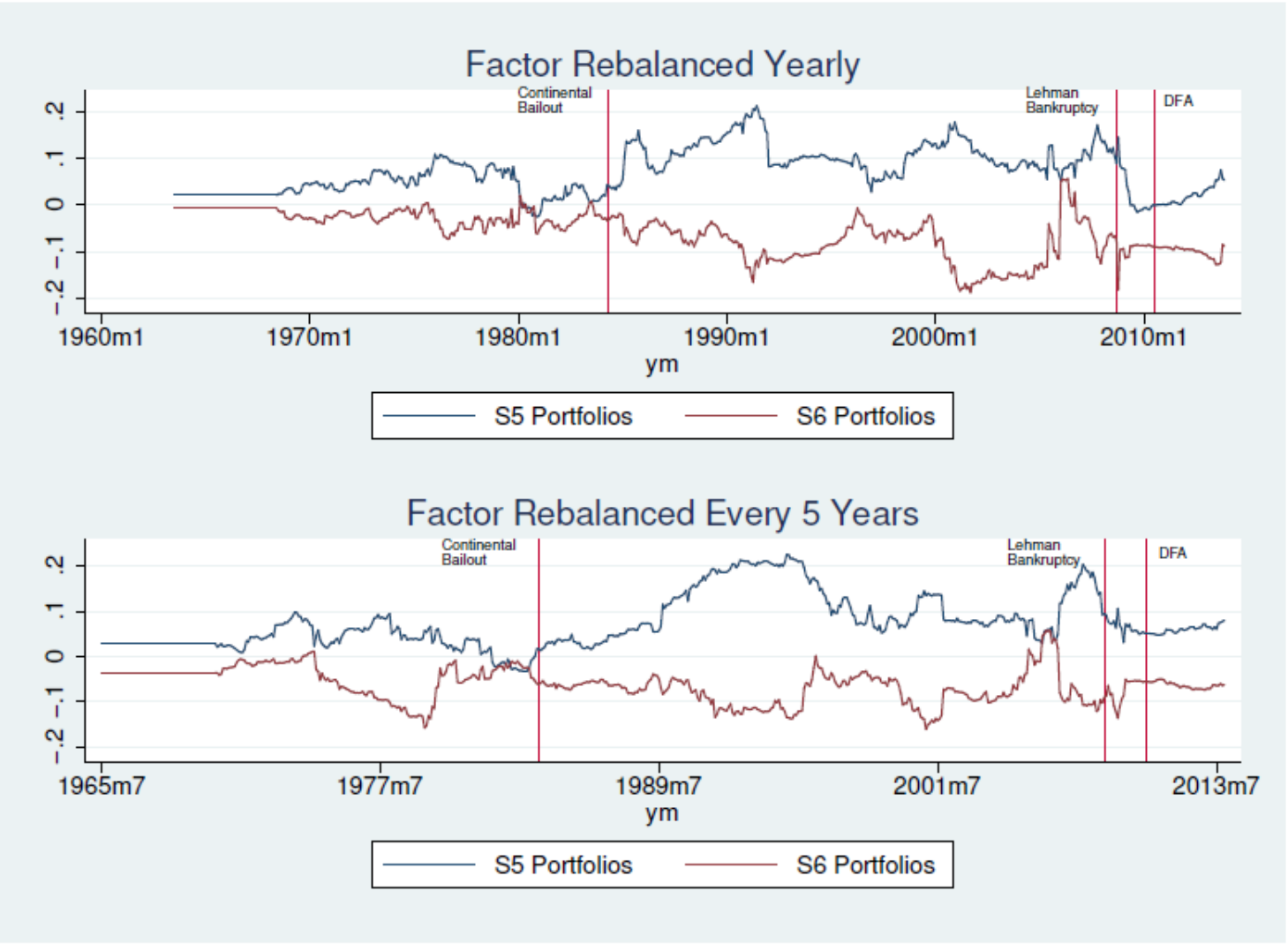
Pricing of SIFI Factor in Cross-Section of Returns

	Cons	SIFI	SMB'	Mktrf	HML	CMA	RMW	MOM
Price of Risk	0.69	1.86						
T-Stat	(3.51)	(3.95)						
Shanken T-Stat	(3.07)	(3.34)						
Price of Risk	0.93	0.82	0.13	-0.44	0.42			
T-Stat	(4.81)	(2.71)	(1.16)	(-1.66)	(2.99)			
Shanken T-Stat	(4.63)	(2.36)	(0.82)	(-1.31)	(2.16)			
Price of Risk	1.07	0.84	0.14	-0.55	0.4	0.4	0.13	
T-Stat	(5.27)	(2.79)	(1.28)	(-1.98)	(2.91)	(3.3)	(1.03)	
Shanken T-Stat	(5.01)	(2.41)	(0.89)	(-1.57)	(2.07)	(2.54)	(0.79)	
Price of Risk	1.06	0.73	0.13	-0.5	0.4	0.37	0.14	0.32
T-Stat	(5.28)	(2.5)	(1.21)	(-1.79)	(2.94)	(3)	(1.04)	(1.21)
Shanken T-Stat	(5.06)	(2.15)	(0.84)	(-1.43)	(2.1)	(2.34)	(0.8)	(0.98)

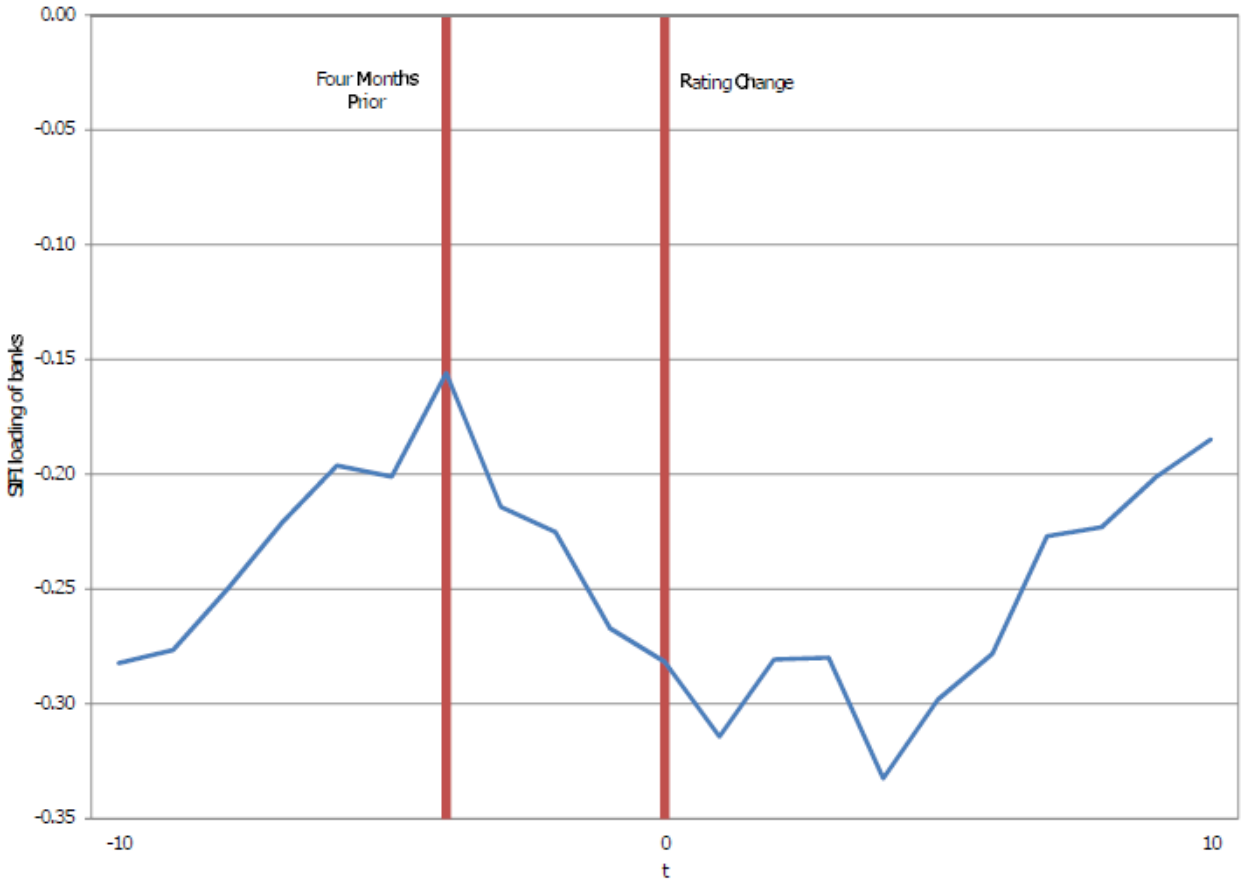
CMA: Conservative (low) minus aggressive (high) investment portfolios
RMW: Robust minus weak profitability portfolios

SIFI Loadings around TBTF Events

Figure 4: Loadings on $SIFI$ from 60 month Rolling Regressions



Government Support Ratings



This figure shows the average SIFI loading of banks leading up to changes in the Fitch Support Floor Rating from below A- to above A- ((indicating a firm with extremely high probability of government support). The first red line is 4 months prior to the rating change, while the second line is the month of the rating change (denoted as 0). The SIFI loadings are estimated from 60-month rolling regressions of excess returns on the $SIFI$ factor, SMB' (the Fama-French factor SMB made orthogonal to

Do SIFI Loadings Predict Systemic Risk in Crisis?

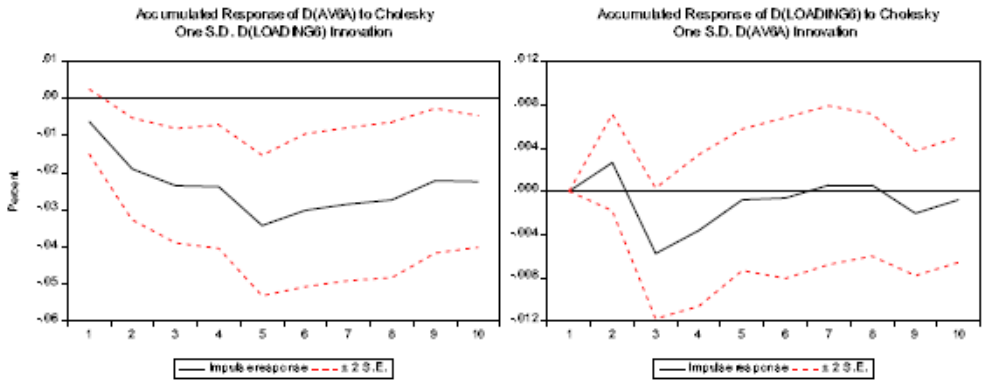
- Systemic risk measures
  - SRISK (Engle and Brownlee, 2012; Acharya et al (2010, 2012)):
    - Expected capital shortage of a firm in case of a systemic event
    - Data available since 2000 for firms exceeding $ 5 billion in market capitalization as of the end of June 2007

  - AV (Duarte and Eisenbach, 2015):
    - Measure of firesale spillovers using
      - monthly triparty repo data
      - quarterly BHC data
    - Extension of Greenwood, Landier and Thomas (2015)
    - Firesale spillover to other firms holding same assets that a firm sells after negative shock to leverage
    - Equal to sum of second round spillover losses as a share of total equity capital in system

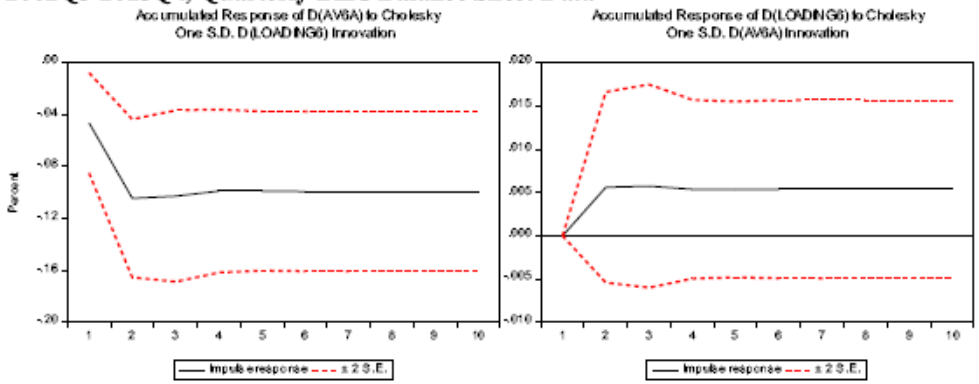
Time Series Predictability: AV

VAR: changes in SIFI loadings and systemic risk measure
: Lagged market cap, leverage and correlation with MSCI World Index returns

Panel A: SIFI Loadings and Firesale Risk of Financial Firms in Largest Size Group: July 2008-November 2013, Monthly Repo Data

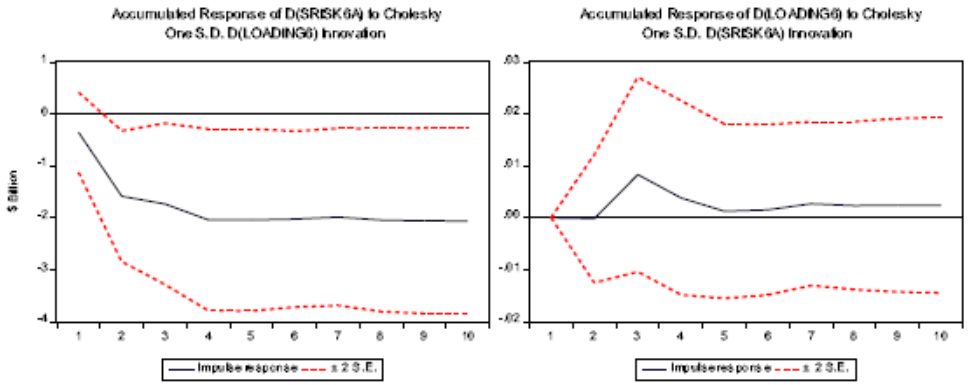


Panel B: SIFI Loadings and Firesale Risk of Financial Firms in Largest Size Group: 2002Q3-2013Q4, Quarterly BHC Balance Sheet Data

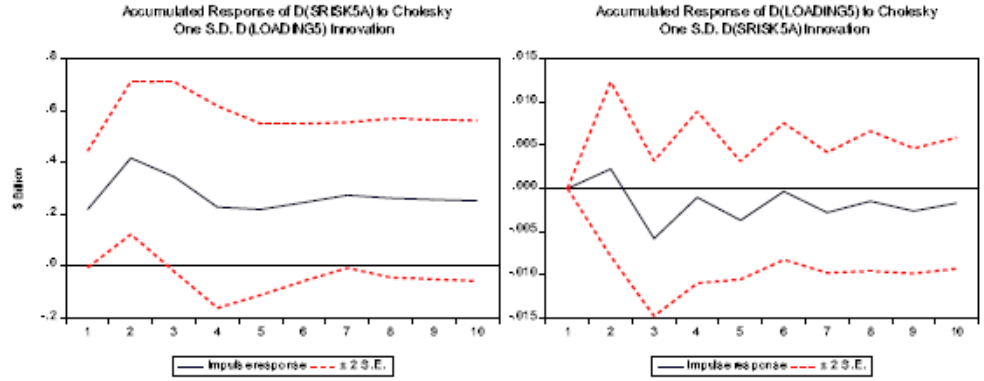


Time Series Predictability: SRISK

Panel A: Financial firms in Largest Size Group: July 2008-November 2013



Panel B: Financial firms in Second Largest Size Group: July 2008-November 2013



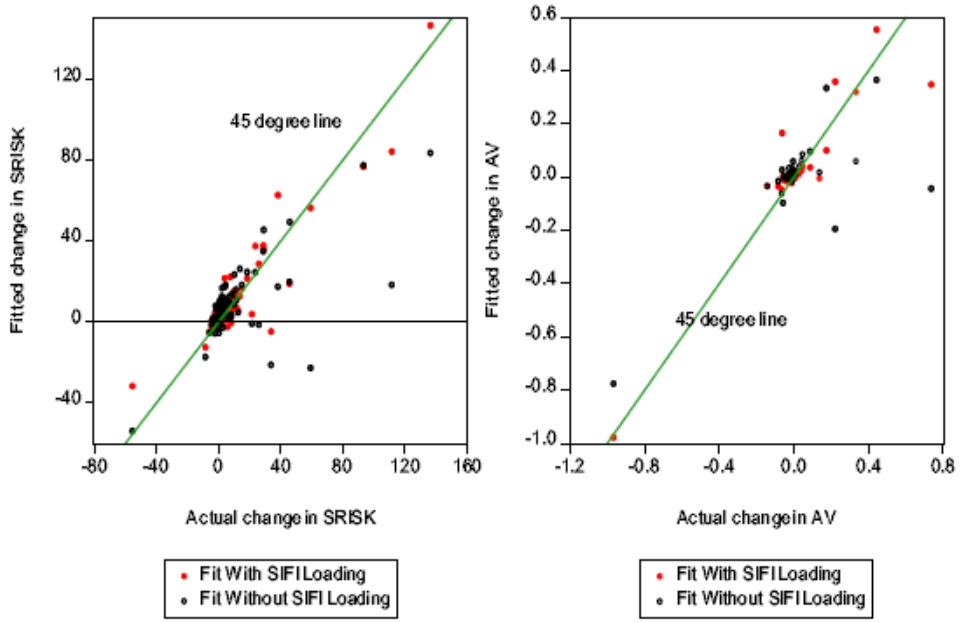
Economic Significance of Time Series Predictability

Systemic risk measure	Estimation Sample	Data frequency	Shock period	Prediction period	% of systemic risk predicted
AV	2002 Q1 - 2013 Q4	Quarterly	2007 Q3	2007 Q3 - 2007 Q4	11.52
AV	July 2008 - November 2013	Monthly	September 2008	September 2008 - January 2009	10.62
SRISK	July 2008 - November 2013	Monthly	September 2008	September 2008 - January 2009	21.04

Cross-Sectional Predictive Regressions

	Estimate (T-stat)	Estimate (T-stat)	Estimate (T-stat)	Estimate (T-stat)	Estimate (T-stat)	Estimate (T-stat)
$SIFI_{Pre-2007} * S5_{Pre-2007}$	13.44*	—	—	—	—	—
	(1.81)	—	—	—	—	—
$SIFI_{Pre-2007} * S6_{Pre-2007}$	-57.47***	—	—	—	—	—
	(-3.15)	—	—	—	—	—
$S6_{Pre-2007}$	26.55***	14.70	—	7.26	5.23	7.31
	(3.83)	(1.12)	—	(0.97)	(0.84)	(0.98)
$SIFIM_{Pre-2007} * S6_{Pre-2007}$		-86.58**	—	-83.88***	-82.81***	-83.70***
		(-2.61)	—	(-5.19)	(-4.66)	(-5.16)
$SIFIP_{Pre-2007} * S6_{Pre-2007}$		-15.54	—	3.48	6.89	3.99
		(-0.59)	—	(0.17)	(0.37)	(0.19)
$SIFIM_{Pre-2007} * S5_{Pre-2007}$		8.31	—	-6.17	-7.35	-6.05
		(0.93)	—	(-0.79)	(-1.11)	(-0.77)
$SIFIP_{Pre-2007} * S5_{Pre-2007}$		5.04	—	3.35	3.22	3.48
		(1.13)	—	(1.26)	(1.29)	(1.36)
$\Delta MarketCap$		—	-0.53**	-0.49***	-0.46***	-0.49***
		—	(-2.58)	(-5.75)	(-3.95)	(-5.78)
$\Delta Leverage$		—	0.44***	0.19**	0.22**	0.18*
		—	(2.88)	(1.99)	(2.53)	(1.91)
$\Delta Correlation$		—	-41.97**	-4.37	-7.00	-4.46
		—	(-2.16)	(-0.60)	(-0.95)	(-0.60)
$\Delta MarketCap^2$	—	—	—	—	0.00	0.14
	—	—	—	—	(0.60)	(0.38)
$SMB_{PreCrisis}$	—	—	—	—	—	—
	—	—	—	—	—	—
$GL_{PreCrisis}$	—	—	—	—	—	-1.77
	—	—	—	—	—	(-1.04)
Intercept	0.77***	0.94***	8.17***	1.14	1.32	0.82
	(2.66)	(2.97)	(2.99)	(1.20)	(1.36)	(0.79)
Adjusted R-squared	0.56	0.60	0.47	0.87	0.87	0.87
Root MSE	13.18	12.41	13.98	7.04	6.96	7.03

AV and SRISK: Cross-Section Predictability



Additional TBTF Factors

- Additional TBTF factors (factor-mimicking portfolios):
  - Interconnectedness: principal component measure (Billio, Getmansky, Lo and Pelizzon (2012))
  - Complexity: number of subsidiaries of BHCs (Cetorelli, Jacobides, Stern (2017))
  - Leverage: He, Kelly and Manela (2016); Adrian, Etula and Muir (2014)
  - Liquidity: Amihud and turnover
- Leverage: returns load significantly in TS regressions
- Different from SIFI:
  - No threshold effect
  - No predictability

Conclusions

- SIFI factor: excess returns of 8-16% of financial firms minus largest 8% of financial firms
  - Has countercyclical variation, as predicted by theory
- Largest 10% of firms load negatively (SIFI subsidy>$5.5M p. year p. firm before 2007)
- Remaining 90% of firms load positively (SIFI tax)
- SIFI is priced in the cross-section of stocks
- SIFI loadings related to systemic risk:
  - Increases after bailout of Continental Illinois
  - Normal period loadings predict systemic risk in crisis
- Results unaffected by including factors related to interconnectedness, complexity, leverage and liquidity

Is Threshold Effect a Risk Factor for Equity Returns?

- May confer advantages to shareholders of largest firms:
  - Ex-ante: if creditors bailed out, then equity may be more valuable
    - Lucas and McDonald (2010): ex-ante value of equity increased by PV of being able to borrow at risk-free rate, if guarantee value accrues to shareholders
    - Acharya, Mehran, Thakor (2013): banks over-leverage in anticipation of bailout, not fully offset by higher debt costs
  - Ex-post: uncertainty how much shareholders might lose

- Empirical evidence:
  - Kelly et al (2016): out-of-money index put options on bank stocks were relatively cheap in crisis
  - Gandhi, Lustig and Plazzi (2016): increase in small bank returns, wrt large banks, forecast lower GDP and stock returns

Results: Pricing of SIFI Factor

- Compared to firms in 8-16% size bin, largest 8% of firms have:
  - Lower expected returns and difference is countercyclical
  - Lower funding costs
  - Higher probability of government support

- Pre-2007: most portfolios load significantly on SIFI factor
  - Largest 10% of firms load negatively: SIFI discount amount to 7 bp per year or about 7.5M per firm per year in 2013 dollars
    - Most accrue to largest financial firms
  - Remaining firms load positively (SIFI premium)

- SIFI priced in the cross-section of stock returns
  - Only if SIFI factor constructed from financial firms

Results: SIFI Factor Relates to Government Support and Systemic Risk

- Loadings related to government support for largest financial firms

- Loadings related to systemic risk:
  - More significant after Continental, less so after Lehman and Dodd Frank
  - Predicts systemic risk during crisis in the cross-section of firms
  - Predicts firesale spillovers in the time-series

Time Series Regressions

- One regression for full sample for each portfolio:

$$R_{it} = \boldsymbol{\alpha} + \beta_1 \boldsymbol{SIFI_{it}} + \beta_2 \boldsymbol{Mkt_{it}} + \beta_3 \boldsymbol{SMB^{/}_{it}} + \beta_4 \boldsymbol{HML_{it}} + \beta_5 \boldsymbol{CMA_{it}} + \beta_6 \boldsymbol{RMW_{it}} + \beta_7 \boldsymbol{MOM_{it}} + \beta_8 \boldsymbol{CORP_{it}} + \beta_9 \boldsymbol{GOV_{it}} + \beta_{10} \boldsymbol{GL_{it}} + \boldsymbol{\varepsilon_{it}}$$

- R_{it}: excess returns of portfolio i in month t

- OLS with Newey-West standard errors

Liquidity and Funding Costs of Largest Firms

	Largest 8 % (1)		Next Largest 8% (2)		Regression (Largest 8%) Dummy	
	Mean	SD	Mean	SD	Coefficient	T-stat
Panel A: Liquidity Measures						
Amihud	30.31	229.75	8.83	79.43	21.15	0.92
Turnover	0.83	1.23	0.93	1.36	-0.05	-0.74
Effective Spread	0.02	0.31	0.01	0.31	0.01	1.7
Panel B: Bond Spreads						
Issue Spread	62.94	67.35	70.21	82.79	-31.8	-3.82

Cross-Sectional Regressions

- One regression for each month:

$$R_{it} = \boldsymbol{\alpha_t} + \gamma_{1t}\beta_{1i} + +\gamma_{2t}\beta_{2i} + \gamma_{3t}\beta_{3i} + +\gamma_{4t}\beta_{4i} + +\gamma_{5t}\beta_{5i} + +\gamma_{6t}\beta_{6i} + \boldsymbol{\mu_{it}}$$

- R_{it}: excess returns of portfolio i in month t
- Report time-series average of α_{it} and γ_{it}
- OLS with Shanken 1992 standard errors

SIFI Loadings Before and After Systemic Events

- Bailout of Continental Illinois May 1984
  - Acknowledged as start of TBTF perception
  - Expect loadings to increase for smaller firms and/or to decrease for the largest size group
  - Loadings on SIFI-NF should not increase

- Lehman
  - Implications are unclear

- Dodd-Frank Act
  - Expect loadings to decrease if perceived to be credible

SIFI Discount and Premium-1

- SIFI discount or premium % = SIFI loading*return on SIFI factor
  =SIFI loading*0.45% per year annualized

- SIFI discount or premium $ = SIFI loading*return on SIFI factor*average market cap of firms in portfolio, in 2013 dollars

Government Support Ratings

- Fitch Support Ratings of A- or higher=extraordinarily high probability of government support
  - Separate from credit ratings

Panel A: Share of Firms that are Banks or have Highest Government Support

	Largest 8 % (1)		Next Largest 8% (2)		Regression (Largest 8%) Dummy	
	Mean	SD	Mean	SD	Coefficient	T-stat
Share of Banks	0.25	0.44	0.24	0.43	0.01	0.21
Ever Rated >= $A-$	0.84	0.37	0.19	0.39	0.62	4.69

Panel B: Estimating Probability of Firms with Highest Government Support

	Coefficient	Standard Error	Tstat	P
MarketCap	2.32	1.21	1.91	0.07
Largest8	0.43	0.18	2.31	0.03
Constant	0.05	0.14	0.34	0.74

Cross-Sectional Predictive Regressions

• Use pre-2007 average SIFI loadings to predict systemic risk of firm i in crisis:

$$\Delta SysRisk_{it} = \boldsymbol{\alpha} + \boldsymbol{\mu_t} + \gamma_1 SIFIplus_{\boldsymbol{pre}} + \gamma_2 SIFIminus_{\boldsymbol{pre}} + \gamma_3 S6_{\boldsymbol{pre}} + \gamma_4 S6_{\boldsymbol{pre}} * SIFIplus_{\boldsymbol{pre}} + \gamma_5 S6_{\boldsymbol{pre}} * SIFIminus_{\boldsymbol{pre}} + \delta \Delta Controls_{i,t} + \boldsymbol{\epsilon_{it}}$$

•$\Delta SysRisk_{it}$: SRISK or AV in post-crisis month t – average SRISK 2000-2006

•$SIFIplus = Max(SIFI_{pre}, 0)$
•$SIFIminus = Min(SIFI_{pre}, 0)$
•S6=1 if in largest size portfolio; 0 otherwise

•Controls= {Mktcap, leverage, volatility, SMB, GL}

•Panel regression: monthly fixed effects; SE clustered at firm level