



NYU STERN SYSTEMIC RISK RANKING

NYU STERN SCHOOL OF BUSINESS

APRIL 2011

THE APPROACH

- We want to estimate for firm i , the expected capital requirements in a future crisis: (e.g. Stress Test)

$$E(\text{Capital Shortfall}_i | \text{Crisis})$$

- As we have little data on crises, it is necessary to carefully structure the problem.
- **Estimate** the expected equity losses for a firm from a modest decline in overall returns, MES
- **Extrapolate** this to a full financial crisis.
- **Calculate** capital shortages.

Equity Loss in Crisis

- To estimate the fall in equity value in a crisis, an adjustment is made to Dynamically-estimated MES (in market outcomes worse than 2% fall) using conditional normality and tail risk possibility
 - MES is adjusted to measure the expected fall in equity prices that would occur in six months if the market return is worse than a 40% decline.
 - Approximately this is 18 times daily MES. The factor 18 is constant across firms and reflects the crisis severity.
 - Crisis MES = 18 times MES
- This is the **extrapolation** step.

SRISK : CAPITAL SHORTFALL IN A CRISIS

- As equity values fall in a crisis, leverage increases until the firm is in distress.
- Nominal debt is taken from Bloomberg and changes little over time. It is from 10-K and 10-Q filings.
- Let $E = E_0 (1 - \text{Crisis MES})$
- $SRISK = \min(0, E - kA) = \min(0, (1-k)E - kD)$ where k is a prudential standard ratio of equity to assets such as 8%. E is equity, D is debt and A is asset value = $E + D$

SRISK%

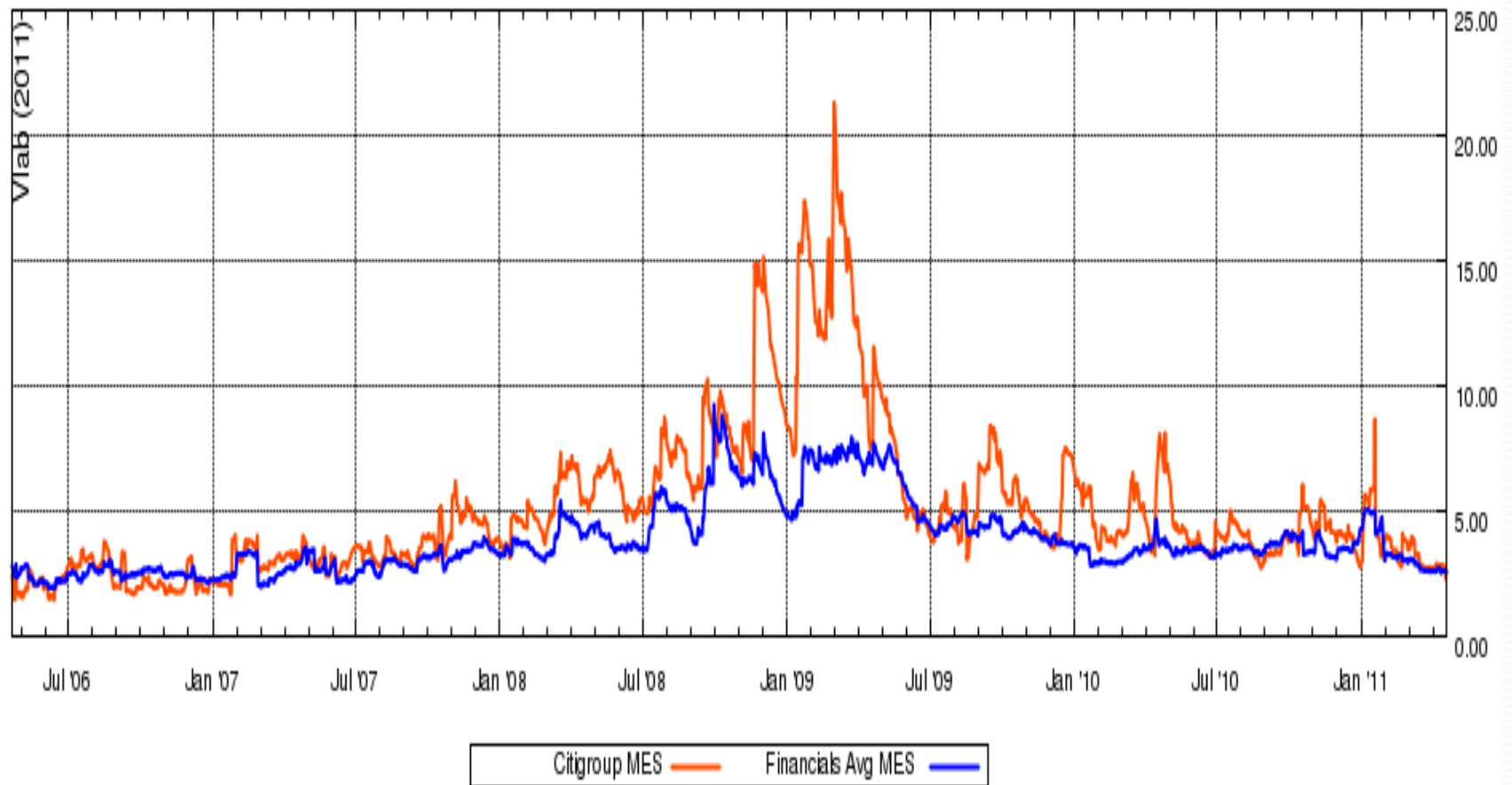
- When equity falls dramatically, CAPITAL SHORTFALL becomes positive and it is the contribution by each firm to aggregate SHORTFALL that is the Stern Systemic Risk measure.
- $SRISK\%_{i,t} = SRISK_{i,t} / (\text{Total } SRISK_t)$
- This is the **calculation** step.
- Alternately, we obtain a systemic capital requirement
- $E_o \geq 8\% \text{ Assets} / (1 - 0.92 \text{ Crisis MES})$
- Equity should be high today to withstand a Crisis



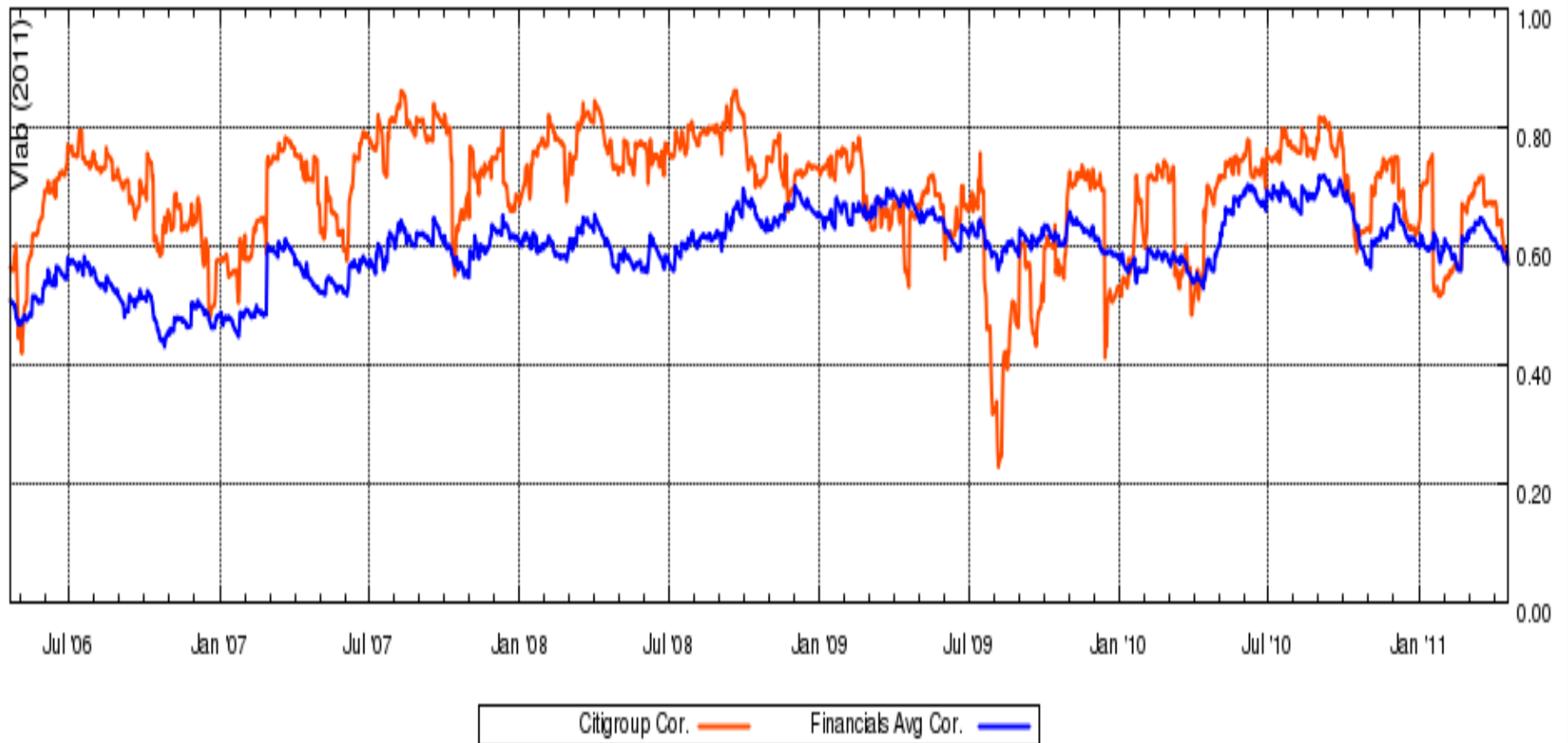
VLAB.STERN.NYU.EDU

- Daily updates of volatilities and correlations of hundreds of assets with a variety of methodologies
- Systemic Risk Measures with details on the components. These are updated weekly.
- How risky is the economy today?
- New measures of Long Term Risk called the LTR Forecasts to assess likelihood of crisis and LT-MES

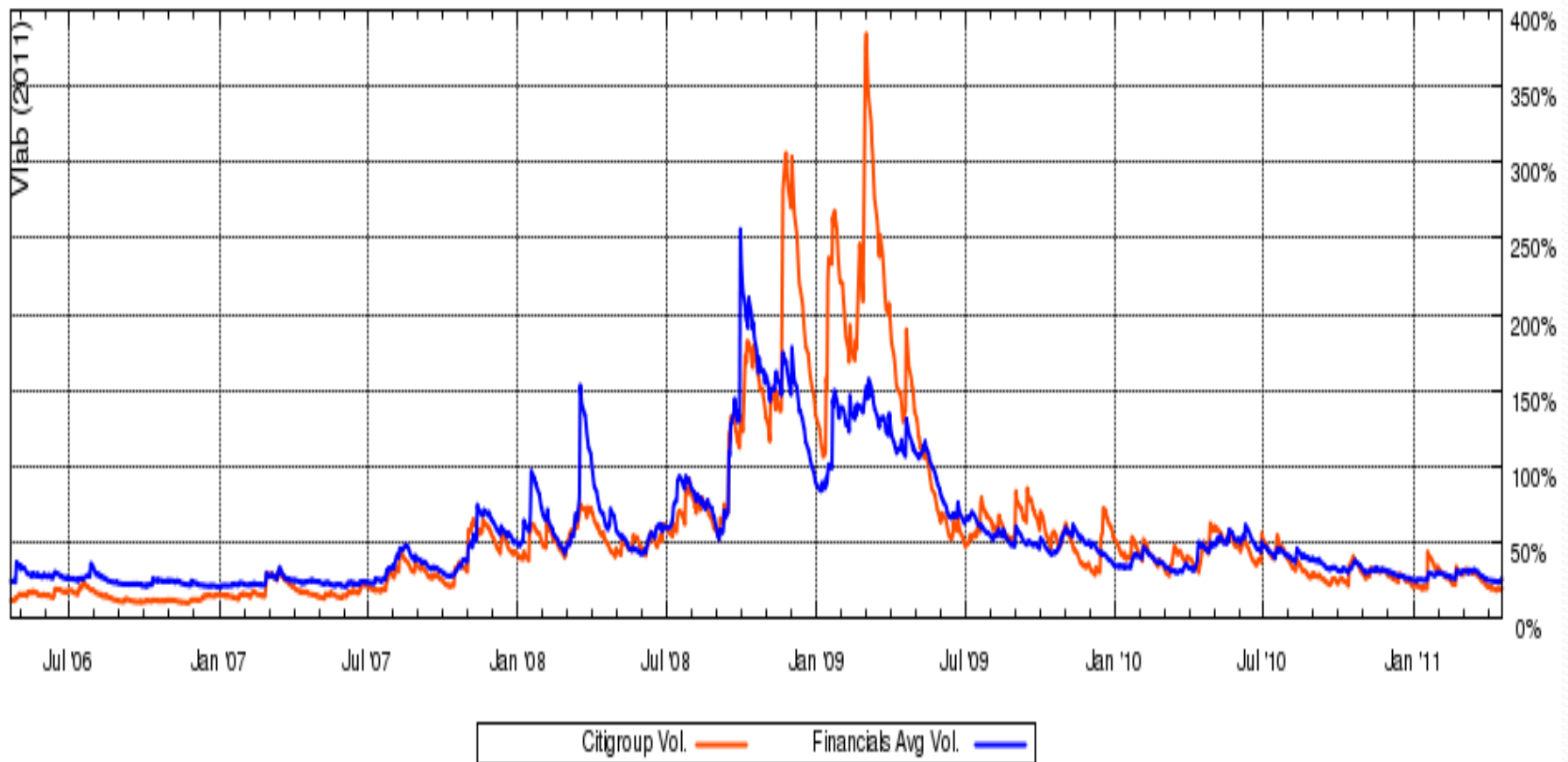
Citigroup MES



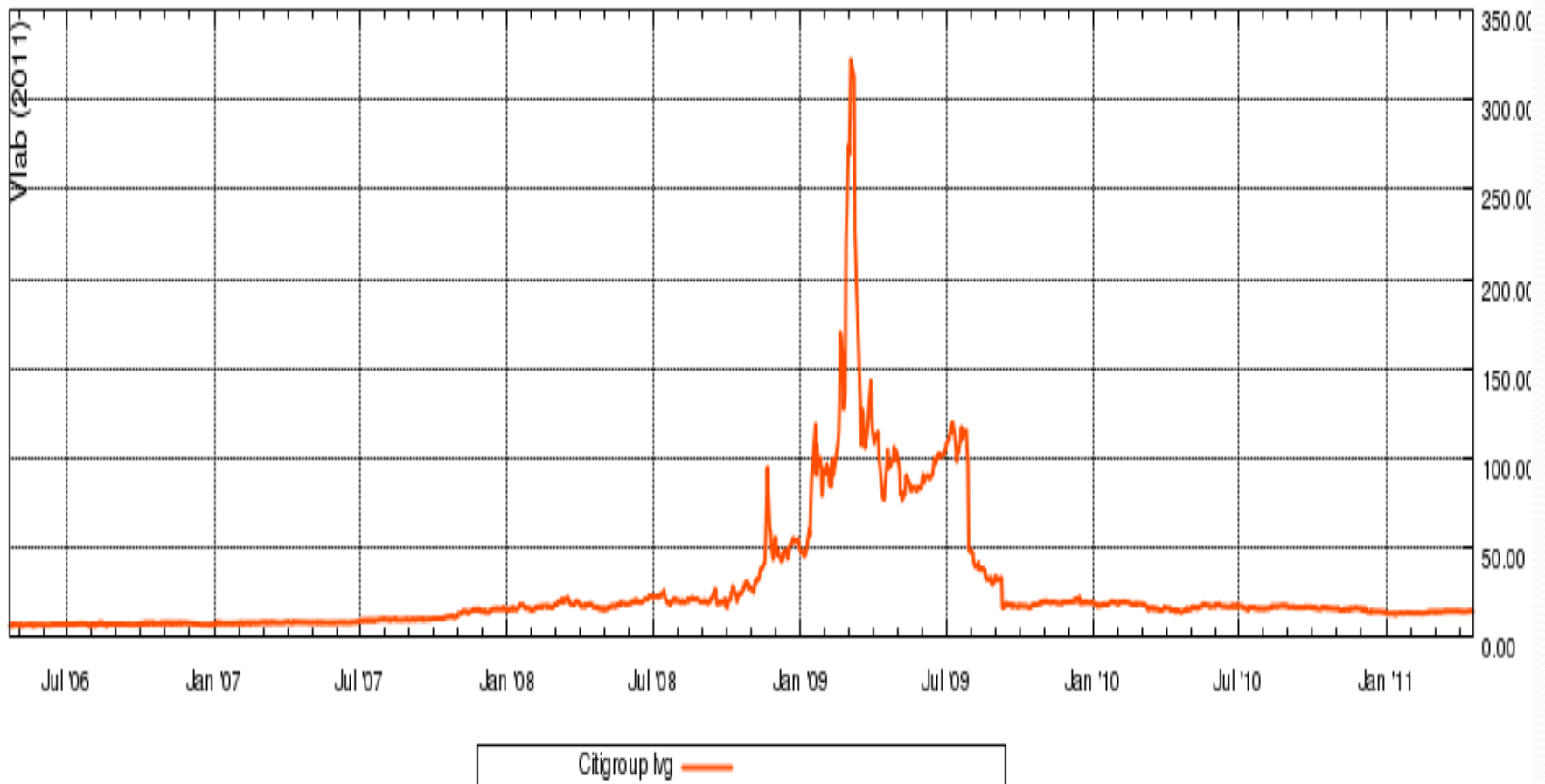
Citigroup Correlation



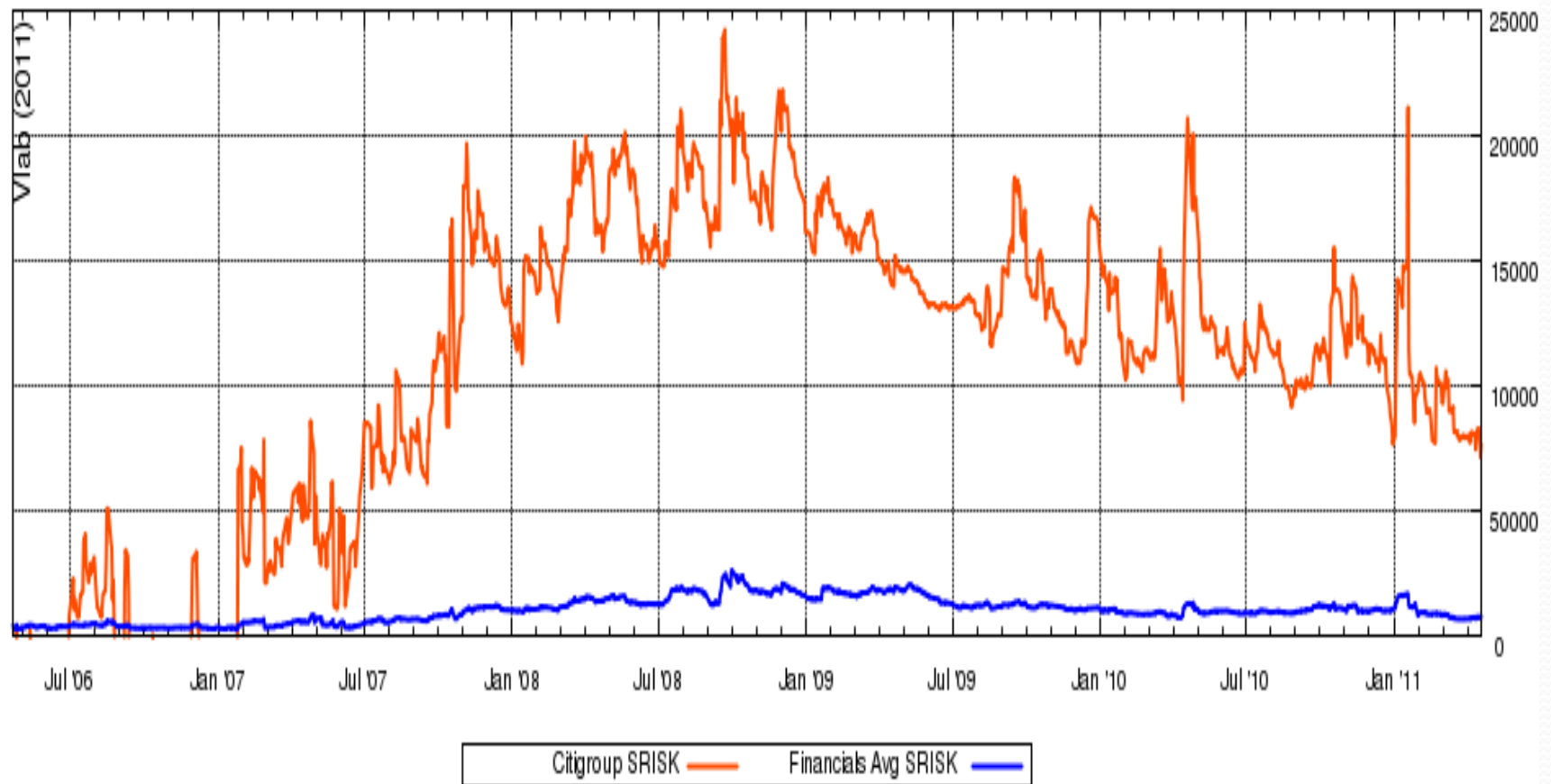
Citigroup Volatility



Citigroup Leverage



Citigroup SRISK



4/24/2011

TOP 10	SRISK%	MES	LVG
Bank Of America	20.4	3.17	17.40
JP Morgan Chase	16.6	3.24	12.34
Citigroup	13.9	2.64	14.35
Morgan Stanley	8.2	3.59	19.14
MetLife	6.4	3.13	15.56
Goldman Sachs	5.7	3.12	10.69
Prudential Financial	5.2	3.30	17.90
American International Group	5.2	3.81	10.86
Hartford Financial Services	3.5	3.57	25.33
SLM Corporation	2.3	3.64	24.06

DETAILS

Systemic Risk Rankings for 2011-04-20 (MES is equity loss for a 2% daily market decline)

<u>Institution</u>	<u>SRISK%</u>	<u>RNK</u>	<u>SRISK (\$ m)</u>	<u>MES</u>	<u>Beta</u>	<u>Cor</u>	<u>Vol</u>	<u>Lvg</u>	<u>MV</u>
<u>Bank Of America</u>	20.7%	1	122,668	3.57	1.19	0.55	27.4	17.46	124186.6
<u>JP Morgan Chase</u>	16.3%	2	96,512	3.35	1.35	0.70	24.3	12.37	177505.2
<u>Citigroup</u>	12.9%	3	76,697	2.59	0.91	0.58	19.8	14.33	133071.9
<u>Morgan Stanley</u>	7.8%	4	46,069	3.56	1.36	0.70	24.4	19.44	40248.3
<u>MetLife</u>	5.9%	5	35,043	3.01	1.16	0.63	23.0	15.74	46258.0
<u>Wells Fargo</u>	5.2%	6	31,170	3.27	1.19	0.61	24.7	8.31	151878.7
<u>Goldman Sachs</u>	5.1%	7	30,370	2.99	1.12	0.58	24.4	10.74	85493.1
<u>Prudential Financial</u>	4.9%	8	29,048	3.21	1.43	0.72	25.0	18.12	29612.0
<u>American International Group</u>	4.8%	9	28,707	3.80	1.07	0.46	29.4	10.80	58123.8
<u>Hartford Financial Services</u>	3.1%	10	18,649	2.96	1.20	0.55	27.2	25.66	12087.9

SORT BY SIZE

Systemic Risk Rankings for 2011-04-20 (MES is equity loss for a 2% daily market decline)

<u>Institution</u>	<u>SRISK %</u>	<u>RNK</u>	<u>SRISK (\$ m)</u>	<u>MES</u>	<u>Beta</u>	<u>Cor</u>	<u>Vol</u>	<u>Lvg</u>	<u>MV</u>
<u>Berkshire Hathaway Shares</u>	0.0%	77	-91,699	2.31	0.80	0.69	14.5	2.04	201983.1
<u>JP Morgan Chase</u>	16.3%	2	96,512	3.35	1.35	0.70	24.3	12.37	177505.2
<u>Wells Fargo</u>	5.2%	6	31,170	3.27	1.19	0.61	24.7	8.31	151878.7
<u>Citigroup</u>	12.9%	3	76,697	2.59	0.91	0.58	19.8	14.33	133071.9
<u>Bank Of America</u>	20.7%	1	122,668	3.57	1.19	0.55	27.4	17.46	124186.6
<u>Goldman Sachs</u>	5.1%	7	30,370	2.99	1.12	0.58	24.4	10.74	85493.1
<u>American International Group</u>	4.8%	9	28,707	3.80	1.07	0.46	29.4	10.80	58123.8
<u>American Express</u>	0.0%	75	-20,075	2.32	0.96	0.68	17.7	3.25	56513.2
<u>UnitedHealth Group</u>	0.0%	76	-20,562	2.62	0.96	0.45	26.6	1.77	48385.1
<u>US Bancorp</u>	0.0%	45	-1,812	2.49	0.93	0.58	20.3	6.87	47741.1

SORT BY MES

Systemic Risk Rankings for 2011-04-20 (MES is equity loss for a 2% daily market decline)

<u>Institution</u>	<u>SRISK %</u>	<u>RNK</u>	<u>SRISK (\$ m)</u>	<u>MES</u>	<u>Beta</u>	<u>Cor</u>	<u>Vol</u>	<u>Lvg</u>	<u>MV</u>
<u>MBIA</u>	0.4%	21	2,090	4.80	2.15	0.47	57.0	14.97	2107.4
<u>Regions Financial</u>	1.1%	14	6,646	3.81	1.42	0.64	28.1	13.97	8879.7
<u>American International Group</u>	4.8%	9	28,707	3.80	1.07	0.46	29.4	10.80	58123.8
<u>T. Rowe Price</u>	0.0%	61	-5,035	3.78	1.58	0.83	23.8	1.02	17189.4
<u>Charles Schwab</u>	0.0%	34	198	3.75	1.67	0.70	30.2	4.85	22412.2
<u>Janus Capital</u>	0.0%	36	-592	3.74	1.71	0.68	31.6	1.62	2352.1
<u>SLM Corporation</u>	2.3%	11	13,703	3.72	1.44	0.61	29.6	27.29	7619.1
<u>Lincoln National</u>	1.9%	12	11,506	3.61	1.49	0.71	26.5	20.62	9224.5
<u>Bank Of America</u>	20.7%	1	122,668	3.57	1.19	0.55	27.4	17.46	124186.6
<u>Morgan Stanley</u>	7.8%	4	46,069	3.56	1.36	0.70	24.4	19.44	40248.3

SORT BY LEVERAGE

Systemic Risk Rankings for 2011-04-20 (MES is equity loss for a 2% daily market decline)

<u>Institution</u>	<u>SRISK%</u>	<u>RNK</u>	<u>SRISK (\$ m)</u>	<u>MES</u>	<u>Beta</u>	<u>Cor</u>	<u>Vol</u>	<u>Lvg</u>	<u>MV</u>
<u>SLM Corporation</u>	2.3%	11	13,703	3.72	1.44	0.61	29.6	27.29	7619.1
<u>Hartford Financial Services</u>	3.1%	10	18,649	2.96	1.20	0.55	27.2	25.66	12087.9
<u>Lincoln National</u>	1.9%	12	11,506	3.61	1.49	0.71	26.5	20.62	9224.5
<u>Morgan Stanley</u>	7.8%	4	46,069	3.56	1.36	0.70	24.4	19.44	40248.3
<u>Prudential Financial</u>	4.9%	8	29,048	3.21	1.43	0.72	25.0	18.12	29612.0
<u>Genworth Financial</u>	1.0%	15	5,712	3.43	1.33	0.56	29.3	17.50	5905.9
<u>Bank Of America</u>	20.7%	1	122,668	3.57	1.19	0.55	27.4	17.46	124186.6
<u>MetLife</u>	5.9%	5	35,043	3.01	1.16	0.63	23.0	15.74	46258.0
<u>MBIA</u>	0.4%	21	2,090	4.80	2.15	0.47	57.0	14.97	2107.4
<u>Synovus Financial</u>	0.2%	30	933	1.79	0.73	0.29	31.5	14.68	1978.9



WHAT IS NEW IN VLAB?

- The entire calculation and web display is now recursive so that the risk measures at any point in time use only information that was available at that time.
- We can look back at past rankings to see how well they worked.



Systemic Risk Rankings



“A Look Back”

2007 3-30

Systemic Risk Rankings for 2007-03-30 (MES is equity loss for a 2% daily market decline)										
Institution	SRISK %	RNK	SRISK (\$ m)	MES	Beta	Cor	Vol	Lvg	MV	
Morgan Stanley	16.5%	1	78,503	4.62	1.71	0.77	33.1	14.65	83845.3	
Merrill Lynch	12.4%	2	58,876	4.19	1.45	0.73	29.4	14.02	72223.7	
Goldman Sachs	10.0%	3	47,777	4.16	1.63	0.84	28.8	10.33	92734.3	
Fannie Mae	9.5%	4	45,368	3.42	1.21	0.67	26.7	16.08	53218.4	
Freddie Mac	8.3%	5	39,315	2.04	0.79	0.59	20.1	20.76	39338.0	
Citigroup	7.9%	6	37,785	3.08	1.12	0.77	21.6	8.01	251694.5	
Lehman Brothers	7.8%	7	36,910	4.50	1.83	0.73	37.3	15.71	36863.0	
JP Morgan Chase	5.9%	8	28,211	3.02	1.24	0.78	23.7	8.35	168040.7	
Bear Stearns	5.7%	9	27,253	4.47	1.64	0.70	34.9	22.18	17997.9	
MetLife	3.7%	10	17,426	2.76	1.02	0.71	21.3	11.36	47531.1	
Hartford Financial Services	2.1%	11	9,932	2.66	0.97	0.73	19.6	11.05	30606.4	
Ameriprise Financial	2.0%	12	9,548	6.36	2.06	0.81	31.4	8.06	13668.2	
Prudential Financial	1.6%	13	7,463	1.71	0.74	0.63	17.3	11.17	42421.3	
Washington Mutual	1.6%	14	7,392	2.53	1.13	0.56	29.7	9.83	35899.2	
Countrywide Financial	1.2%	15	5,605	2.74	1.33	0.51	38.7	10.36	19841.4	
Lincoln National	1.1%	16	5,120	2.92	1.16	0.80	21.4	9.86	18764.9	
Bank Of America	1.0%	17	4,907	2.88	1.02	0.79	19.2	6.80	228177.5	

DID THIS PREDICT WELL?

- EIGHT OUT OF TOP TEN FAILED OR NEARLY FAILED IN CRISIS
- Morgan Stanley, Merrill Lynch, Goldman Sachs, Fannie Mae, Freddie Mac, Citigroup, Lehman Bros, J.P. Morgan Chase, Bear Stearns, Met Life.
- Where are Bank of America and AIG?



Systemic Risk Ranking Progressions

Bank of America

Date	Rank	SRISK %	MES	LVG
6/29/2007	87	0.0%	2.07	7.30
1/30/2008	11	4.8%	3.15	9.01
7/31/2008	1	11.9%	8.78	11.61
6/30/2009	1	18.6%	7.01	19.12
6/30/2010	1	17.1%	3.73	15.78
Current	1	21.5%	3.38	16.10



BAC Predicted Capital Shortfall





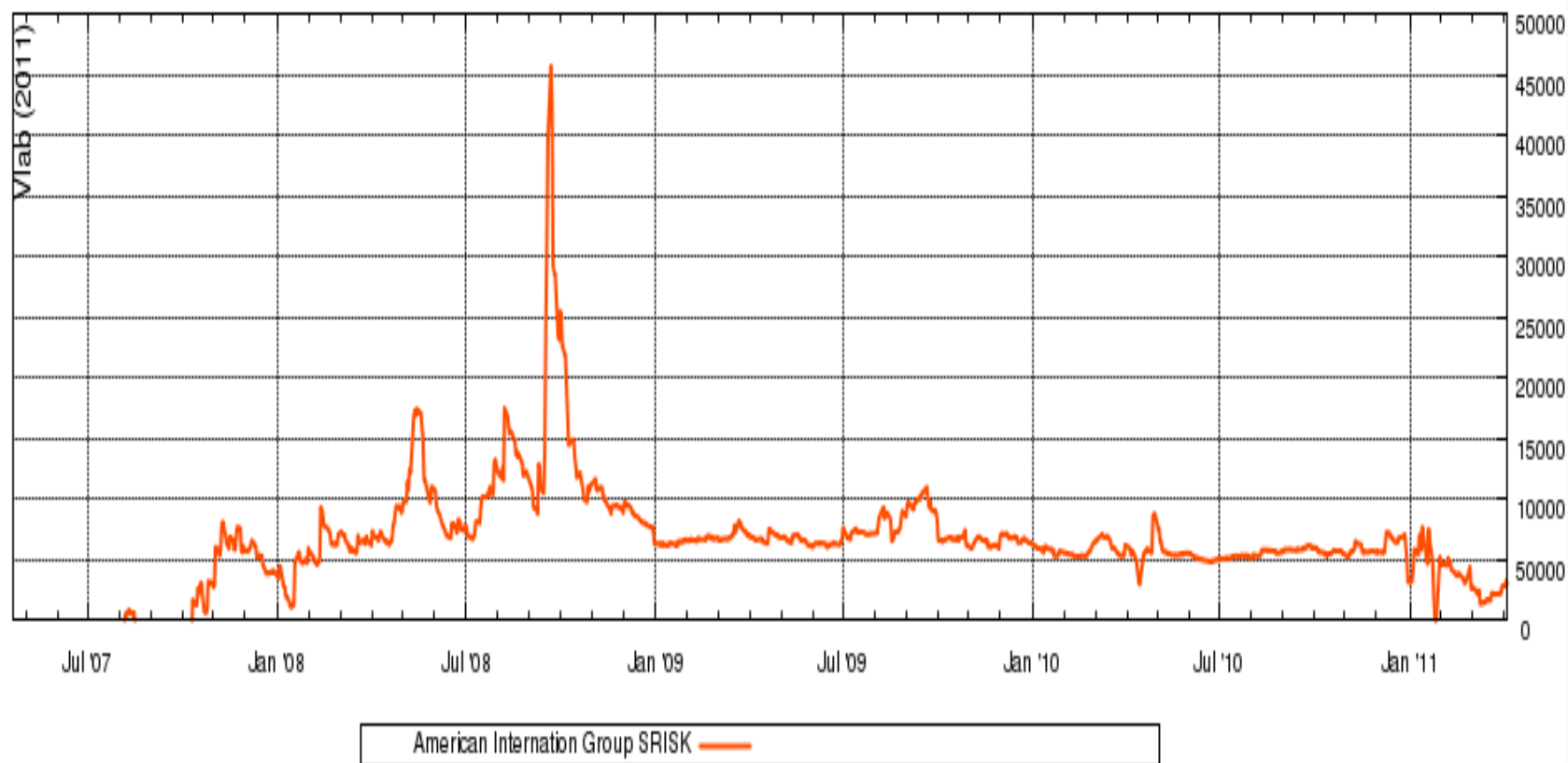
Systemic Risk Ranking Progressions

American International Group

Date	Rank	SRISK %	MES	LVG
6/29/2007	91	0.0%	1.99	5.89
10/31/2007	9	3.7%	3.80	6.92
7/31/2008	4	7.3%	9.58	14.85
6/30/2009	5	6.4%	6.72	48.42
6/30/2010	4	6.9%	3.37	32.03
Current	8	4.1%	3.30	10.03



AIG Predicted Capital Shortfall



BEFORE BEAR STERNS

Systemic Risk Rankings for 2008-02-29 (MES is equity loss for a 2% daily market decline)

Institution	SRISK %	RNK	SRISK (\$ m)	MES	Beta	Cor	Vol	Lvg	MV
Citigroup	12.6%	1	132,746	3.93	1.51	0.69	41.8	17.80	123441.8
JP Morgan Chase	7.8%	2	81,776	4.08	1.64	0.70	44.8	11.51	136884.8
Merrill Lynch	7.5%	3	78,614	5.50	2.08	0.72	54.9	21.52	48150.0
Morgan Stanley	7.2%	4	75,642	4.39	1.61	0.72	42.6	23.73	46527.5
American International Group	6.3%	5	66,263	5.09	1.81	0.58	59.3	8.97	118196.7
Goldman Sachs	6.0%	6	62,977	3.28	1.38	0.61	43.0	16.29	74467.6
Bank Of America	5.9%	7	62,295	3.39	1.31	0.71	35.3	9.89	176534.2
Fannie Mae	5.7%	8	59,501	3.92	1.46	0.52	53.5	31.88	27049.6
Lehman Brothers	5.6%	9	58,873	5.10	2.04	0.73	53.6	29.14	27054.7
Freddie Mac	5.5%	10	57,920	4.26	1.60	0.47	65.5	48.18	16267.9
Wachovia Bank	4.7%	11	49,299	4.87	1.86	0.72	49.1	12.58	60688.4
Bear Stearns	2.9%	12	29,937	4.90	1.74	0.66	51.4	42.05	9430.7
Prudential Financial	2.7%	13	27,873	3.86	1.49	0.63	46.9	15.21	32544.6
MetLife	2.5%	14	25,854	3.23	1.24	0.68	34.7	13.64	41316.1
Washington Mutual	2.2%	15	22,689	4.97	1.99	0.51	73.7	23.92	13061.8

BEFORE FREDDIE AND FANNIE, LEHMAN and A.I.G.

Systemic Risk Rankings for 2008-08-29 (MES is equity loss for a 2% daily market decline)

Institution	SRISK %	RNK	SRISK (\$ m)	MES	Beta	Cor	Vol	Lvg	MV
Citigroup	11.7%	1	173,289	6.50	2.51	0.80	59.1	19.99	103408.0
Bank Of America	11.5%	2	171,334	7.55	2.94	0.75	74.8	11.94	142001.9
JP Morgan Chase	9.8%	3	145,537	6.20	2.48	0.75	62.7	13.42	132291.7
American International Group	8.2%	4	121,658	10.24	3.72	0.70	99.9	17.62	57783.0
Merrill Lynch	6.7%	5	100,114	9.12	3.46	0.78	84.0	22.45	43417.0
Morgan Stanley	5.4%	6	79,906	5.58	2.10	0.75	52.9	23.01	45281.0
Fannie Mae	5.3%	7	78,878	14.84	5.55	0.51	205.3	115.68	7363.9
Freddie Mac	4.9%	8	72,801	12.85	5.00	0.43	220.4	297.76	2918.0
Wachovia Bank	4.9%	9	72,553	7.99	3.09	0.66	88.3	22.40	34304.2
Goldman Sachs	4.4%	10	65,839	4.11	1.70	0.76	42.7	15.73	70113.6
Lehman Brothers	4.2%	11	61,849	12.47	5.07	0.74	129.9	55.88	11172.9
Wells Fargo	2.6%	12	38,418	5.17	1.99	0.71	53.3	6.60	100162.3
MetLife	2.0%	13	30,041	3.72	1.44	0.79	34.5	14.56	38470.0
Prudential Financial	1.7%	14	25,515	3.50	1.35	0.72	36.0	15.39	31474.2
Washington Mutual	1.6%	15	23,898	6.88	2.74	0.45	116.4	41.50	6906.7

DURING STRESS TEST

Systemic Risk Rankings for 2009-04-30 (MES is equity loss for a 2% daily market decline)

<u>Institution</u>	<u>SRISK%</u>	<u>RNK</u>	<u>SRISK (\$ m)</u>	<u>MES</u>	<u>Beta</u>	<u>Cor</u>	<u>Vol</u>	<u>Lvg</u>	<u>MV</u>
<u>Bank Of America</u>	17.3%	1	244,409	13.78	4.58	0.77	174.2	37.43	57160.5
<u>JP Morgan Chase</u>	14.2%	2	200,222	7.87	2.63	0.80	95.6	16.39	124004.1
<u>Wells Fargo</u>	11.3%	3	159,404	10.17	3.40	0.75	131.4	14.82	85270.6
<u>Citigroup</u>	10.4%	4	146,658	10.05	3.33	0.67	144.7	100.72	16814.0
<u>American International Group</u>	4.9%	5	69,757	8.23	2.71	0.56	140.4	40.77	19248.5
<u>Goldman Sachs</u>	4.5%	6	64,115	5.15	1.81	0.74	71.5	13.28	70070.7
<u>Morgan Stanley</u>	3.8%	7	53,748	7.35	2.46	0.74	96.4	23.55	25583.2
<u>MetLife</u>	3.1%	8	43,975	7.18	2.55	0.75	98.8	20.23	24337.9
<u>Prudential Financial</u>	3.0%	9	42,322	10.09	3.30	0.76	129.9	34.81	12245.1
<u>US Bancorp</u>	2.9%	10	41,061	9.75	3.23	0.76	123.8	8.37	31978.7
<u>Hartford Financial Services</u>	1.7%	11	24,394	10.30	3.38	0.74	132.9	72.87	3732.7
<u>PNC Financial Services</u>	1.6%	12	22,131	6.07	2.08	0.65	93.5	15.61	17639.2
<u>American Express</u>	1.6%	13	21,968	8.33	2.81	0.81	101.4	4.58	29457.0
<u>State Street</u>	1.5%	14	21,557	10.16	3.34	0.59	163.8	9.65	14825.3
<u>Capital One Financial</u>	1.4%	15	20,433	13.26	4.48	0.70	186.6	23.92	6573.8
<u>BB&T Corporation</u>	1.3%	16	17,872	9.11	2.98	0.79	109.2	10.74	13065.8
<u>Suntrust Banks</u>	1.3%	17	17,752	11.60	3.92	0.75	151.2	31.57	5150.6
<u>Lincoln National</u>	1.1%	18	15,519	12.92	4.19	0.67	182.2	53.16	2877.9
<u>SLM Corporation</u>	1.0%	19	14,252	8.03	2.90	0.53	159.0	74.76	2258.5
<u>Bank Of New York Mellon</u>	1.0%	20	13,797	5.51	1.84	0.69	78.3	6.96	29389.9

SCAP

FIRM	SCAP	SCAP%
Bank of America	33.9	45.44236
Wells Fargo	13.7	18.36461
GMAC	11.5	15.41555
Citigroup	5.5	7.372654
Regions Financial	2.5	3.351206
SunTrust Banks	2.2	2.949062
Morgan Stanley	1.8	2.412869
KeyCorp	1.8	2.412869
Fifth Third Bancorp	1.1	1.474531
PNC Financial Services	0.6	0.80429
JP Morgan Chase	0	0
Goldman Sachs	0	0
US Bancorp	0	0
Capital One Financial	0	0
American Express	0	0
MetLife	0	0
BB&T Corporation	0	0
State Street	0	0
Bank of NY Mellon	0	0

SRISK%

FIRM	SRISK-BHC%
Bank Of America	21.77594
JP Morgan Chase	17.83904
Wells Fargo	14.20231
Citigroup	13.06669
Goldman Sachs	5.71241
Morgan Stanley	4.788748
MetLife	3.91801
US Bancorp	3.658383
PNC Financial Services	1.97179
American Express	1.957268
State Street	1.920649
Capital One Financial	1.820505
BB&T Corporation	1.592329
Suntrust Banks	1.581638
Bank Of New York Mellon	1.229262
Regions Financial	1.11406
Fifth Third Bancorp	0.939253
Keycorp	0.911722

HOW RISKY IS THE ECONOMY TODAY?

- The total capital shortfall expected if we have another crisis is a measure of the external cost of a crisis today.
- If firms reduce leverage, size, correlation or volatility, their shortfall will be reduced.
- What is total capital shortfall?

$$\text{Total Capital Shortfall} = \sum_{i=1}^N E(\text{Firm}_i \text{ Shortfall} | \text{Crisis})$$

SYSTEM CAPITAL SHORTFALL

