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Director of Volatility Institute
At NYU Stern
Tokyo, June 4, 2014

THE GLOBAL OUTLOOK ON SYSTEMIC RISK

FAILURE OF FINANCIAL INSTITUTIONS

- September 15, 2008 Lehman declared bankruptcy and the most severe events of the financial crisis began.
- The U.S. had arranged an orderly rescue of Fannie Mae and Freddie Mac the week before and then saved AIG, Merrill Lynch, Citigroup, Bank of America, Morgan Stanley, Goldman Sachs, Washington Mutual and Wachovia in the following days and weeks
- Should we rescue such firms? Should we have rescued Lehman?
- If firms count on being rescued, they will take on too much risk. Dodd Frank seeks improved resolution authority and “living wills” so future bailouts may be unnecessary.



SYSTEMIC RISK

SYSTEMIC RISK

- WHEN THE FAILURE OF AN INSTITUTION TO MEET ITS OBLIGATIONS HAS SERIOUS CONSEQUENCES FOR THE REAL ECONOMY
- FAILURE OF ONE INSTITUTION WILL BE MUCH MORE DANGEROUS IF THE WHOLE FINANCIAL SECTOR IS WEAK.

REGULATORY CHALLENGE

- ENSURE THAT FINANCIAL INSTITUTIONS HAVE SUFFICIENT CAPITAL SO THAT THEY CAN NOT ONLY SURVIVE A FINANCIAL CRISIS, BUT CONTINUE TO INTERMEDIATE AND PROVIDE FINANCIAL SERVICES TO THE REAL ECONOMY.
- GOOD REGULATION IS PREVENTION – NOT RESCUE



DEFINITION

- *How much capital would a financial institution need to raise in order to function normally if we have another financial crisis?*
- We measure this econometrically based on market data on equities and balance sheet data on liabilities. We update weekly on V-LAB for US and Global financial firms. We call this *SRISK*.
- Principle investigators: Viral Acharya, Matt Richardson and me at the Volatility Institute at NYU's Stern School. Collaboration with HEC Lausanne and the Institute for Global Finance at University of New South Wales. Contributions by Christian Brownlees, Rob Capellini, Diane Perriet, Emil Siriwardane.
- References: Acharya, Pedersen, Phillipon, Richardson "Measuring Systemic Risk (2010); Acharya, Engle, Richardson "Capital Shortfall, A New Approach to Ranking and Regulating Systemic Risks, AEAPP (2012), Brownlees and Engle, "Volatilities, Correlations and Tails for Systemic Risk Measurement", 2010

SRISK

- SRISK is computed from:

$$\begin{aligned} SRISK_{i,t} &= E_t \left(Capital\ Shortfall_i \mid Crisis \right) \\ &= E_t \left(k \left(Debt_{t+n} + Equity_{t+n} \right) - Equity_{t+n} \mid Crisis_{t+n} \right) \\ &= k Debt_t - (1 - k) \left(1 - LRMES_{i,t} \right) Equity_{i,t} \end{aligned}$$

- Where k is a prudential level of equity relative to assets taken to be 8% (and 5.5% for IFRS firms) and LRMES is the decline in equity values to be expected if there is another financial crisis.
- *SRISK depends upon size, leverage and risk.*

FOR EXAMPLE: BAC

- Bank of America has a market cap of \$161 billion. Its accounting liabilities are \$1.9 trillion for a leverage ratio of 12.7
- If we have another financial crisis which is assumed to be a fall of 40% in broad US equities over six months, then we estimate shares in BAC will fall by 50%.
- This reflects a Dynamic Conditional Beta of 1.25 today that will move in the future due to mean reversion in volatilities and correlations and also will rise with downside returns.
- SRISK = \$77 billion.

FOR EXAMPLE: ACA

- Credit Agricole has a market cap of \$30 billion
- It has liabilities of \$2.3 trillion for a leverage ratio of 78
- Any fluctuation in asset or liability valuations can easily move the firm into bankruptcy.
- Most of the capital shortfall, \$112b, is needed to bring the leverage down now. The risk is only a small part of the capital shortfall calculation.
- Most likely, Credit Agricole is no longer making loans except possibly the most secure.



ECONOMETRICS OF SRISK

DYNAMIC CONDITIONAL BETA

WHAT IS BETA?

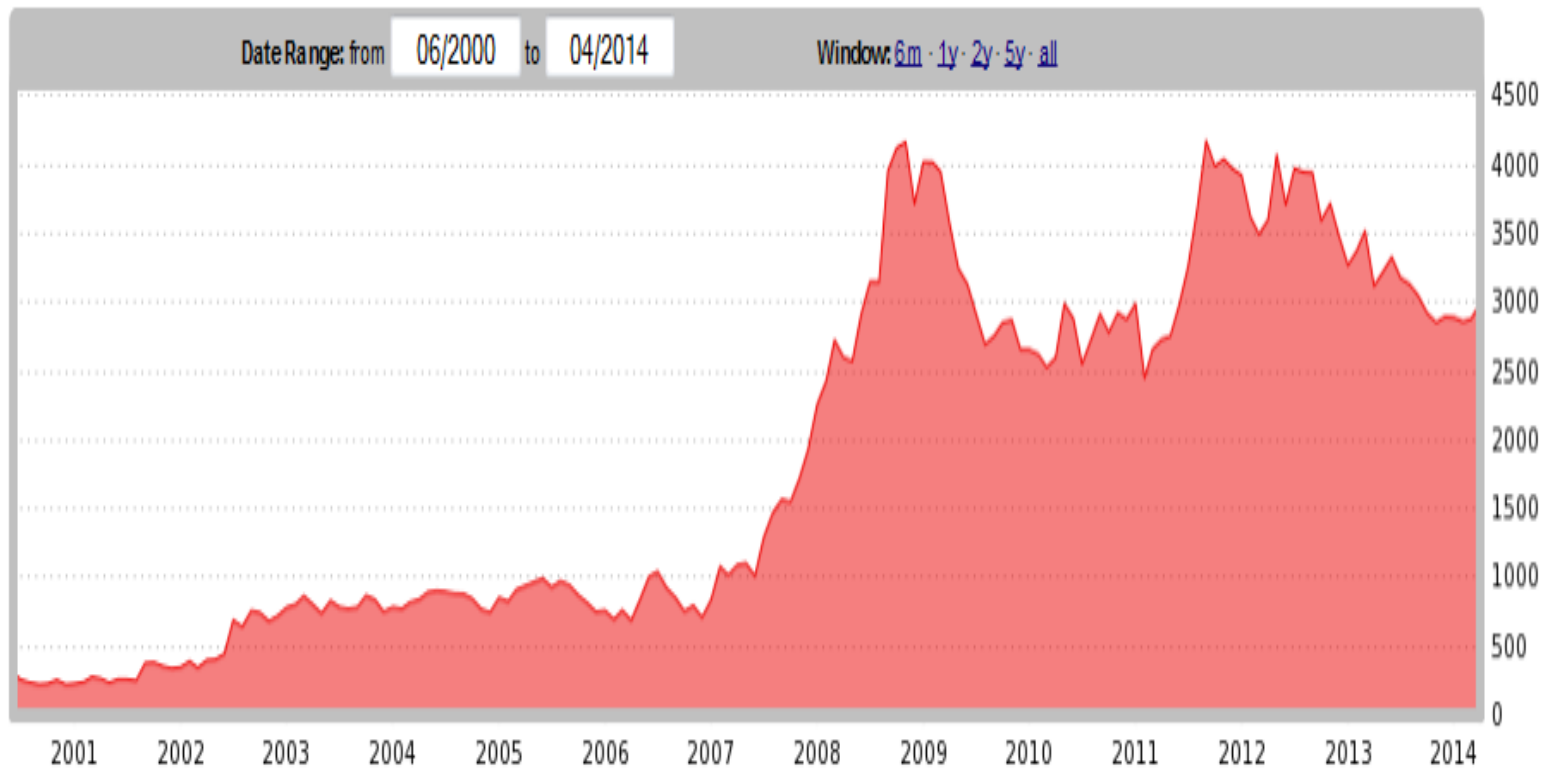
- Beta measures the decline in a firm stock price as the market declines.
- Beta is not constant – it is a correlation times the ratio of firm volatility to market volatility.
- We use a global ETF and correct for asynchronicity in daily returns.
- We estimate volatility (GJR) and correlation (DCC) models for more than 1000 global firms.
- We do this every week and post it on V-LAB.



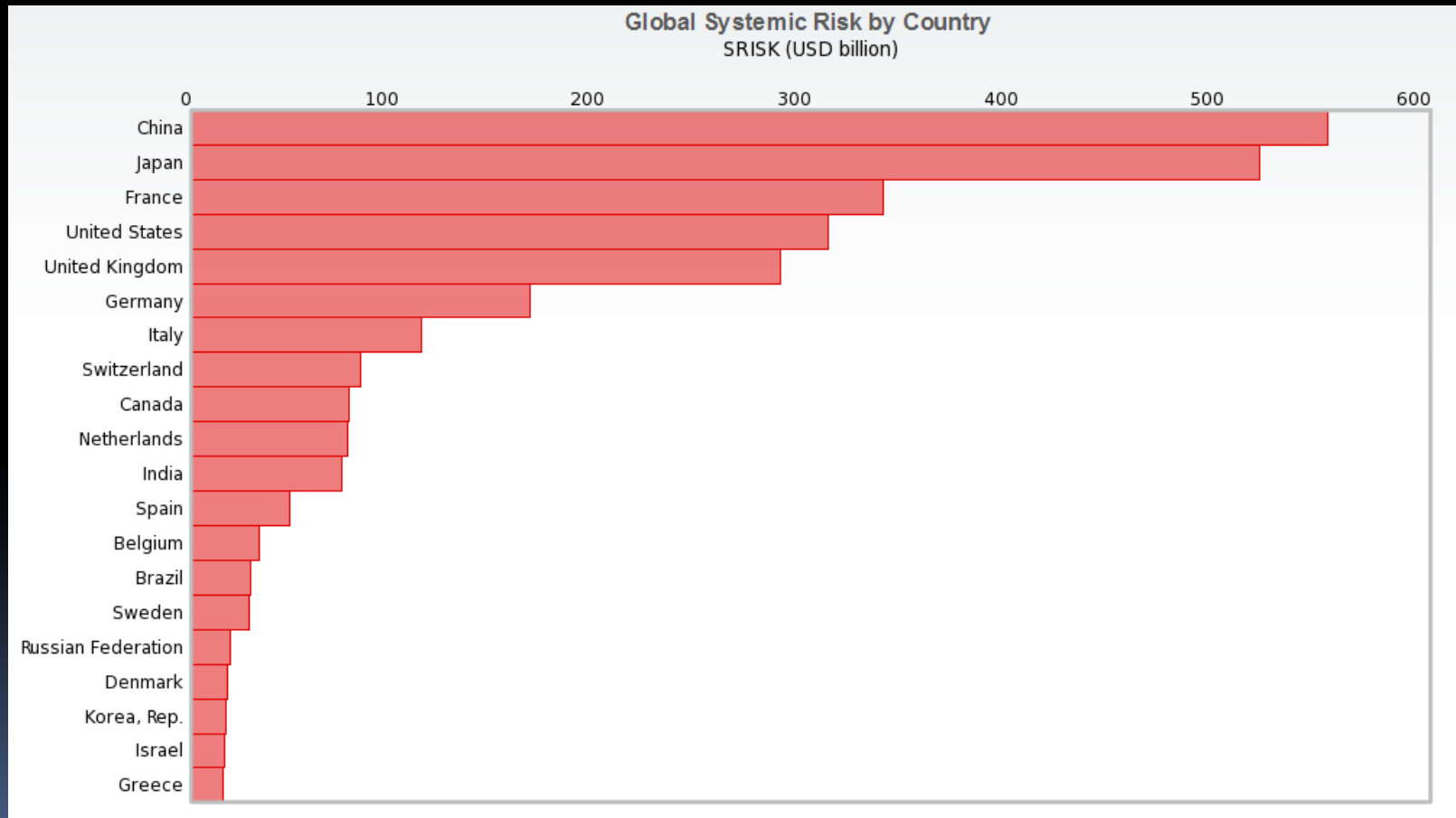
GLOBAL SYSTEMIC RISK

GLOBAL SRISK SINCE 2000

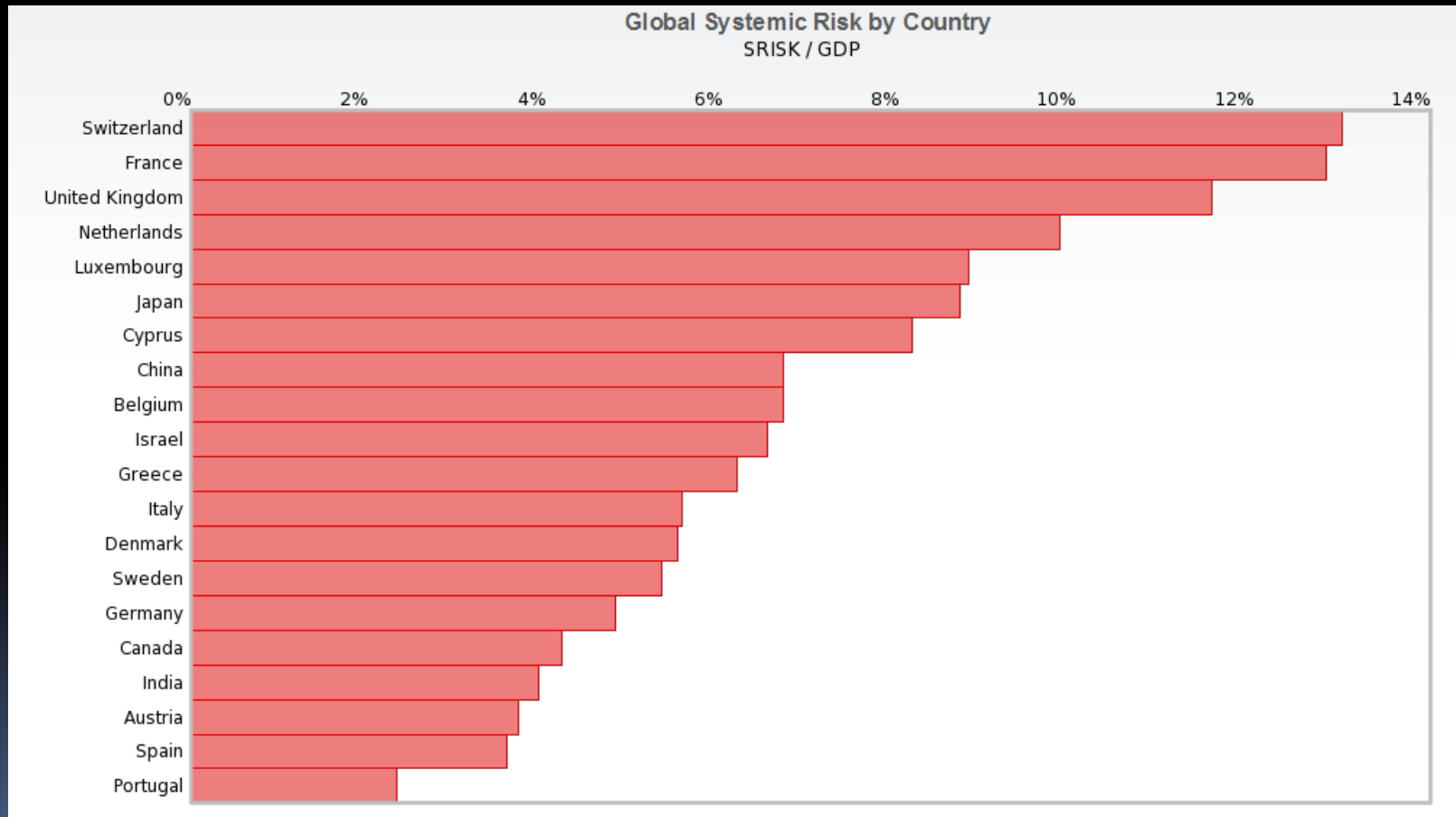
Risk Analysis Overview - World Financials Total SRISK (US\$ billion)



WHERE IS THE RISK *today*?

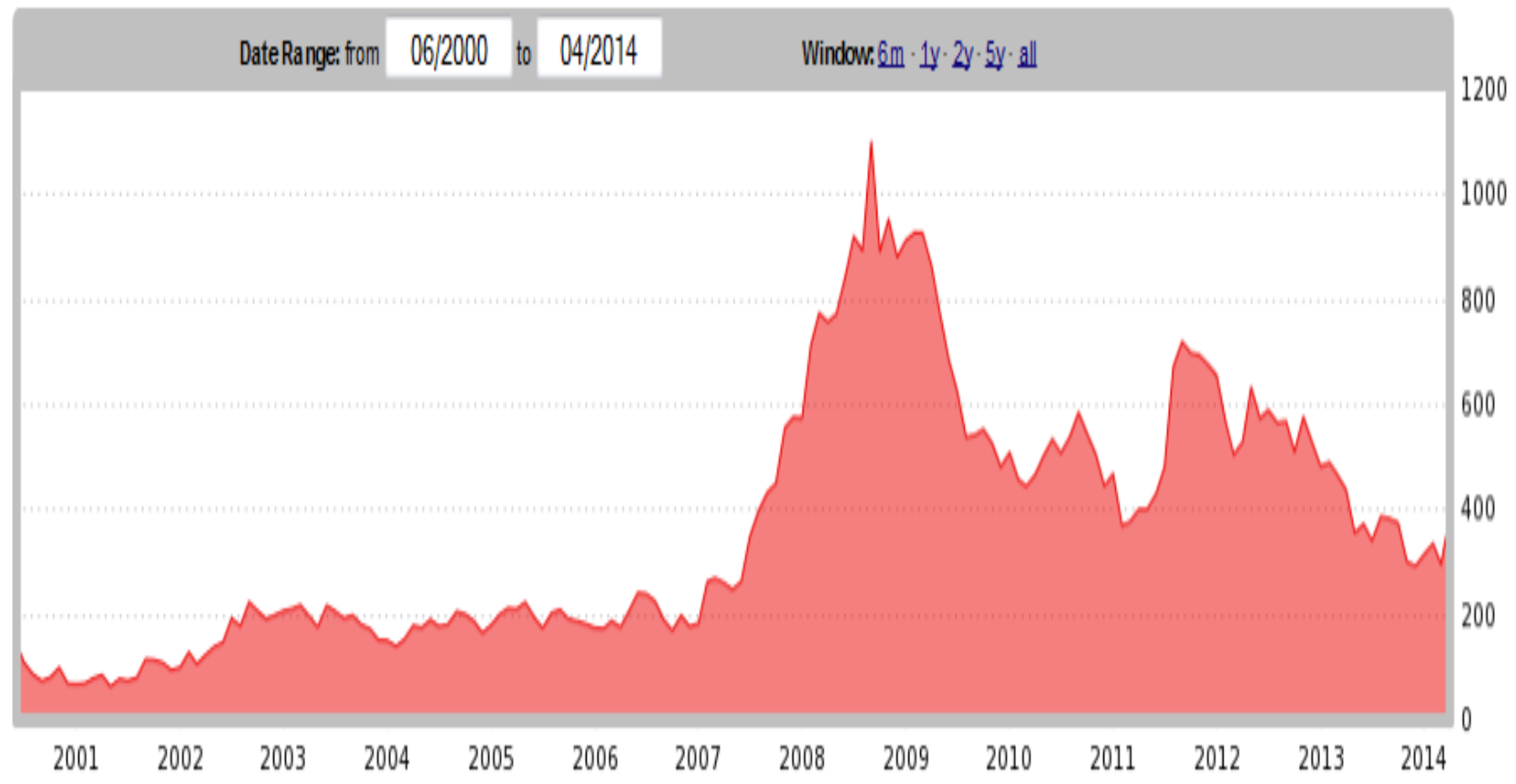


RELATIVE TO GDP

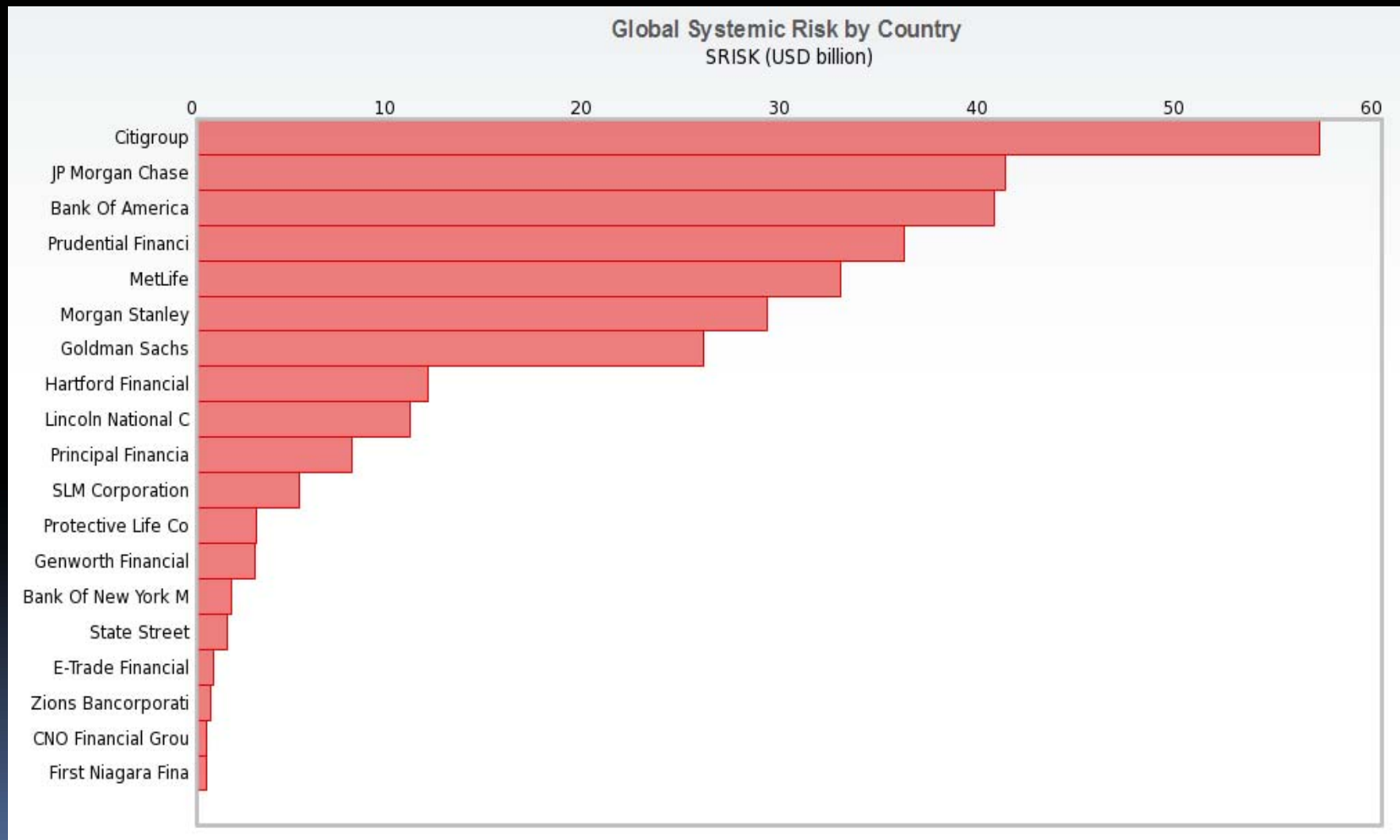


US SINCE 2000

Risk Analysis Overview - United States Financials Total SRISK (US\$ billion)



US FIRMS TODAY





Global Systemic Risk Rankings



“A Look Back”

AUGUST 29, 2008 US

Systemic Risk Rankings for (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>Citigroup</u>	12.66	1	123,611	5.80	2.16	0.66	59.2	19.99	103,408.0
<u>JP Morgan Chase</u>	8.52	2	83,203	5.15	1.92	0.61	62.7	13.42	132,291.7
<u>Freddie Mac</u>	7.05	3	68,892	10.79	4.02	0.38	220.4	297.76	2,918.0
<u>Fannie Mae</u>	6.83	4	66,726	11.62	4.34	0.41	205.2	115.68	7,363.9
<u>American International Group</u>	6.74	5	65,801	8.73	3.26	0.58	99.8	17.62	57,783.0
<u>Merrill Lynch</u>	6.46	6	63,127	6.97	2.60	0.65	83.9	22.45	43,417.0
<u>Morgan Stanley</u>	6.39	7	62,408	4.87	1.82	0.60	53	23.01	45,281.0
<u>Bank Of America</u>	6.28	8	61,376	4.06	1.51	0.58	71.9	11.94	142,001.9
<u>Goldman Sachs</u>	5.13	9	50,074	3.80	1.42	0.61	42.6	15.73	70,113.6
<u>Lehman Brothers</u>	4.87	10	47,601	10.88	4.06	0.62	129.2	55.88	11,172.9
<u>Wachovia Bank</u>	4.73	11	46,154	5.11	1.90	0.54	87.7	22.40	34,304.2
<u>Washington Mutual</u>	1.99	12	19,458	4.32	1.61	0.38	116	41.50	6,906.7
<u>MetLife</u>	1.96	13	19,173	2.50	0.93	0.57	34.2	14.56	38,470.0
<u>Prudential Financial</u>	1.92	14	18,759	2.80	1.03	0.57	36.2	15.39	31,474.2
<u>Hartford Financial Services</u>	1.56	15	15,279	3.06	1.14	0.57	41.7	17.68	19,005.6

JAN 31, 2007 AMERICAS

Systemic Risk Rankings for (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>Morgan Stanley</u>	21.52	1	41,541	3.15	1.27	0.62	21.7	13.50	86,838.4
<u>Freddie Mac</u>	15.00	2	28,943	1.21	0.49	0.40	12.7	18.29	44,978.1
<u>Fannie Mae</u>	13.14	3	25,354	1.48	0.60	0.39	19.4	15.56	55,119.7
<u>Merrill Lynch</u>	9.65	4	18,629	2.85	1.15	0.58	20.8	10.70	82,704.2
<u>Lehman Brothers</u>	8.56	5	16,526	3.28	1.33	0.61	26.1	12.11	43,591.9
<u>Bear Stearns</u>	8.21	6	15,845	2.57	1.04	0.57	23.5	18.48	19,354.9
<u>Goldman Sachs</u>	7.06	7	13,635	3.04	1.23	0.57	24.4	9.45	94,352.3
<u>MetLife</u>	4.94	8	9,531	2.08	0.84	0.45	17.7	11.43	47,225.7
<u>Hartford Financial Services</u>	3.25	9	6,278	2.29	0.92	0.53	18.5	11.23	30,080.6
<u>Prudential Financial</u>	3.12	10	6,016	1.78	0.74	0.47	15.9	11.10	42,693.3
<u>Banco Santander Brasil SA</u>	1.48	11	2,847	-1.05	-0.51	0.14	49.5	73.39	608.3
<u>Bank of Montreal</u>	1.06	12	2,051	1.47	0.59	0.30	12.9	10.69	29,761.1
<u>Lincoln National Corp</u>	0.96	13	1,848	2.24	0.90	0.59	15.3	9.93	18,623.3
<u>Ameriprise Financial</u>	0.79	14	1,517	4.15	1.57	0.56	19.7	7.78	14,232.9
<u>National Bank of Canada</u>	0.73	15	1,412	1.30	0.52	0.26	13.9	12.10	8,837.4

JAN 31, 2005

Systemic Risk Rankings for (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>Fannie Mae</u>	18.72	1	37,092	1.81	0.75	0.38	25.8	16.72	62,478.2
<u>Freddie Mac</u>	15.20	2	30,124	1.63	0.67	0.42	16.7	17.96	44,957.0
<u>Morgan Stanley</u>	12.12	3	24,016	2.85	1.18	0.61	18.7	12.82	60,834.1
<u>Merrill Lynch</u>	8.33	4	16,502	2.78	1.15	0.64	17.1	11.67	55,950.0
<u>Bear Stearns</u>	6.80	5	13,477	2.36	0.97	0.52	16.8	24.67	10,433.9
<u>Prudential Financial</u>	6.44	6	12,751	2.07	0.88	0.50	18.2	14.69	27,655.8
<u>Lehman Brothers</u>	6.33	7	12,539	2.43	1.01	0.60	16.3	14.69	25,004.3
<u>Goldman Sachs</u>	5.56	8	11,016	2.80	1.16	0.58	17.7	10.56	52,781.6
<u>Hartford Financial Services</u>	3.94	9	7,812	2.39	0.99	0.50	22.5	13.42	19,763.8
<u>MetLife</u>	3.90	10	7,721	2.02	0.84	0.46	22.1	12.25	29,587.4
<u>JP Morgan Chase</u>	2.70	11	5,340	2.44	1.01	0.64	15.7	8.92	132,753.0
<u>Canadian Imperial Bank of Commerce/Canada</u>	2.21	12	4,375	1.61	0.67	0.34	18.6	12.44	19,236.1
<u>Lincoln National Corp</u>	2.05	13	4,063	2.48	1.03	0.55	20.4	14.66	8,055.9
<u>Toronto-Dominion Bank/The</u>	1.47	14	2,912	1.55	0.64	0.32	18	11.12	25,528.5



STRESS TESTS

COMPARISON WITH REGULATORY STRESS TESTS

- Supervisory stress tests have access to firm books and confidential records.
- Stress tests typically specify one or more scenarios that can be quite complex with assumed values for many risk factors for many quarters.
- Regulators must use their own models or the institutions models to translate the scenario into losses.
- Capital adequacy compares the ratio of remaining capital to some measure of size with regulatory standards.
- Capital shortfall is the capital that would be needed to bring capital ratios up to the regulatory standard.

STRENGTHS AND WEAKNESSES OF REGULATORY STRESS TESTS

- Scenario is both a strength and a weakness. An Ideal scenario would be coherent and robust to various economic environments. Regulator has to determine how severe and what risks to stress.
- Ability to “game” the stress test. If the scenario is known in advance, then changes in portfolios and accounting may make it easy to pass. To combat this, it is common to have the new scenario be a secret. Consequently, a time series of stress tests is not very useful.

FURTHER STRENGTHS AND WEAKNESSES

- The denominator of capital adequacy favored by Basel is risk weighted assets that take no account of correlation or hedges. Diversification is not valued.
- Risks on the liability side are typically ignored such as funding risks.
- There is no need for market data that can be misleading or unavailable. However regulatory models must value the firm by valuing the assets now and under stress. It is not clear that such answers will be better than market prices.
- Very expensive and time consuming both for the regulator and the regulatee.



Viral Acharya, Robert Engle and Diane Pierret
Forthcoming in Journal of Monetary Economics

TESTING MACROPRUDENTIAL STRESS TESTS: THE RISK OF REGULATORY RISK WEIGHTS

SCOPE OF PAPER

- Compares US and European stress tests since 2009 with V-LAB estimates at the same time.
- How similar are the rankings?
- How well do risk weights predict risks?
- When something approximating the scenario occurs, which rankings are more accurate?

Risk-based vs. leverage ratio

Tier 1 Leverage ratio (T1 LVGR = T1 Capital/Total Assets) recommended under Basel III to supplement the risk-based regime.

Rank correlations with Vlab market leverage ratio ($M - LVGR_s$) increase considerably when RWA are replaced by Total Assets.

Vlab market leverage ratio under stress

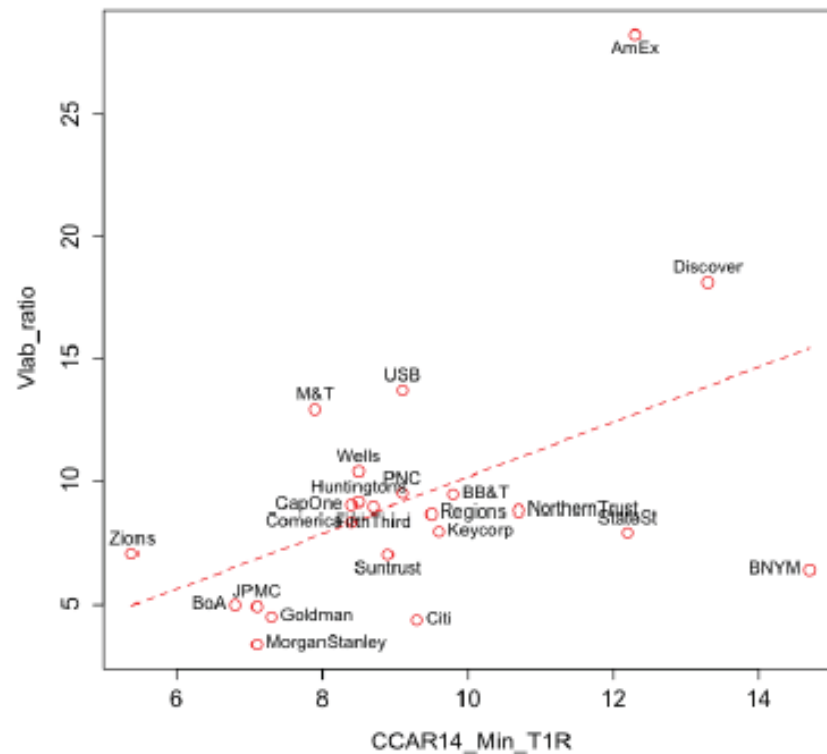
$$M - LVGR_s = \frac{MV(1 - LRMES)}{MV(1 - LRMES) + D}$$

Rank correlations with Vlab M-LVGR _s			
Stress tests projected ratios	CCAR 2012	CCAR 2013	EBA 2011
T1CR, scenario end	0.242		0.282*
T1 LVGR, scenario end	0.576*		0.570**
min T1CR	0.797**	0.581*	
min T1 LVGR	0.846**	0.877**	

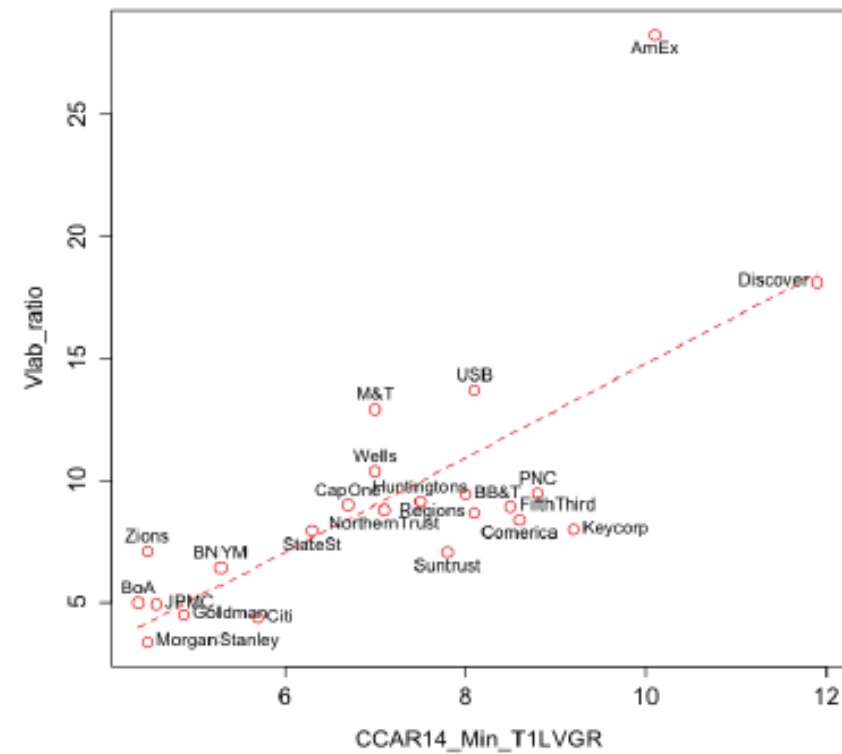
* Significant parameters at 5%; ** at 1%. Sample size: 18 (CCAR 2012), 17 (CCAR 2013), 53 (EBA).

CCAR 2014: Risk-based vs. leverage ratio

T1 Risk-based ratio:
 $T1\ Capitals_S / RWA_S$
 (correlation with M-LVGR_S: 0.376)



T1 Leverage ratio:
 $T1\ Capitals_S / TA_S$
 (correlation with M-LVGR_S: 0.710)

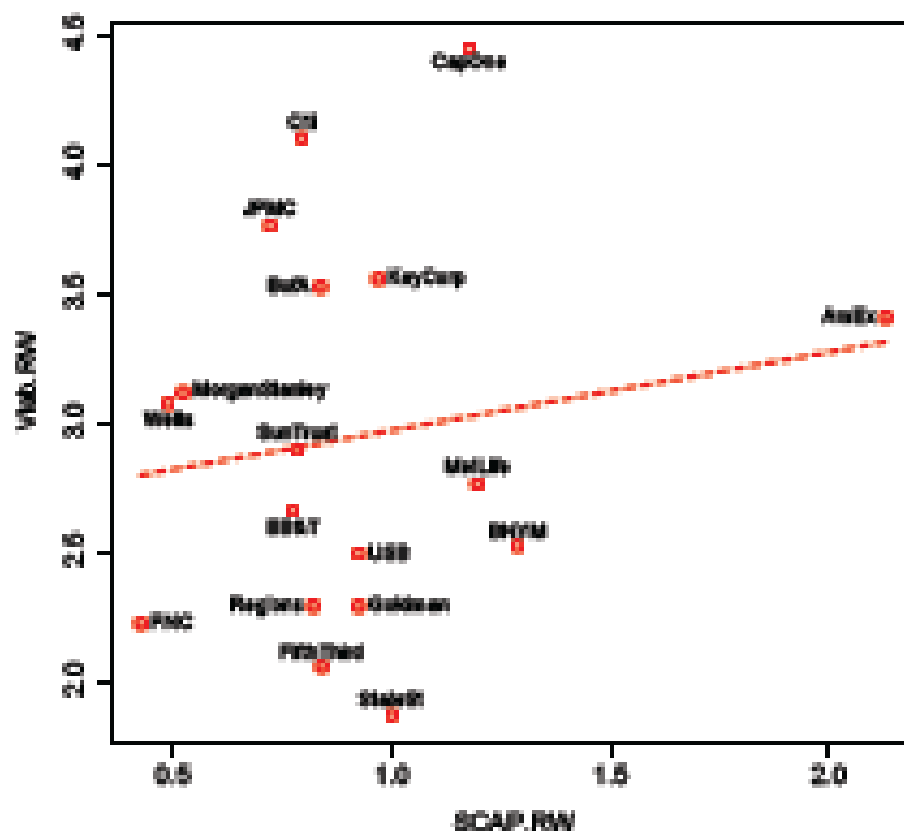


Regulatory risk weight vs. market risk weight (SCAP 2009)

Stressed regulatory risk weight = RWA_S / TA_S

Vlab RWA: $SRISK \leq 0 \Leftrightarrow MV \geq \frac{k}{1-(1-k)LRMES} TA$ (Acharya, Engle and Richardson (2012))

Vlab risk weight = $(1 - (1 - k)LRMES)^{-1}$ (rank correlation: -0.011)



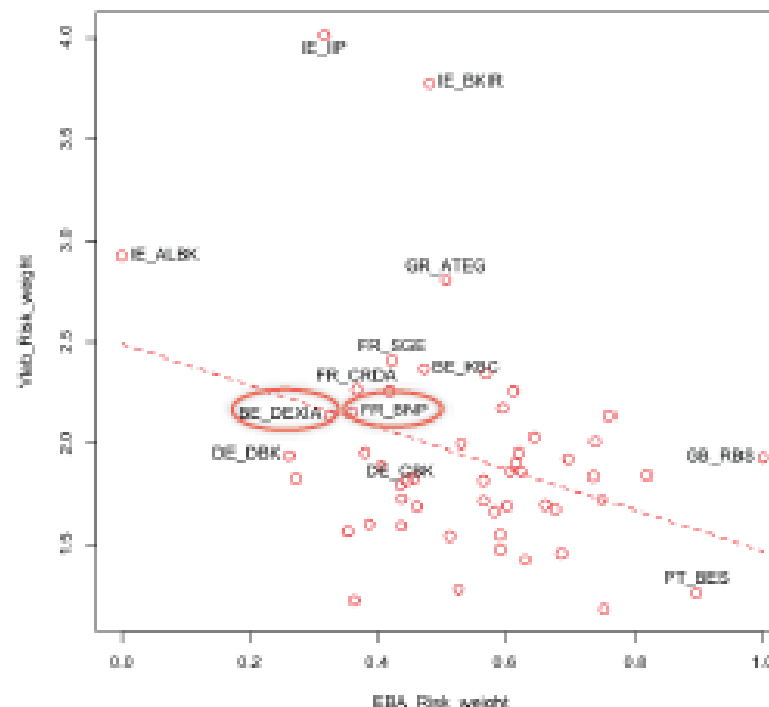
Regulatory risk weight vs. market risk weight (EBA 2011)

Stressed regulatory risk weight = RWA_S/TA_S

Vlab RWA: $SRISK \leq 0 \Leftrightarrow MV \geq \frac{k}{1-(1-k)LRMES} TA$ (Acharya, Engle and Richardson (2012))

Vlab risk weight = $(1 - (1 - k)LRMES)^{-1}$ (rank correlation: -0.238)

Dexia and Crédit Agricole: below 25% quantile of RWA_S/TA_S , above the 75% quantile of Vlab risk weight distribution



Predicting realized returns with stress tests ratios (EBA 2011)

Rank correlations of stressed capital ratios with the 6-month realized stock return of banks, after disclosure of the EBA 2011 stress test.

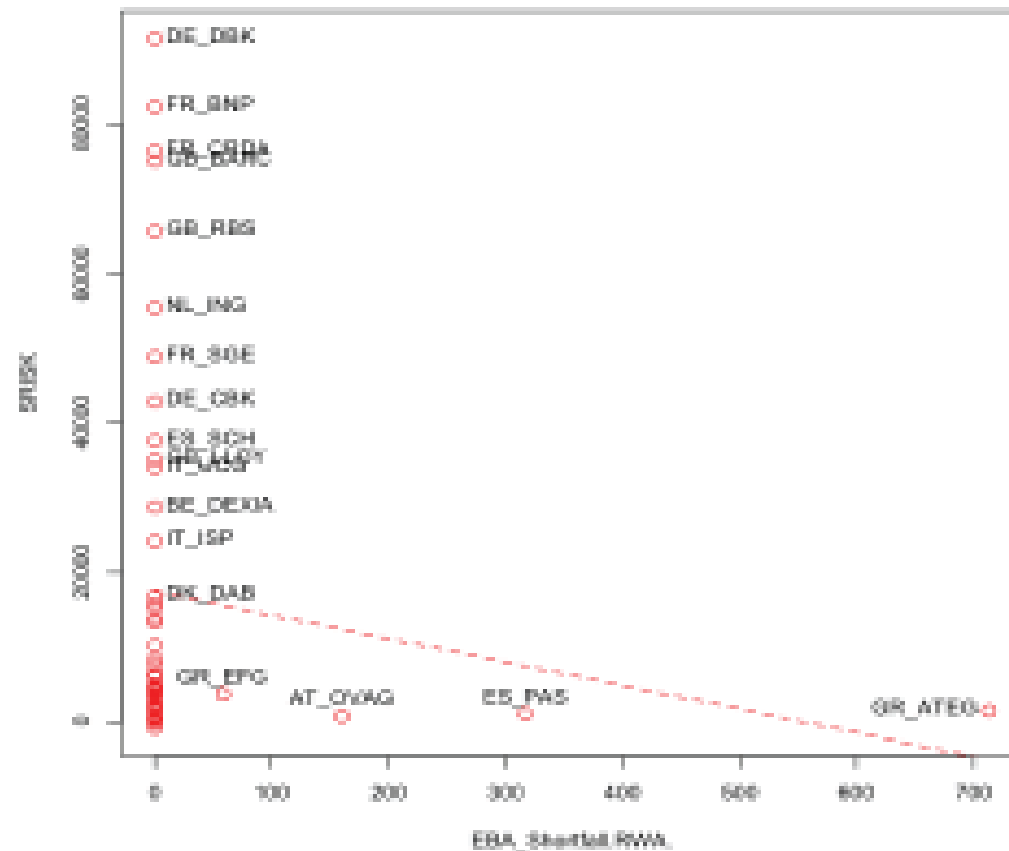
Rank correlations with 6-month realized return				
Estimated capital ratio		Large	Small	All
V-Lab	$M-LVGR_s$	0.721** (0.002)	0.293** (0.074)	0.354** (0.009)
EBA	$T1CR$, scenario end	0.446** (0.095)	-0.031 (0.854)	0.046 (0.742)
EBA	$T1LVGR$, scenario end	0.275 (0.321)	0.152 (0.364)	0.208 (0.136)

* Significant parameters at 5%; ** at 1%. Standard errors in parentheses. Sample size: 15 (large), 38 (small), 53 (all).

EBA capital shortfall vs. SRISK (EBA 2011)

$$V_{lab} \text{ SRISK} = k \text{ Debt} - (1 - k)(1 - LRMES) * MV$$

EBA disclosed capital shortfall = $\max(0, [k' + RWA_S - Capital_S])$
 ($k=0.055$, $k'=0.05$, rank correlation: -0.273)



Conclusion

- The average regulatory risk weight of stress tests is uncorrelated with the V-Lab risk weight, and is unconnected with the realized risk of European banks during the European sovereign debt crisis.
- As a result, when capital adequacy is a function of *risk-weighted assets* in regulatory stress tests, stress tests rankings deviate considerably from the V-Lab rankings.
- When stress tests rely on *total assets* to indicate capital requirements, rankings are similar to the V-Lab rankings.

Static regulatory risk weights are flawed and provide perverse incentives to build exposures to low-risk weight asset categories (Acharya and Steffen (2013)).

Recommendations:

- complement the assessment of banks and system risks with market measures of risk
- use multiple ratios in bank capital requirements to reduce regulatory arbitrage (e.g. T1CR and T1 LVGR)



REGULATION

IDEALLY $SRISK=0$

- IF ALL FIRMS HAVE ADEQUATE CAPITAL TO WITHSTAND A FINANCIAL CRISIS, THEN THERE CANNOT BE ONE.
- BUT THIS MEANS FIRMS WILL BE FORCED TO RAISE CAPITAL JUST WHEN THEY HAVE BAD OUTCOMES. IT IS PRO-CYCLICAL!
- INSTEAD RAISE EXCESS CAPITAL IN GOOD TIMES TO PROVIDE EXTRA CUSHION IN BAD TIMES. COUNTER CYCLICAL

CHALLENGES

- **TIMING:** today we do one stress test a year. If a firm fails the stress test, then it will need to improve over the next year or two.
- If capital ratios are adjusted over time, the signal would need to be accurate far in advance.
- If a high frequency capital adequacy measure is used for planning and is then checked against the annual stress test, the timeliness can be substantially improved.



NEXT STEPS AT V-LAB

A TAYLOR RULE FOR CAPITAL ADEQUACY - WOULD IT WORK?

- Suppose we agree that $k = 8\%$ is the right leverage ratio under stress in order to prevent massive firm failure in a crisis.
- When economic growth (or credit growth) is above average, then raise k slightly. Continue raising it until growth falls below normal and then lower it back toward 8% but not below.
- Why not below? Regulatory forbearance?
- Financial institutions would have to satisfy these requirements on a time average basis.

PRECAUTIONARY CAPITAL

- How much capital should a firm have today so that with probability $1 - \alpha$, its leverage will not exceed k in a financial crisis?
- This focuses on today's capital and today's risk.
- It is a risk based total leverage capital requirement.

PRECAUTIONARY CAPITAL

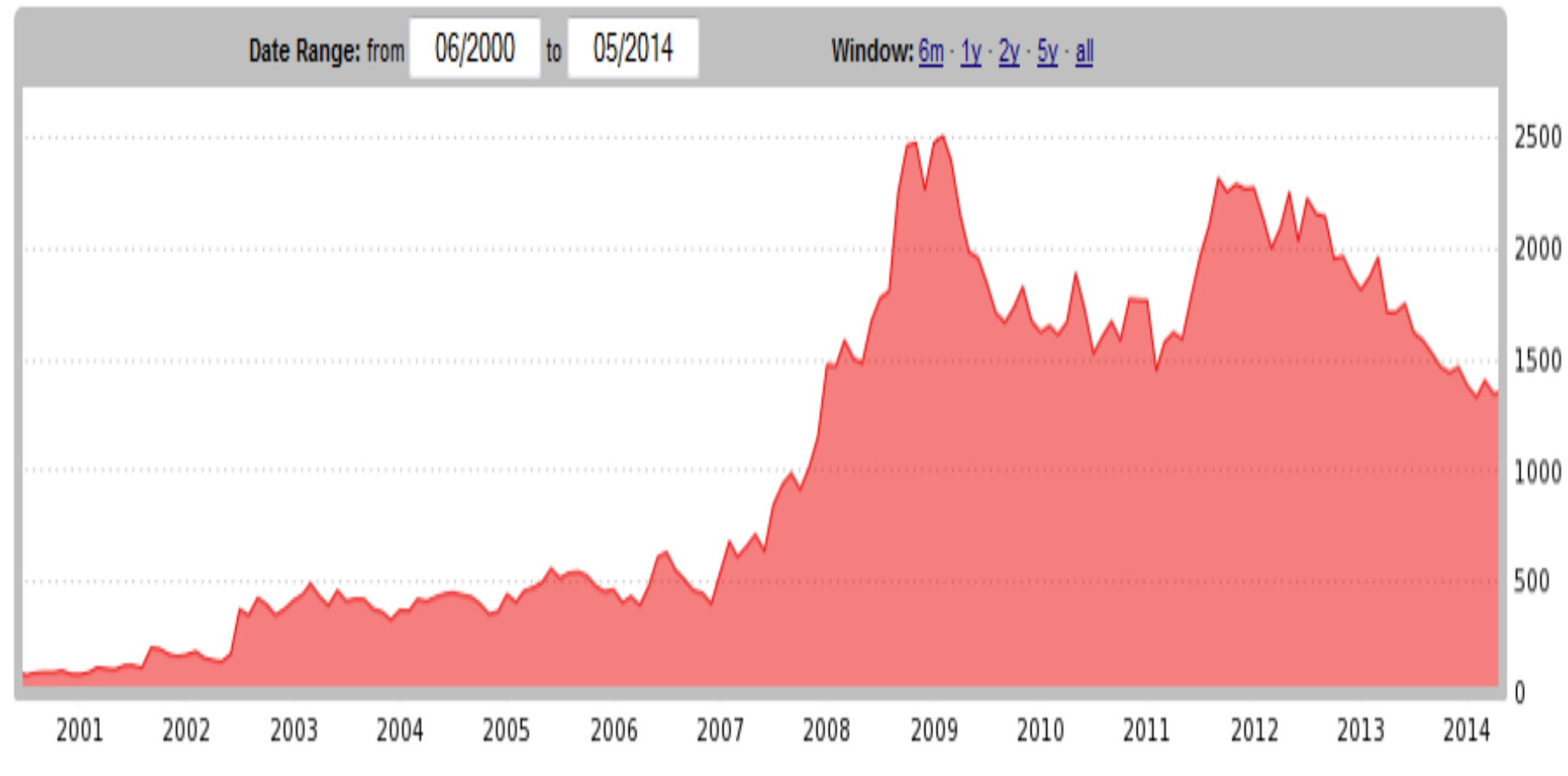
- Under the assumption that the risk is unchanged by adding capital, this is a simple transformation of SRISK.
- However, adding capital should change risk because
 - It reduces leverage and volatility
 - It reduces the risk of runs and fire sales
 - It reduces the risk from counterparties if they have sufficient precautionary capital.
- The Structural GARCH model of Engle and Siriwardane provides a measure of this effect.



THE REST OF THE STORY

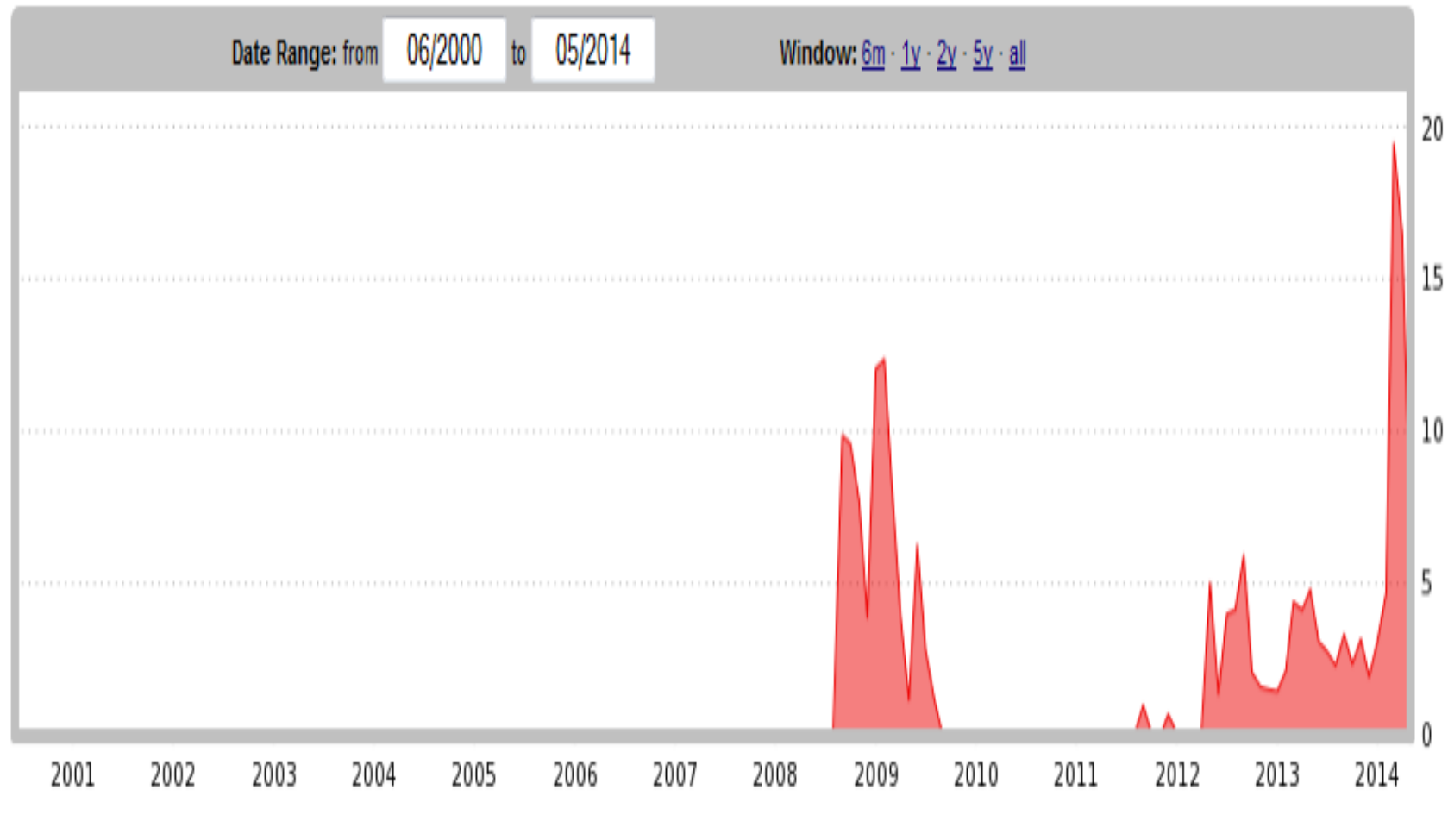
EUROPE SINCE 2000

Risk Analysis Overview - Europe Financials Total SRISK (US\$ billion)



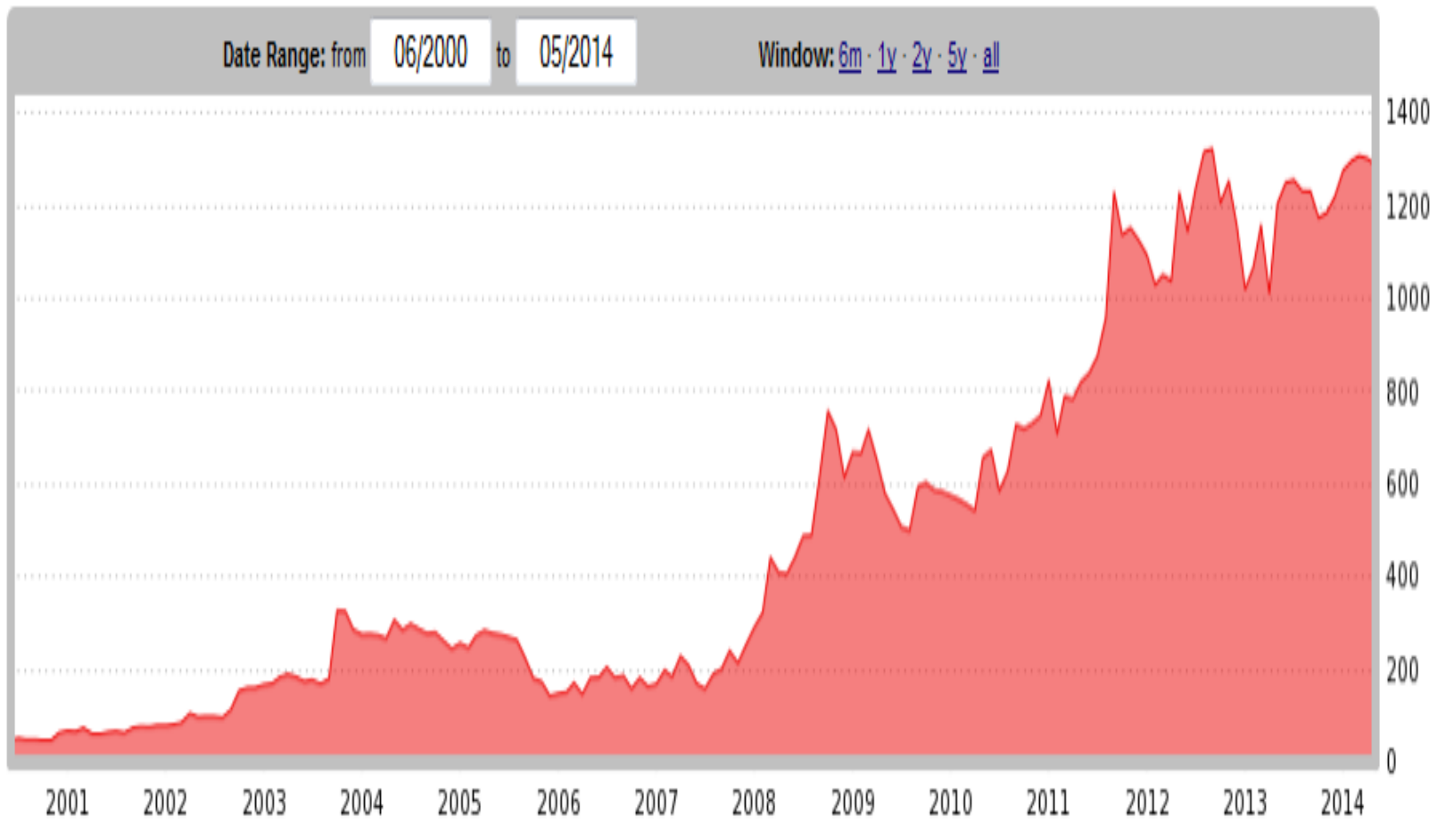
RUSSIA TODAY

Risk Analysis Overview - Russian Federation Financials Total SRISK (US\$ billion)



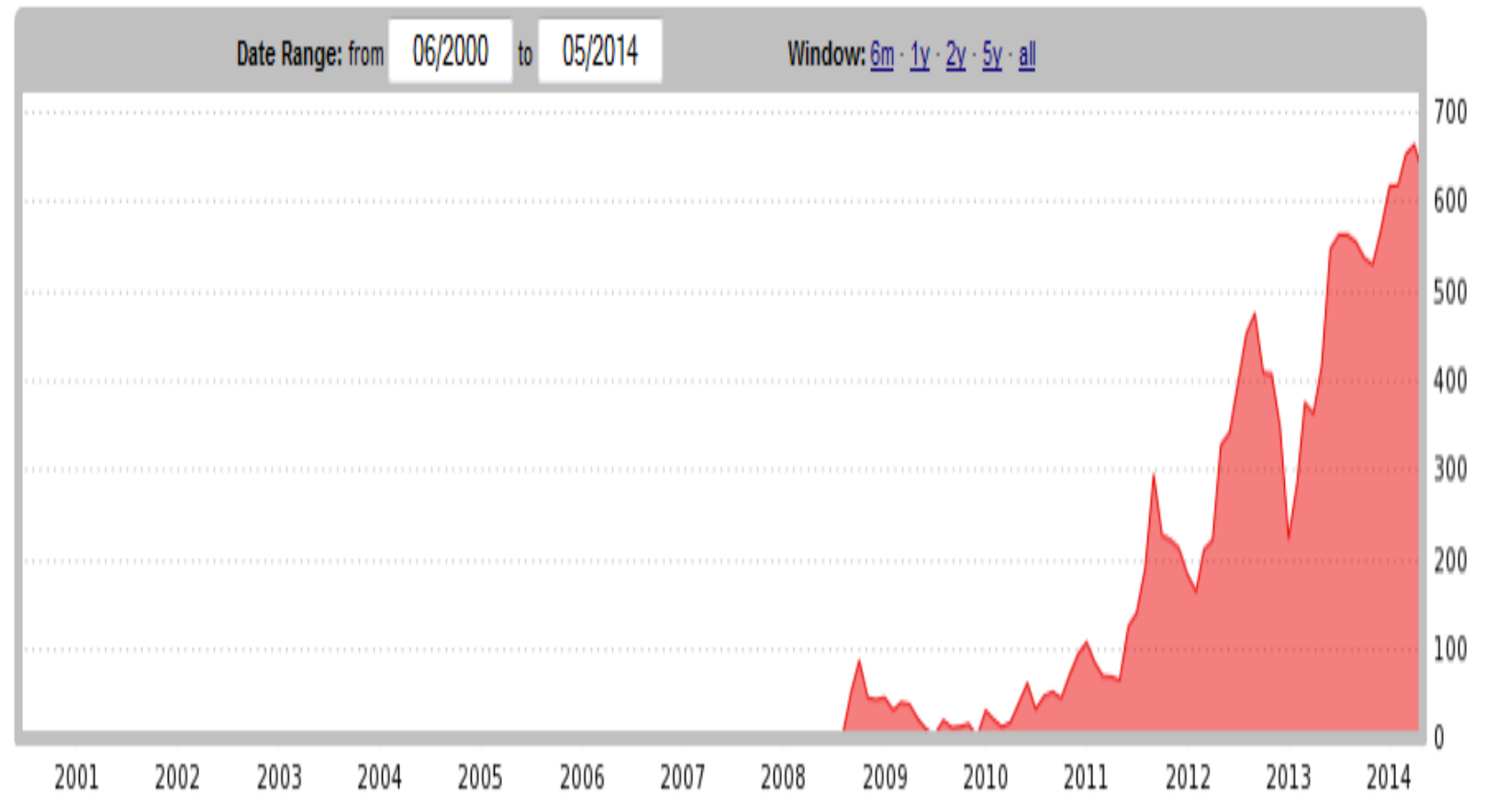
ASIA SINCE 2000

Risk Analysis Overview - Asia Financials Total SRISK (US\$ billion)



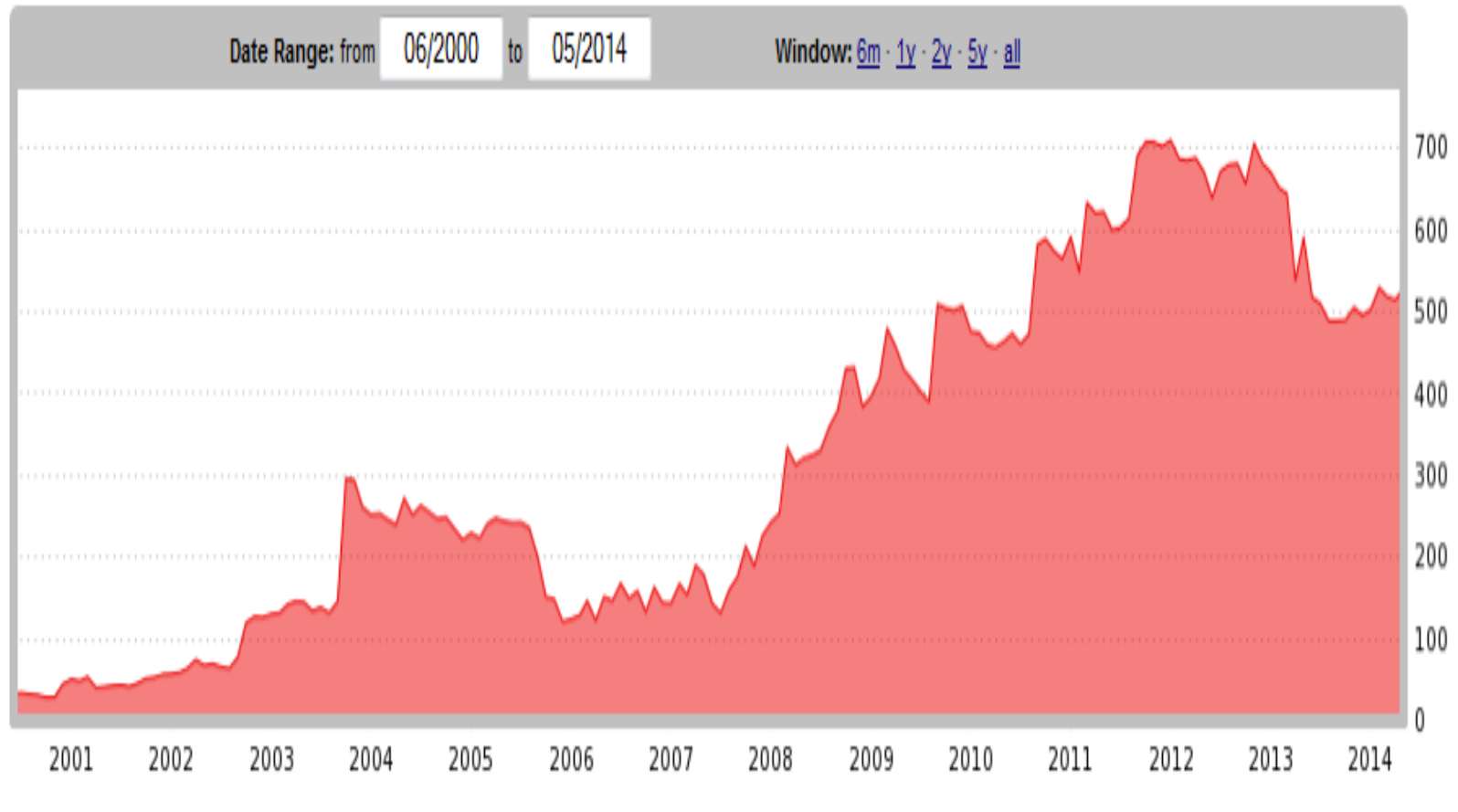
CHINA

Risk Analysis Overview - China Financials Total SRISK (US\$ billion)

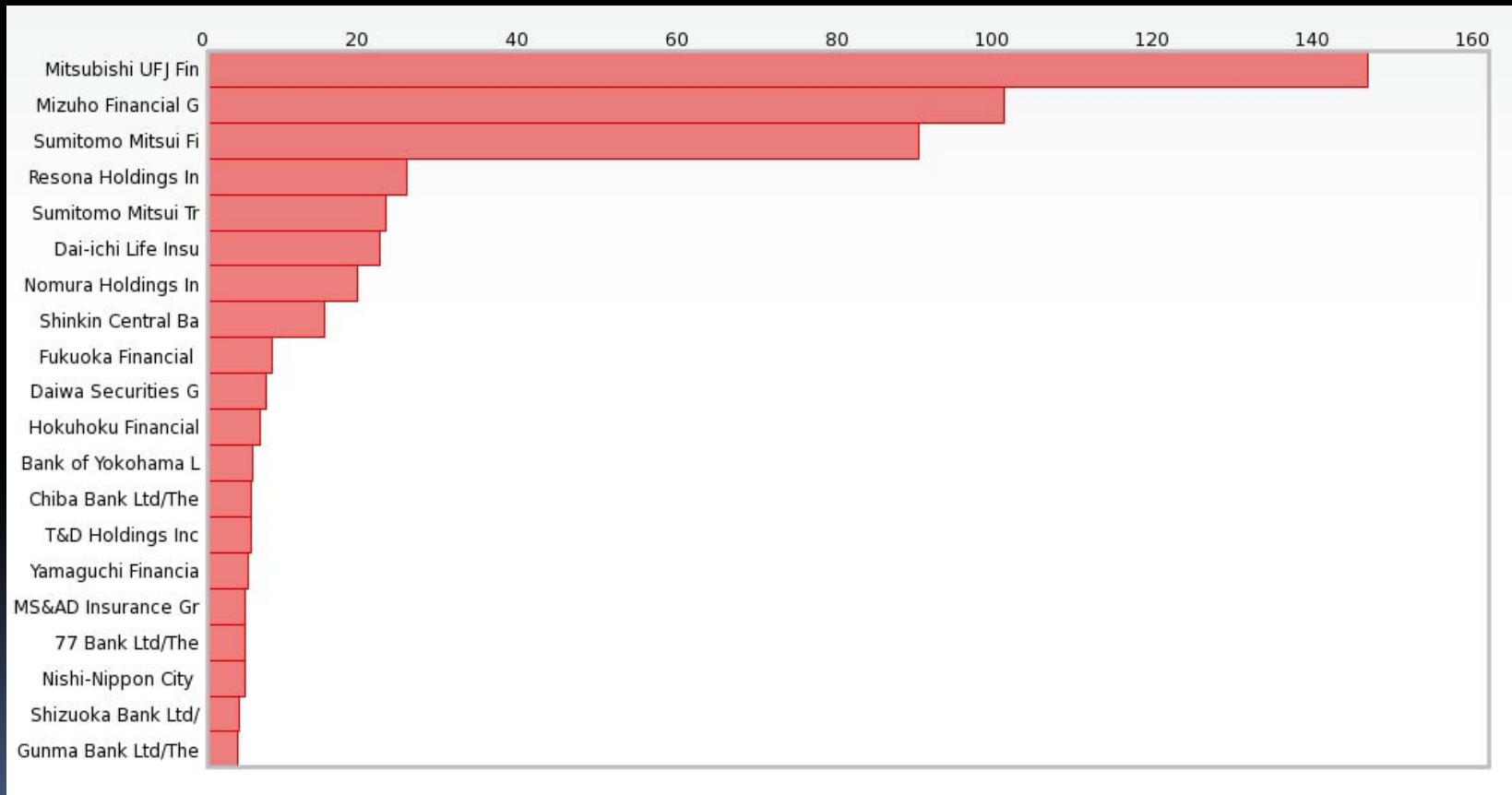


JAPAN

Risk Analysis Overview - Japan Financials Total SRISK (US\$ billion)



WHERE IS THE RISK

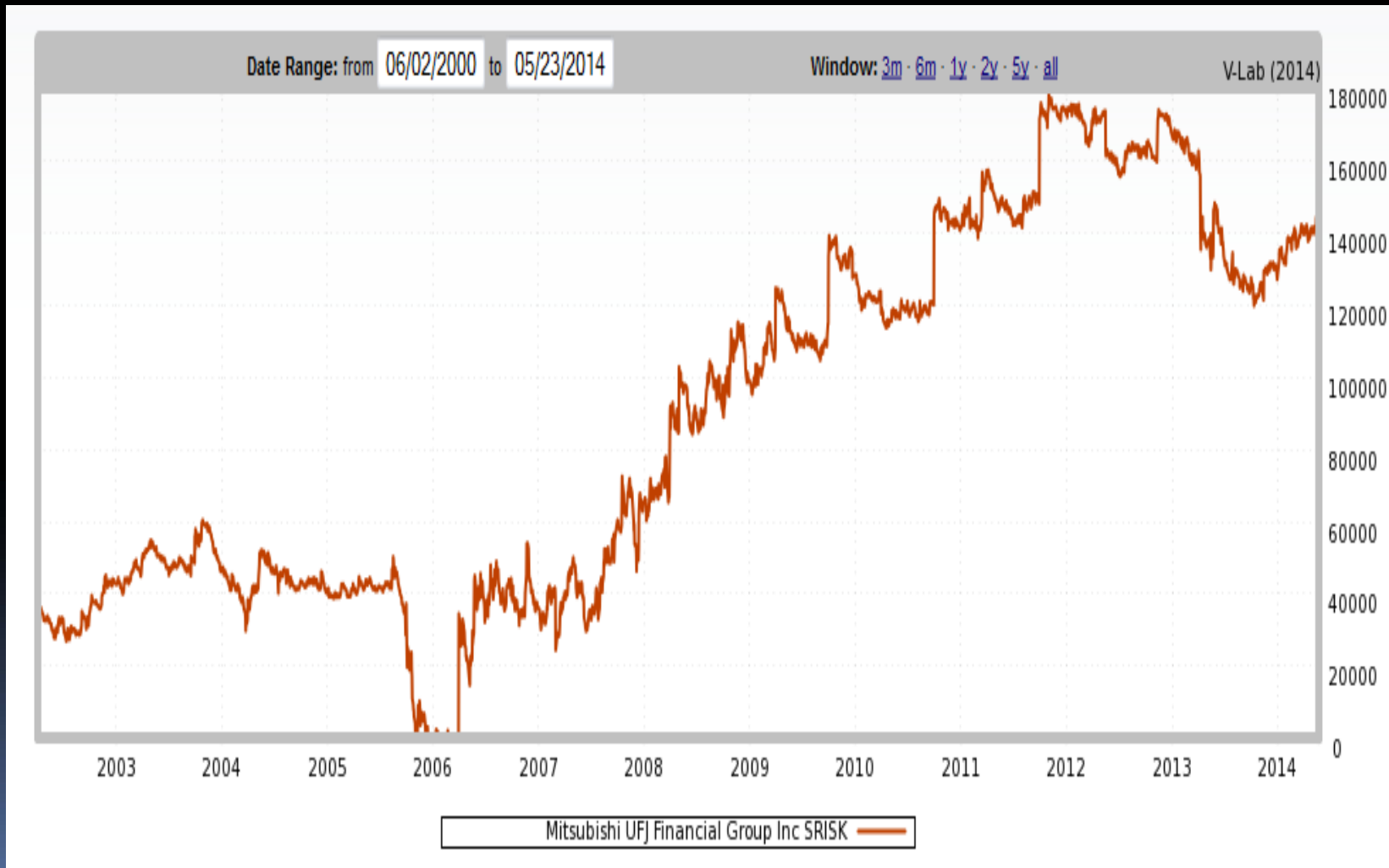


FIRM DETAILS

Systemic Risk Rankings for 2014-05-23 View changes

<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>Mitsubishi UFJ Financial Group Inc</u>	27.35	1	144,751	2.82	1.14	0.09	31.2	30.78
<u>Mizuho Financial Group Inc</u>	18.78	2	99,422	1.85	0.73	0.05	20.5	36.02
<u>Sumitomo Mitsui Financial Group Inc</u>	16.77	3	88,749	2.95	1.17	0.12	30.9	27.99
<u>Resona Holdings Inc</u>	4.67	4	24,712	1.49	0.60	0.02	23.6	35.41
<u>Sumitomo Mitsui Trust Holdings Inc</u>	4.18	5	22,139	3.02	1.22	0.08	35.1	25.09
<u>Dai-ichi Life Insurance Co Ltd/The</u>	4.04	6	21,375	4.15	1.70	0.13	35.2	24.68
<u>Nomura Holdings Inc</u>	3.52	7	18,607	2.97	1.21	0.07	31.0	17.24
<u>Shinkin Central Bank</u>	2.75	8	14,544	-0.43	-0.17	-0.19	10.2	34.25
<u>Fukuoka Financial Group Inc</u>	1.49	9	7,900	1.75	0.72	0.03	22.3	36.08
<u>Daiwa Securities Group Inc</u>	1.37	10	7,247	3.30	1.34	0.10	34.7	14.02

MITSUBISHI UFJ SRISK



MIZUHO



SUMITOMO



CHANGES SINCE 12/31/12

Systemic Risk Rankings for 2014-05-23 View changes since: 2012-12-31

<u>Institution</u>	<u>SRISK (t)</u> ▼	<u>SRISK (t - 1)</u>	<u>Δ SRISK</u>	<u>Δ(DEBT)</u>	<u>Δ(EQUITY)</u>	<u>Δ(RISK)</u>
<u>Mitsubishi UFJ Financial Group Inc</u>	144,751.3	168,051.8	-23,300.4	-23,674.5	-1,901.1	2,275.2
<u>Mizuho Financial Group Inc</u>	99,421.9	135,969.0	-36,547.1	-33,065.7	-1,205.7	-2,275.7
<u>Sumitomo Mitsui Financial Group Inc</u>	88,748.8	103,309.5	-14,560.7	-17,235.1	-2,142.1	4,816.5
<u>Resona Holdings Inc</u>	24,712.0	33,838.1	-9,126.1	-8,446.0	-417.4	-262.7
<u>Sumitomo Mitsui Trust Holdings Inc</u>	22,138.9	25,156.0	-3,017.1	-2,697.2	-745.7	425.9
<u>Dai-ichi Life Insurance Co Ltd/The</u>	21,374.9	27,181.3	-5,806.4	-5,913.7	-330.2	437.4
<u>Nomura Holdings Inc</u>	18,606.6	23,698.5	-5,091.8	-2,090.5	-1,064.7	-1,936.7
<u>Shinkin Central Bank</u>	14,543.7	22,579.2	-8,035.4	-7,768.9	385.6	-652.2
<u>Fukuoka Financial Group Inc</u>	7,899.8	9,792.1	-1,892.3	-1,847.5	-183.3	138.5
<u>Daiwa Securities Group Inc</u>	7,247.0	13,222.2	-5,975.2	-3,975.3	-1,997.0	-2.9



Don't ask....

