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China Research Luncheon
February 5, 2013

SYSTEMIC RISK IN CHINA?

SYSTEMIC RISK

- When the failure of one or more financial institutions to meet its obligations has substantial negative impacts on the real economy, then these are systemic institutions.
- We saw that Lehman bankruptcy began the worst episode of the financial crisis. But it coincided with deep distress at FANNY and FREDDIE, Citi, Bank of America, Merrill Lynch, Goldman, Morgan Stanley, AIG, WAMU, Wachovia, and many more.

SRISK - 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.

RESEARCH ON SYSTEMIC RISK

- Regulators measure this based on supervisory data and stress scenarios.
- Many other related measures are being developed or are in use by regulators in Europe and the US.
- Some measures are firm specific such as CoVaR, and network models that trace linkages. Others are financial industry quality measures such as volatility.
- Recent surveys by Brunnermeier and Oehmke and by Bisias, Flood, Lo and Valvanis cover many measures.

DOMINO VS. TSUNAMI

- The domino or network model says that one firm can be so important or interconnected that its failure will precipitate the failure of its counterparties and then they will bring down their counter parties until the sector and the real economy fails.
 - Question: what are the other dominos doing while the first are falling? What are investors doing?
 - Question: what is the difference between interconnectedness and risk sharing?
- The tsunami model is based on many institutions having large risks on the same events. If these events occur, then all the institutions will be stressed at the same time and the sector and economy will collapse.

SRISK

- SRISK is computed from:

$$\begin{aligned} SRISK_{i,t} &= E_{t-1} \left(\text{Capital Shortfall} \mid \text{Crisis} \right) \\ &= E_{t-1} \left(k \left(\text{Debt} + \text{Equity} \right) - \text{Equity} \mid \text{Crisis} \right) \\ &= k \text{Debt} - (1 - k) \left(1 - LRMES_{i,t} \right) \text{Equity}_{i,t} \end{aligned}$$

- 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:

- Bank of America has a market cap of \$114 billion. Its accounting liabilities are \$1.9 trillion for a leverage ratio of 17.9
- 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 60%.
- This reflects a Dynamic Conditional Beta of 1.7 today that will move in the future due to mean reversion in volatilities and correlations and also will rise with downside returns.
- SRISK = \$112 billion.
 - It is undercapitalized somewhat today and this will be more severe under the stress of an equity decline.

FOR EXAMPLE:

- Credit Agricole has a market cap of \$19 billion
- It has liabilities of \$2.1 trillion for a leverage ratio of 124
- Any fluctuation in asset or liability valuations can easily move the firm into bankruptcy.
- Most of the capital shortfall 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.

WHY IS THIS A MEASURE OF SYSTEMIC RISK?

- If we have a financial crisis, then all firms with positive SRISK will try simultaneously to raise capital and the only source is likely to be taxpayers. The bigger SRISK, the more serious the threat to financial stability.
- SRISK is estimated conditional on an endogenous variable – a stress test does not indicate causality.
- But how does this happen?

A MACRO-FINANCE LINK

- If any firms have high SRISK, they will recognize their vulnerability and will begin to delever and derisk, thereby impacting the real economy. If only a few firms have high SRISK, the remaining firms can take up the slack.
- As the macro economy slows, stock prices will fall, volatility will rise, and SRISK will go up more.
- Firms may delever and derisk by attempting to sell illiquid assets and hoarding cash leading to further declines in real and financial sectors.

SPIRAL

- Investors recognize financial institution weakness and lower valuations, increasing SRISK
- Forward looking investors could make this happen in one step.
- Bankruptcies and other failures will occur until eventually, the return to capital is high enough to bring new capital to the industry.

IF TAXPAYERS STEP UP

- The spiral can be arrested before the bottom.
- However, this will erode market discipline and may impose huge regulatory costs on the financial sector going forward.
- Thus regulation is needed in advance. Ideally it would be countercyclical.

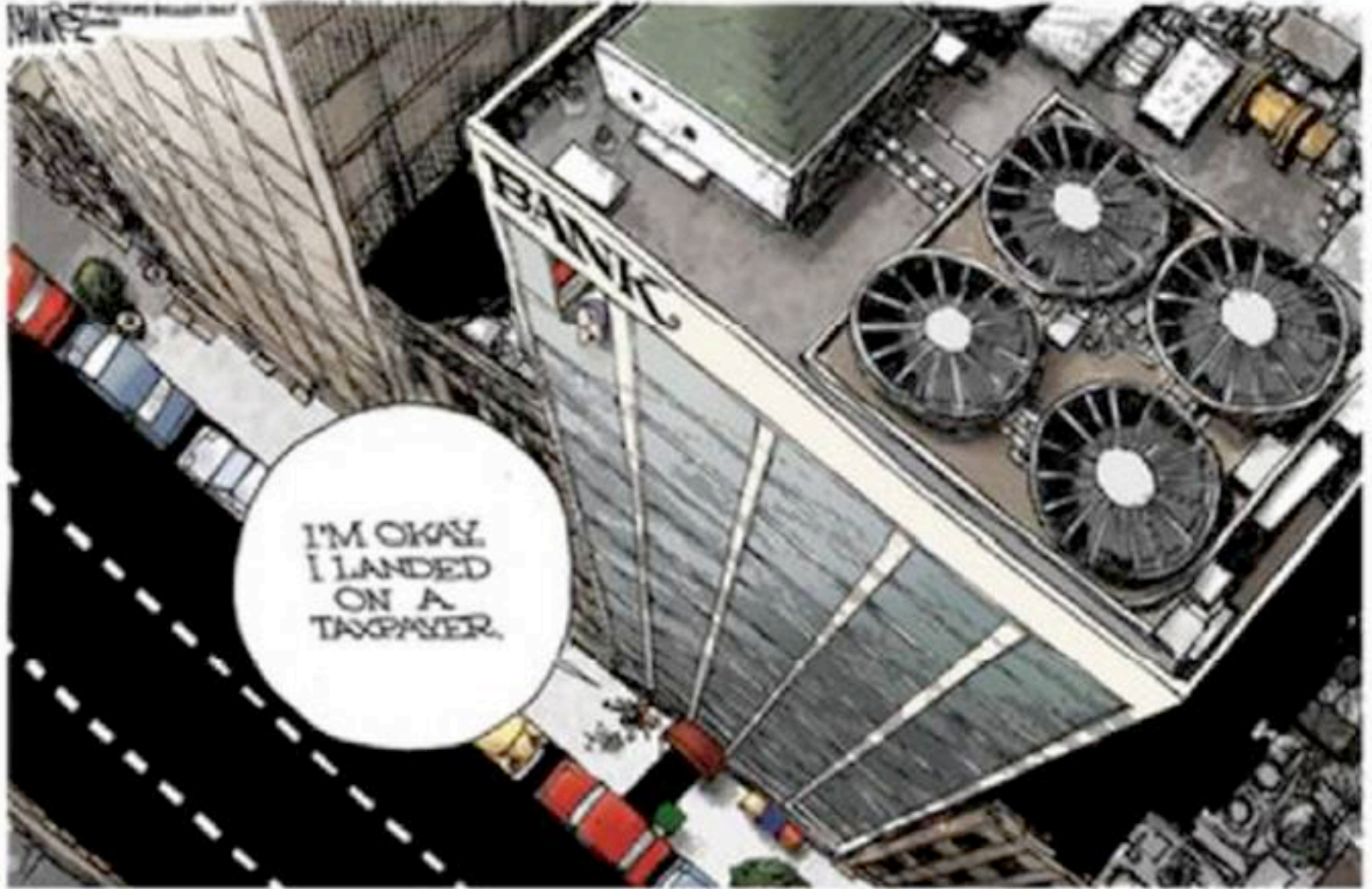
SO WHY WOULD ANY INSTITUTION HAVE POSITIVE SRISK?

- Externalities – if only one firm has high SRISK, there is no spiral.
- Implicit and Explicit government guarantees such as deposit insurance or “too big to fail”
- Regulatory incentives – the measure: “risk weighted assets” ignores correlation and hence leads to non-diversified asset mix
- Risk weights may be poor measures of risk.

MISCALCULATION

- Miscalculation: use short run risk measures to choose leverage rather than long run risk.
- Miscalculation: valuing exotic securities such as CDOs without recognizing all the risks.
- Miscalculation: housing prices can go down
- Agency problems – wall street big shots.
-Too many possibilities

REGULATION



WWW.REPRODUCTION.COM/CARTOONS







FIRM SPECIFIC CAPITAL REQUIREMENTS

- Regulators might require that firms hold sufficient capital so that their SRISK is zero. Thus they would not have to raise capital in a future crisis.
- Thus firms would be required to reduce SRISK which can be done by
 - Deleveraging
 - Demerging
 - Derisking
 - Declining to follow the herd with identical bets.

COUNTER CYCLICAL CAPITAL REQUIREMENTS

- It is best if capital requirements can be increased in good times since the banks can easily raise capital and increase their buffer.
- In bad times, it is natural to reduce requirements because new capital is very hard and expensive to raise at that time and because draconian cuts will hurt the rest of the economy.

DYNAMIC CONDITIONAL BETA

Econometrics of srisk

Time zones

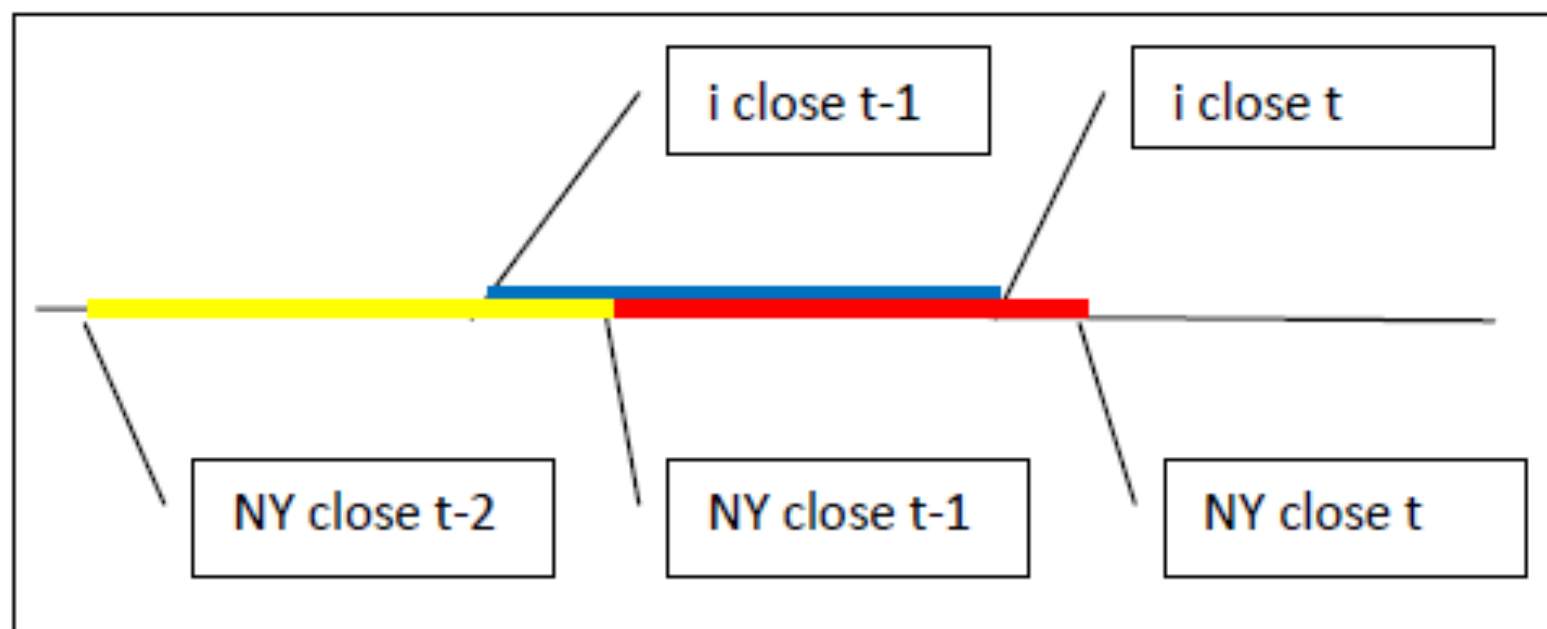


Figure 1

Model

- Condition on $t-2$
$$\begin{pmatrix} R_{i,t} \\ R_{m,t} \\ R_{m,t-1} \end{pmatrix} | \mathcal{F}_{t-2} \sim N(0, H_t)$$
- The equation
$$R_{i,t} = \beta_{i,t} R_{m,t} + \gamma_{i,t} R_{m,t-1} + u_{i,t}$$
- But u can be an MA(1) and GARCH. In fact, it must have MA(1) if R_i is to be a Martingale difference.

Nested model

- Combining the constant beta and dynamic conditional beta into one regression:

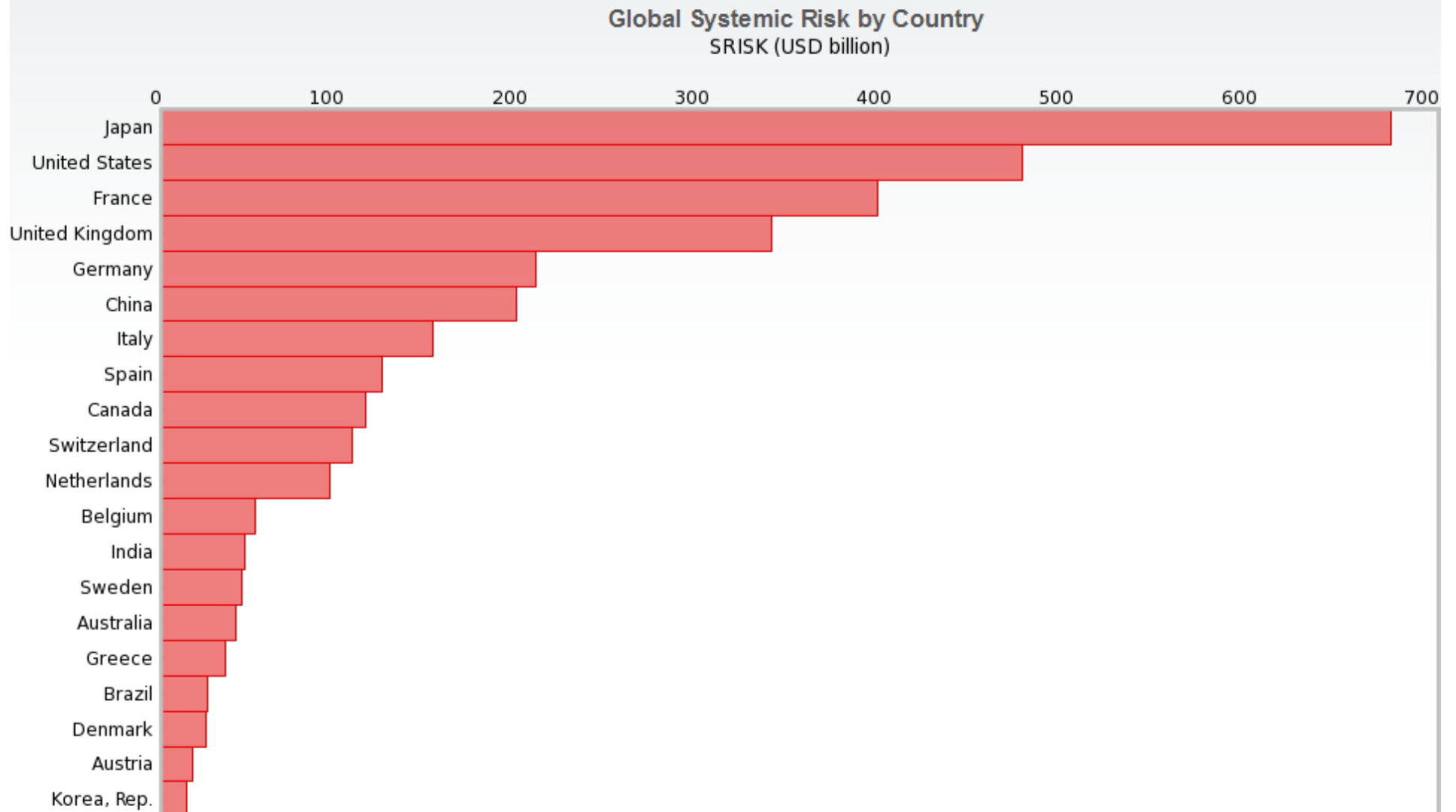
$$R_{i,t} = (\phi_1 \beta_{i,t} + \phi_2) R_{m,t} + (\phi_3 \gamma_{i,t} + \phi_4) R_{m,t-1} + u_t$$

- Where u will be an MA(1) GARCH

V-LAB

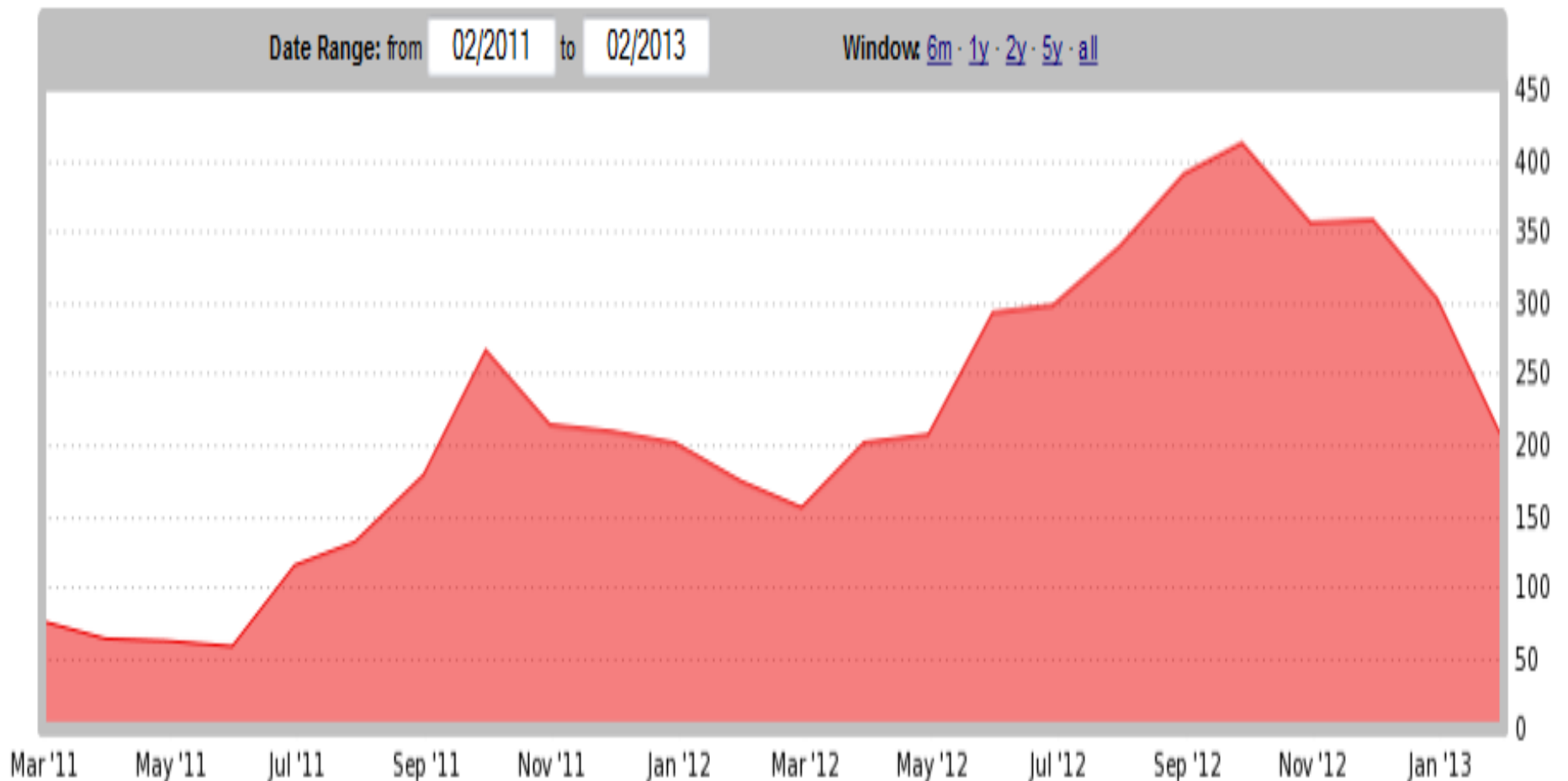
- For 1200 global financial institutions we update weekly estimates of SRISK. These now use Nested Dynamic Conditional Beta with MA(1) and GARCH.
- <http://vlab.stern.nyu.edu>
- I may also show you results correcting for differences between GAAP and IFRS accounting that are not yet on the web site.

GLOBAL SRISK



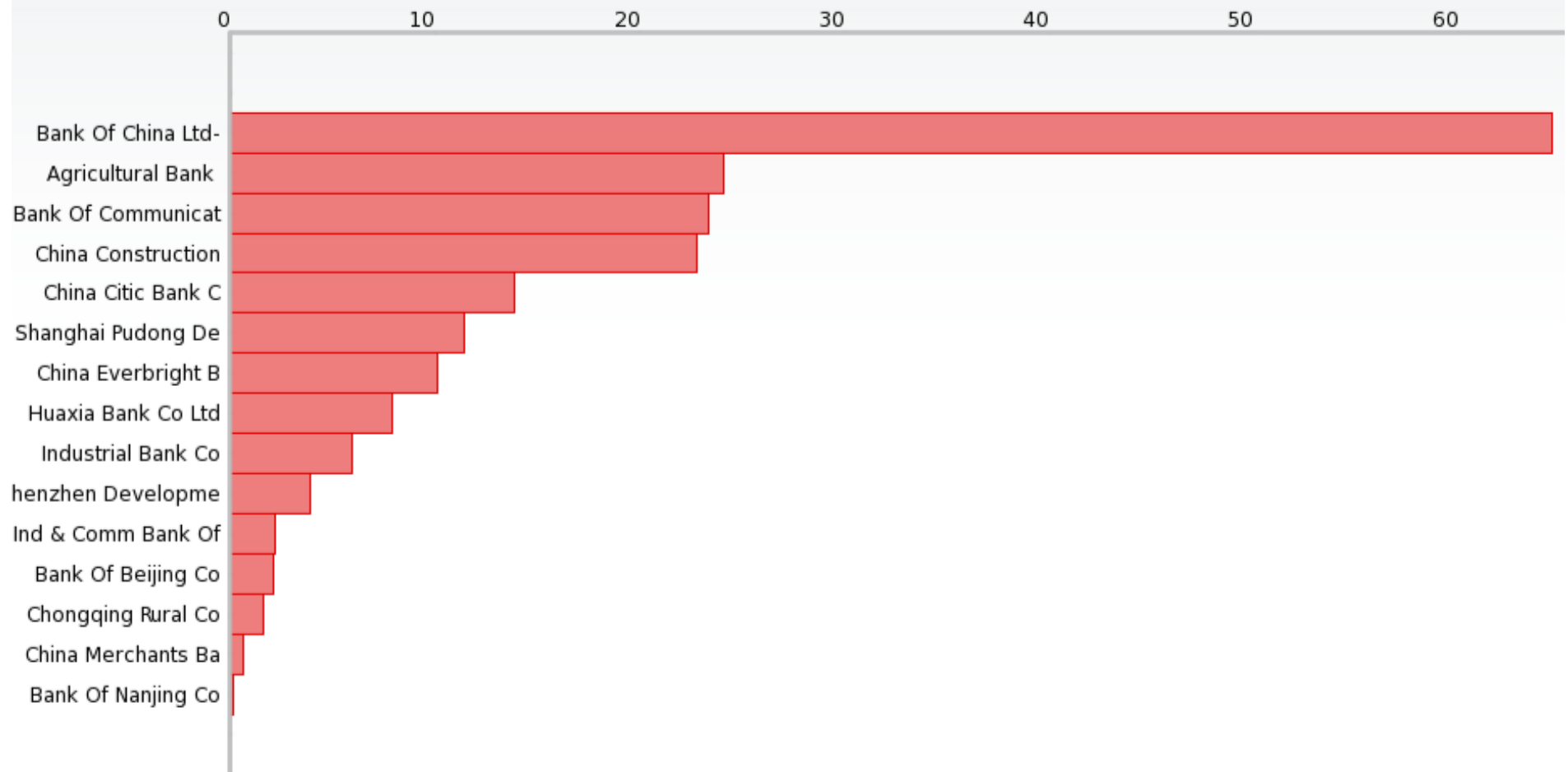
CHINESE AGGREGATE SRISK

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



SRISK FOR CHINESE INSTITUTIONS 2/4/2013

Global Systemic Risk by Country
SRISK (USD billion)

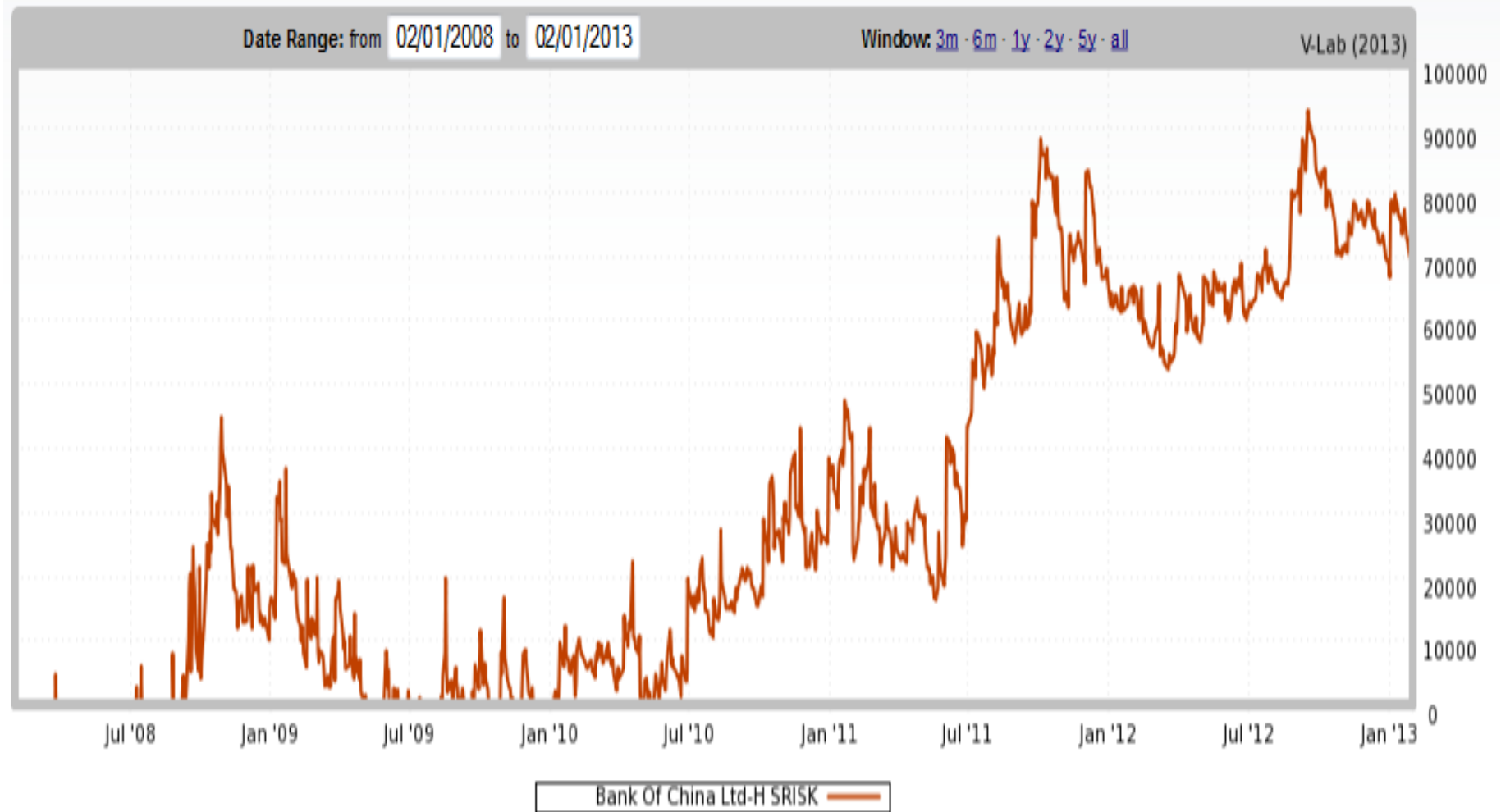


DETAILS

Systemic Risk Rankings for 2013-02-01 (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>
Bank Of China Ltd-H	33.21	1	64,565	2.25	0.96	0.28	16.3	14.37	141,595.4
Agricultural Bank Of China-A	12.38	2	24,067	0.76	0.32	0.12	28.7	12.85	165,563.1
Bank Of Communications Co-H	12.01	3	23,359	2.55	1.09	0.30	19.4	12.76	64,934.4
China Construction Bank-H	11.70	4	22,747	2.13	0.92	0.27	16.4	10.15	215,160.3
China Citic Bank Corp Ltd-H	7.11	5	13,830	2.87	1.23	0.26	30.8	12.49	37,289.1
Shanghai Pudong Development Bank-A	5.87	6	11,413	1.23	0.54	0.17	32.6	14.20	35,806.9
China Everbright Bank Co Ltd	5.19	7	10,092	1.37	0.59	0.17	36.7	15.42	23,252.9
Huaxia Bank Co Ltd	4.05	8	7,884	1.28	0.56	0.19	36	17.61	13,170.6
Industrial Bank Co Ltd -A	3.07	9	5,970	1.42	0.62	0.15	39.4	11.67	42,132.5
Shenzhen Development Bank Co	2.00	10	3,895	1.13	0.50	0.11	49.5	13.03	18,459.6
Ind & Comm Bank Of China-A	1.12	11	2,179	0.71	0.31	0.14	22.8	11.22	253,575.8
Bank Of Beijing Co Ltd	1.08	12	2,102	1.06	0.46	0.17	37.2	12.29	14,772.2
Chongqing Rural Commercial Ban	0.82	13	1,587	2.98	1.28	0.17	41.2	11.17	5,767.7
China Merchants Bank-A	0.33	14	639	1.09	0.48	0.18	37.1	10.61	51,433.4
Bank Of Nanjing Co Ltd	0.06	15	115	1.08	0.47	0.19	31.1	10.75	5,036.2
Bank of Ningbo Co Ltd	0.00	16	-185	1.31	0.58	0.17	35.3	9.68	5,818.3
China Calson Group Co Ltd	0.00	17	-593	0.92	0.39	0.10	39.2	4.04	1,104.2
Kaisa Group Holdings Ltd	0.00	18	-633	1.71	0.73	0.15	43.1	4.49	1,594.0
Tibet Urban Development and In	0.00	19	-707	0.92	0.40	0.10	32.4	2.14	1,028.4
Zhongtian Urban Development Gr	0.00	20	-774	0.91	0.40	0.09	35.8	3.39	1,310.6
Shanghai Great Wisdom Co Ltd	0.00	21	-839	1.11	0.47	0.07	40.7	1.02	1,116.4
Shui On Land Ltd	0.00	22	-1,025	2.83	1.21	0.28	27.2	3.51	2,909.4
China Baoan Group Co Ltd	0.00	23	-1,148	1.19	0.52	0.01	47.2	1.79	1,689.0
Renhe Commercial Holdings Co L	0.00	24	-1,155	1.39	0.60	0.09	64.2	2.29	1,881.5

BANK OF CHINA



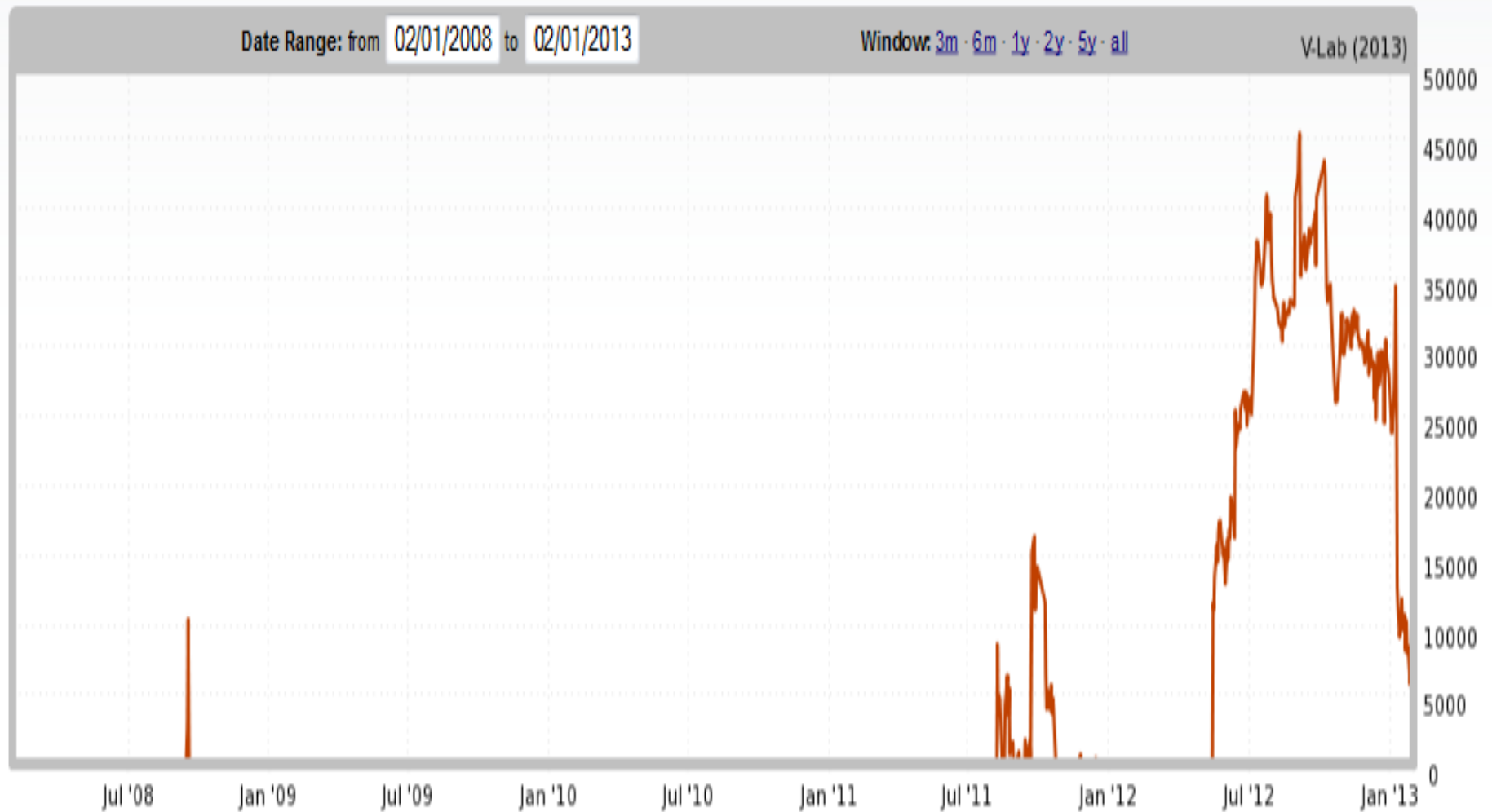
AGRICULTURAL BANK OF CHINA



CHINA CONSTRUCTION BANK



INDUSTRIAL AND COMMERCIAL BANK OF CHINA



DECOMPOSING SRISK

- The change in SRISK from one time period to another can be attributed to changes in debt, equity or risk.

$$\Delta SRISK = k \Delta DEBT - (1 - k) \left(1 - \overline{LRMES}\right) \Delta E + (1 - k) \overline{E} \Delta LRMES$$

$$\overline{LRMES} = .5 (\Delta LRMES) + LRMES(t)$$

$$\overline{E} = .5 (\Delta E) + E(t)$$

DECOMPOSITION SINCE LAST YEAR

Systemic Risk Rankings for 2013-02-01 ☒ View changes since: 2012-01-31

Institution	SRISK (t) ▼	SRISK (t - 1)	Δ SRISK	Δ(DEBT)	Δ(EQUITY)	Δ(RISK)
Bank Of China Ltd-H	66,423.6	63,981.8	2,441.8	18,065.1	-7,239.8	-8,383.4
Agricultural Bank Of China-A	25,155.8	23,388.1	1,767.7	19,516.2	-19,703.9	1,955.5
Bank Of Communications Co-H	24,276.8	26,017.8	-1,741.1	10,358.2	-8,850.1	-3,249.2
China Construction Bank-H	22,504.2	20,191.0	2,313.2	19,764.3	-9,373.8	-8,077.3
Ind & Comm Bank Of China-A	18,235.0	-16,423.0	34,658.0	33,681.8	-10,862.8	11,839.0
China Citic Bank Corp Ltd-H	13,862.3	8,666.3	5,196.0	8,229.8	-3,154.0	120.2
Shanghai Pudong Development Bank-A	11,378.1	8,794.3	2,583.8	7,960.1	-6,455.5	1,079.2
China Everbright Bank Co Ltd	9,973.5	1,730.0	8,243.5	9,794.1	-3,060.5	1,509.9
Huaxia Bank Co Ltd	8,408.3	2,991.3	5,417.0	4,733.6	-174.0	857.4
Industrial Bank Co Ltd -A	5,651.4	7,288.7	-1,637.3	11,087.9	-13,475.1	749.9
Shenzhen Development Bank Co	4,560.0	4,373.2	186.8	3,532.7	-3,574.4	228.5
China Merchants Bank-A	4,359.6	-2,143.8	6,503.4	8,630.7	-5,295.7	3,168.4
Bank Of Beijing Co Ltd	2,599.2	2,815.5	-216.3	3,132.7	-3,616.9	267.9
Chongqing Rural Commercial Ban	1,483.9	808.0	675.9	1,498.3	-254.3	-568.0

DECOMPOSITION

SINCE AUGUST 2008

Systemic Risk Rankings for 2013-02-01 ☒ View changes since: 2008-08-29

Institution	SRISK (t) ▼	SRISK (t - 1)	Δ SRISK	Δ(DEBT)	Δ(EQUITY)	Δ(RISK)
Bank Of China Ltd-H	66,423.6	-1,574.5	67,998.1	81,188.1	-7,146.9	-6,043.2
Bank Of Communications Co-H	24,276.8	-3,090.3	27,367.1	34,352.9	-5,157.7	-1,828.1
Ind & Comm Bank Of China-A	18,235.0	-53,562.3	71,797.3	104,162.2	-10,565.2	-21,799.7
China Citic Bank Corp Ltd-H	13,862.3	-4,820.5	18,682.8	22,302.3	-4,486.7	867.2
Huaxia Bank Co Ltd	8,408.3	2,229.6	6,178.7	10,340.6	-4,453.1	291.2
Industrial Bank Co Ltd -A	5,651.4	-386.6	6,038.0	25,774.1	-17,851.4	-1,884.8
Shenzhen Development Bank Co	4,560.0	-1,015.9	5,575.9	12,805.6	-8,905.5	1,675.9
China Merchants Bank-A	4,359.6	-18,703.4	23,063.0	24,157.7	-1,213.8	119.1
Tibet Urban Development and In	-731.9	-87.6	-644.3	92.7	-778.2	41.2
Zhongtian Urban Development Gr	-808.3	-181.5	-626.7	237.0	-616.2	-247.5
Shui On Land Ltd	-1,003.5	-1,904.5	901.0	389.6	172.6	338.9
Shanghai Zhangjiang High-Tech	-1,238.7	-1,575.8	337.1	66.8	215.0	55.3
China Baoan Group Co Ltd	-1,250.4	-418.8	-831.5	64.8	-915.3	19.0
Beijing Capital Development Co	-1,355.4	-416.3	-939.1	513.3	-1,216.4	-236.0

CHANGE OVER 3 MONTHS

Systemic Risk Rankings for 2013-02-01 ☐ View changes since: 2012-10-31 ☐

Institution	SRISK (t) ▼	SRISK (t - 1)	Δ SRISK	Δ(DEBT)	Δ(EQUITY)	Δ(RISK)
<u>Bank Of China Ltd-H</u>	66,423.6	70,070.6	-3,647.0	0.0	-13,814.6	10,167.6
<u>Agricultural Bank Of China-A</u>	25,155.8	53,398.1	-28,242.3	0.0	-27,255.4	-986.9
<u>Bank Of Communications Co-H</u>	24,276.8	29,319.6	-5,042.8	0.0	-7,896.8	2,854.0
<u>China Construction Bank-H</u>	22,504.2	40,340.4	-17,836.2	-1,527.1	-17,428.5	1,119.5
<u>Ind & Comm Bank Of China-A</u>	18,235.0	32,392.6	-14,157.6	0.0	-27,350.5	13,192.8
<u>China Citic Bank Corp Ltd-H</u>	13,862.3	19,529.1	-5,666.7	0.0	-6,353.4	686.7
<u>Shanghai Pudong Development Bank-A</u>	11,378.1	21,142.4	-9,764.2	0.0	-9,877.2	112.9
<u>China Everbright Bank Co Ltd</u>	9,973.5	13,362.3	-3,388.7	0.0	-4,463.8	1,075.1
<u>Huaxia Bank Co Ltd</u>	8,408.3	10,586.0	-2,177.7	0.0	-2,880.4	702.6
<u>Industrial Bank Co Ltd -A</u>	5,651.4	20,171.5	-14,520.1	0.0	-15,060.4	540.2
<u>Shenzhen Development Bank Co</u>	4,560.0	9,632.7	-5,072.8	0.0	-5,613.3	540.5
<u>China Merchants Bank-A</u>	4,359.6	13,170.8	-8,811.2	0.0	-11,056.4	2,245.1

CHINESE MUNICIPAL DEBT



Li Meng, SERI Quarterly, April 2012

- In early 2008 Local Government Debt in China was 1.7 trillion yuan. At the end of 2010 it was 10.7 trillion or 27% of GDP (National Audit Office June 2011)
- Local Governments cannot borrow directly and established 6,576 special financing vehicles.
- 8.5 trillion yuan are from bank loans due 2011-2013

NATIONAL AUDIT OFFICE REPORT

JAN 3, 2012

- 530 billion yuan of irregularities in local government debt
 - 46 billion in irregular credit guarantees
 - 73 billion secured with irregular collateral
 - 35 billion spent on stocks, housing and polluting plants
 - 132 billion not made by approved deadline
 - 244 billion of fraudulent underpayment of registered capital in financing vehicles
- Orders to correct these irregularities have only been partially successful thus far.

EXPLANATION

- Local governments are not permitted to borrow or issue bonds
- Local government tax revenues grew more slowly than expenditures
- Stimulus was allocated to local expenditures and exacerbated the problem.

Stimulus

- 4 trillion yuan (\$618 billion) allocated to 10 areas including including low-income housing, rural infrastructure, water, electricity, transportation, the environment, technological innovation, and reconstruction from several disasters.
- Financed by 1.2 trillion from central government and the rest by local governments. They set up financing vehicles and borrowed massively from the banks as credit standards were eased and regulators shifted flows to local governments.
- Net interest margins shrunk because of macroeconomic policy; banks expanded loans to make up the revenue.

BANKS RELIED ON LOAN INCOME

Table 1 Percentage of Net Interest Income in Gross Business Income of Chinese Listed Commercial Banks

Bank		Net interest income	Business income	Percentage of net interest income(%)
Industrial and Commercial Bank of China	ICBC	245,821,000,000.00	309,454,000,000.00	79
Bank of China	BOC	158,881,000,000.00	232,198,000,000.00	68
China Construction Bank	CCB	211,885,000,000.00	267,184,000,000.00	79
Hua Xia Bank	HXB	15,807,187,606.44	17,129,634,873.02	92
Bank of Communications	BoComm	66,564,000,000.00	80,937,000,000.00	82
Bank of Nanjing		3,166,853,137.01	3,627,610,531.53	87
Bank of Beijing		10,953,922,000.00	11,894,105,000.00	92
China Citic Bank	CNCB	35,984,000,000.00	40,801,000,000.00	88
China Minsheng Banking Corp.	CMBC	32,240,000,000.00	42,060,000,000.00	77
China Merchants Bank	CMB	40,364,000,000.00	51,446,000,000.00	79
Shanghai Pudong Development Bank	SPDB	33,538,388,090.24	36,823,932,168.81	91
Bank of Ningbo	NBCB	3,553,900,000.00	4,175,506,000.00	85
Shenzhen Development Bank	SDB	12,984,374,000.00	15,114,440,000.00	86
Industrial Bank	IB	27,201,737,211.91	31,679,045,403.17	86
Average				84

Source: Finchina Financial Analysis Platform.

WILL THESE LOANS PERFORM?

- Chief revenue source for local governments is land sales which are slowing. Inflation fears will lead to macroeconomic tightening which will further slow this growth.
- Projects have long lives and cannot cover interest payments in the short run. More than half of China's GDP growth over the last couple of years is based on fixed investment. But such stimulus is not necessarily commercially viable on its own.
- Much of this borrowing is off balance sheet using government land or assets as collateral.
- Recently WSJ reported that all municipal loans were rolled over at the end of 2012.

GROWTH OF SOEs

- Bank lending to state owned enterprises grew rapidly in this period presumably as these were more secure.
- Growth of SOEs at the expense of private firms is likely to slow economic growth
- SOEs reportedly invested in real estate rather than core businesses.

SOLUTIONS FOR MUNICIPAL DEBT

- Debt forgiveness or rollover are temporary fixes.
- Municipalities need greater access to funds. Need tax reform to give more sources.
- Municipalities need to be able to issue bonds which would make financing more transparent. This is now being experimentally tried.

SUMMARY

CAUSES OF SYSTEMIC RISK

- “TOO BIG TO FAIL” guarantee leads each institution to take more risk than socially or privately optimal.
- “LEVERAGE EXTERNALITY” leads each bank to take more leverage than is socially optimal
- “RISK MYOPIA” leads institutions to take long run positions based on short run risks.
- “HERDING” leads each institution to choose same investment portfolio. Regulation may also do this.
- “REGULATION” must offset these incentives.

ARE CHINESE BANKS SYSTEMIC?

- They are state-owned and will surely be rescued should they need it.
- The sovereign has \$3 trillion of reserves so rescue should be easy. However, selling these \$ assets will make it hard to manage exchange rates.
- Total SRISK is only \$200 billion today.
- Off balance sheet items are likely to be important so SRISK is probably understated.
- Financial equity may be more valuable because of the guarantees and hence lead to lower SRISK.

AND NOW THE ANSWER?

- The causes of systemic financial risk are all very apparent in the Chinese setting thus the risk to the financial sector is likely to grow.
- Regulation may offset these incentives if it is effective.
- FSB lists only Bank of China as GSIFI.
- My Guess – probably not now but pay attention!



Don't ask...