WHAT'S NEW IN V-LAB

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April 26,2013

Volatility Conference on "Volatility of Credit Risk"

NEW YORK UNIVERSITY
NYU STERN
LEONARD N. STERN SCHOOL OF BUSINESS

MEASURING AND FORECASTING VOLATILITY OF CREDIT DEFAULT SWAPS

WHY IS THIS INTERESTING?

- How much short run risk is an investor incurring by buying or selling a CDS?
- How much margin must a central counterparty charge to be certain that it can replace a CDS of a failed agent?
- How volatile is the asset value of a firm?
- How volatile is the probability of default?

WHAT DO WE MEAN BY VOLATILITY OF CDS

- If I purchase a CDS contract today and sell it tomorrow I will have either a capital gain or loss. Since the "big bang" this is entirely measured by the "up front" payment since coupons are fixed. However previously CDS were traded as spreads and still today Markit reports spreads, making it easy to compare with corporate bond spreads.

PRICING CDS

- At initiation, a CDS is priced so that it has no value to either buyer or seller. In this case the present value of protection is just equal to the present value of the payment for protection.
- Over time the two sides diverge and the value of a CDS contract will become either positive or negative.

WHAT VOLATILITY TO MEASURE?

- The short run risk of CDS owner or writer is the change in the "up front" payment. The volatility is therefore the volatility of the percent change in "up front" which is approximately proportional to the change in spread, not the change in log spread.
- For other purposes the volatility of the change in log spread may be of most interest.
- Fortunately

$$Vol_{t-1}\left(\Delta spread_t\right) \cong Vol_{t-1}(\Delta \log(spread_t)) * spread_{t-1}$$

TESTING WHICH TO MEASURE

- ESTIMATE MODEL FOR $\Delta spread$
- ESTIMATE MODEL FOR $\Delta \log(spread)$
- And compare their accuracy for forecasting realized changes in spread using Patton's consistent loss function. We will use QUASI LIKELIHOOD

$$QLIKE^1 = -.5\sum_{t=1}^{T}\left(\log(h_t) + \frac{(\Delta spread)^2}{h_t}\right),\ h_t = Vol_{t-1}(\Delta spread)$$

$$QLIKE^2 = -.5\sum_{t=1}^{T}\left(\log(g_t * spread_{t-1}) + \frac{(\Delta spread_t)^2}{g_t * spread_{t-1}^2}\right),\ g_t = Vol_{t-1}(\Delta \log(spread))$$

TESTING

- The data prefers the model with the higher likelihood.
- The models are significantly different if the difference in the QLIKE are regressed on a constant and a robust t-statistic is significant. Cf. Diebold and Mariano and Vuong
- For GS and CAT, delta log spread is significantly better and for AA, it is better but not significantly.

STATISTICAL PROPERTIES

- DELTA LOG(SPREAD) AND DELTA(SPREAD)
- Both have very high kurtosis (7 to 1800) for logs
- Both have some serial correlation
- DELTA(SPREAD) is dramatically different before the financial crisis. It is potentially non-stationary but both models show evidence of this.
- There is little asymmetry in volatility.

MODELS

- ESTIMATE GARCH MODELS WITH MOVING AVERAGE(1) ERRORS AND A STUDENT T DISTRIBUTION WITH D.F. >=4:CDS-GARCH
- STUDENT T WITH 4 DF HAS FINITE FOURTH MOMENTS WHICH IS REQUIRED FOR CONSITENCY OF STANDARD ERRORS. TAILS FATTER THAN THIS MAY BE DIFFICULT TO ESTIMATE.
- ADD MA TERMS AND ARCH TERMS TO IMPROVE B.I.C. AND LJUNG-BOX STATS. CDS-GARCH-DYN

GARCH ESTIMATES AETNA

CDS-GARCH

Parameter Estimates

	param	t-stat
θ_1	0.08396	4.835
ω	0.11802	5.847
α	0.10785	10.861
β	0.86126	86.715
ν	4.00000	0.000

Estimation period: 2001-10-22 to 2013-04-23

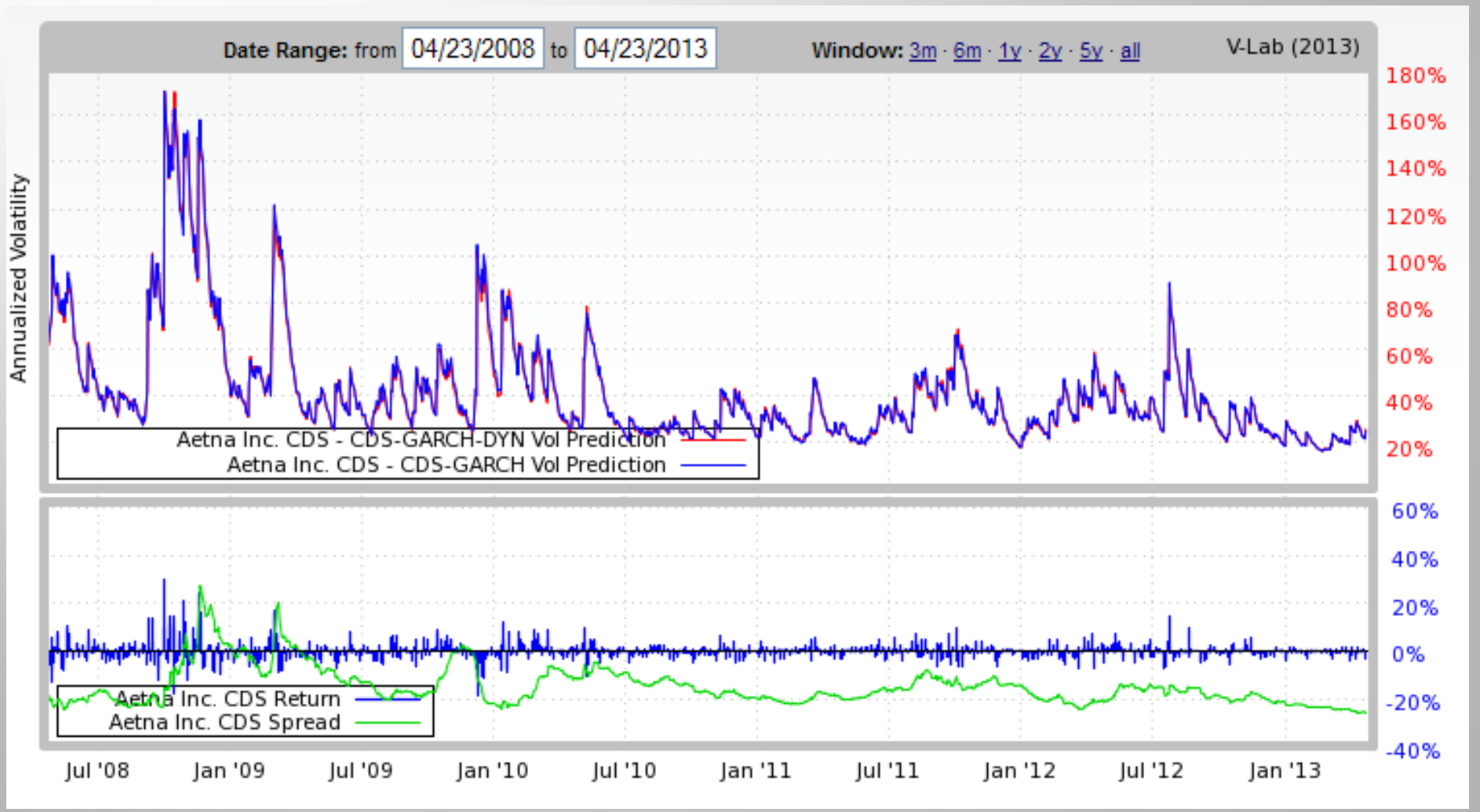
CDS-GARCH-DYN

Parameter Estimates

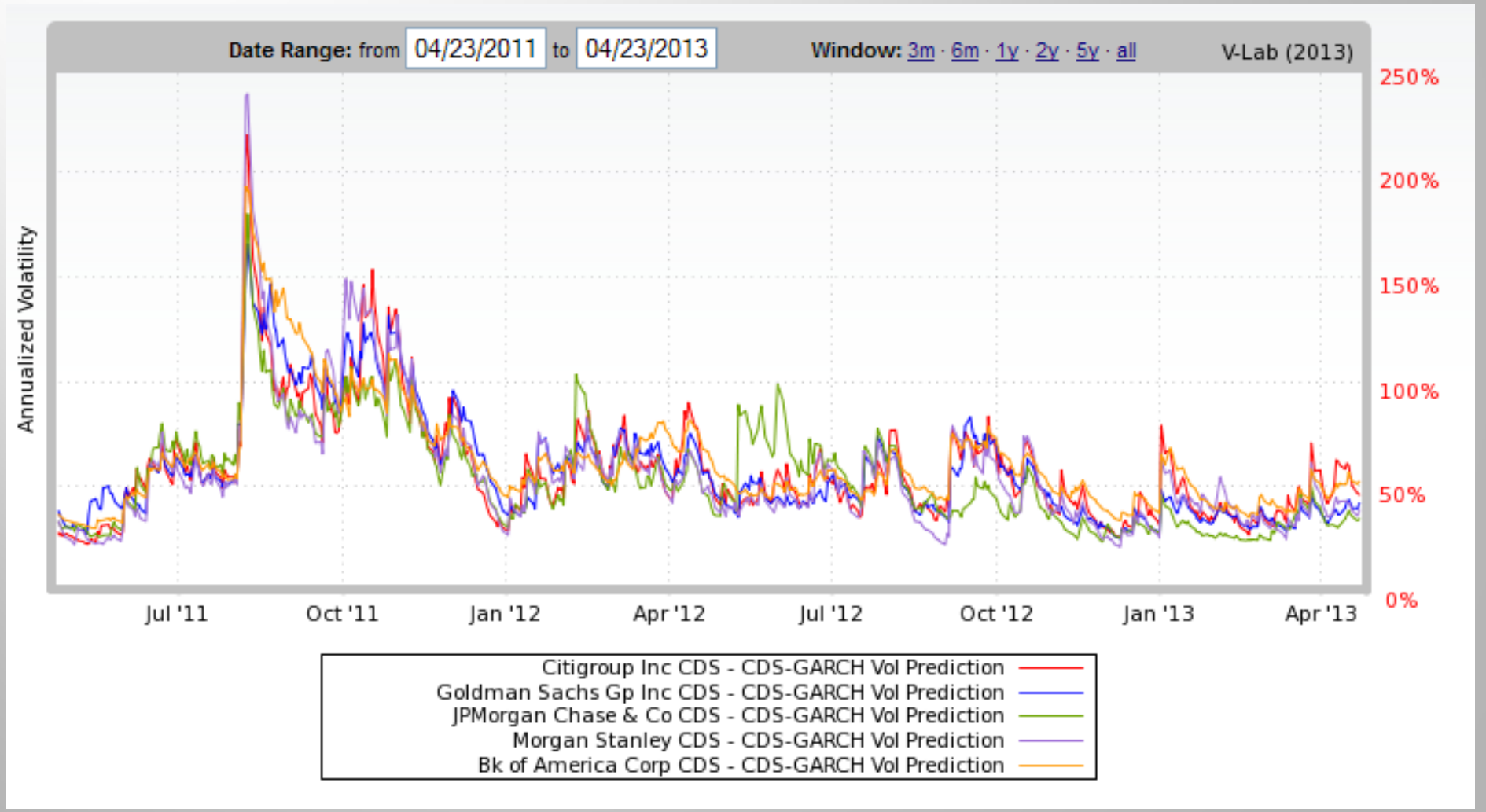
	param	t-stat
θ_1	0.08479	4.859
θ_2	0.07648	4.391
θ_3	0.04880	2.760
ω	0.12173	5.902
α_1	0.10931	10.816
β	0.85930	85.105
ν	4.00000	0.000

Estimation period: 2001-10-22 to 2013-04-23

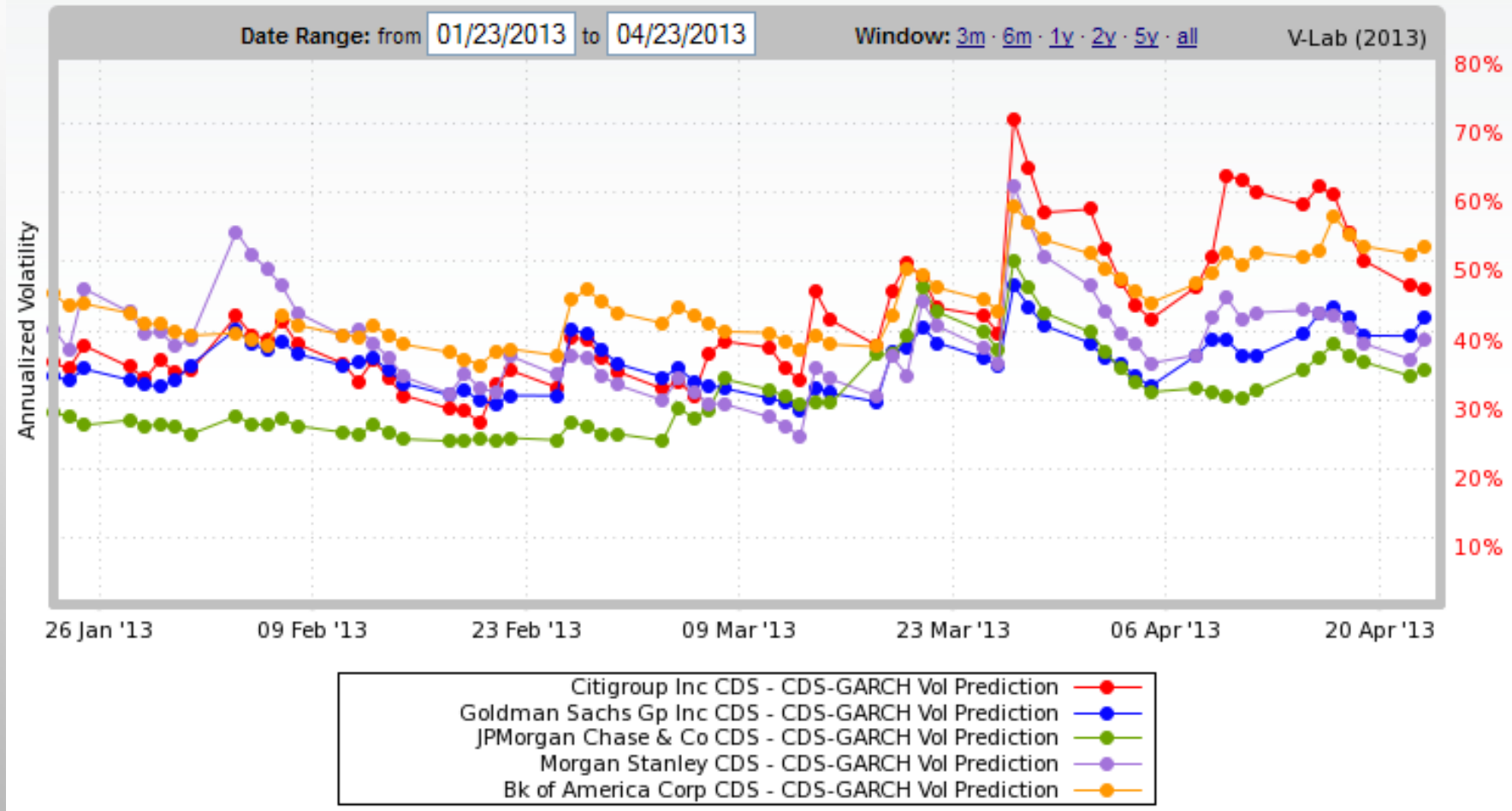
CDS-GARCH AND CDS-GARCH-DYN FOR AETNA



BIG BANKS

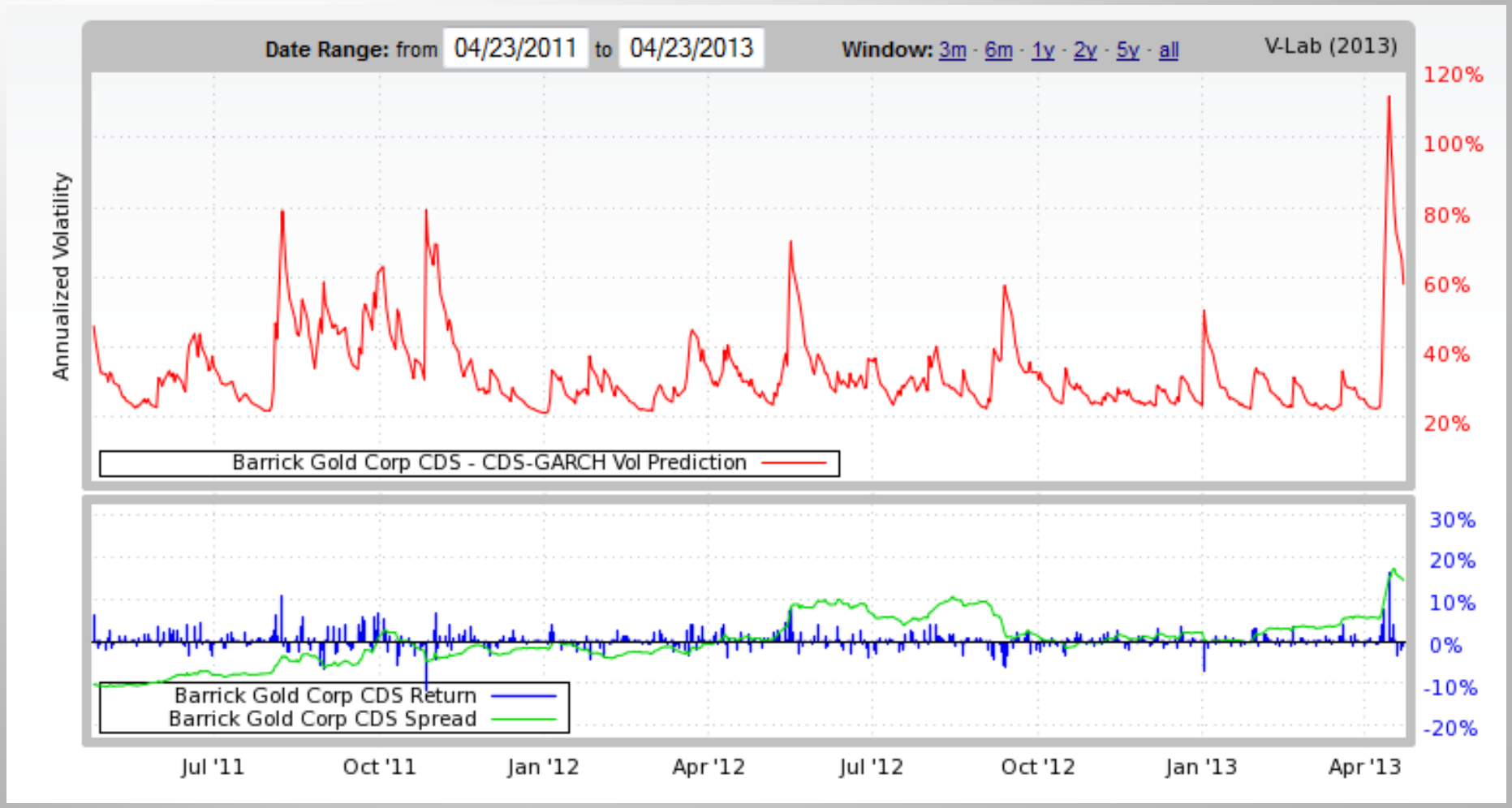

Date Range: from 04/23/2011 to 04/23/2013
Window: 3m · 6m · 1y · 2y · 5y · all
V-Lab (2013)
Annualized Volatility
250%
200%
150%
100%
50%
0%
Jul '11
Oct '11
Jan '12
Apr '12
Jul '12
Oct '12
Jan '13
Apr '13
Citigroup Inc CDS - CDS-GARCH Vol Prediction
Goldman Sachs Gp Inc CDS - CDS-GARCH Vol Prediction
JPMorgan Chase & Co CDS - CDS-GARCH Vol Prediction
Morgan Stanley CDS - CDS-GARCH Vol Prediction
Bk of America Corp CDS - CDS-GARCH Vol Prediction

RECENT CDS VOLS

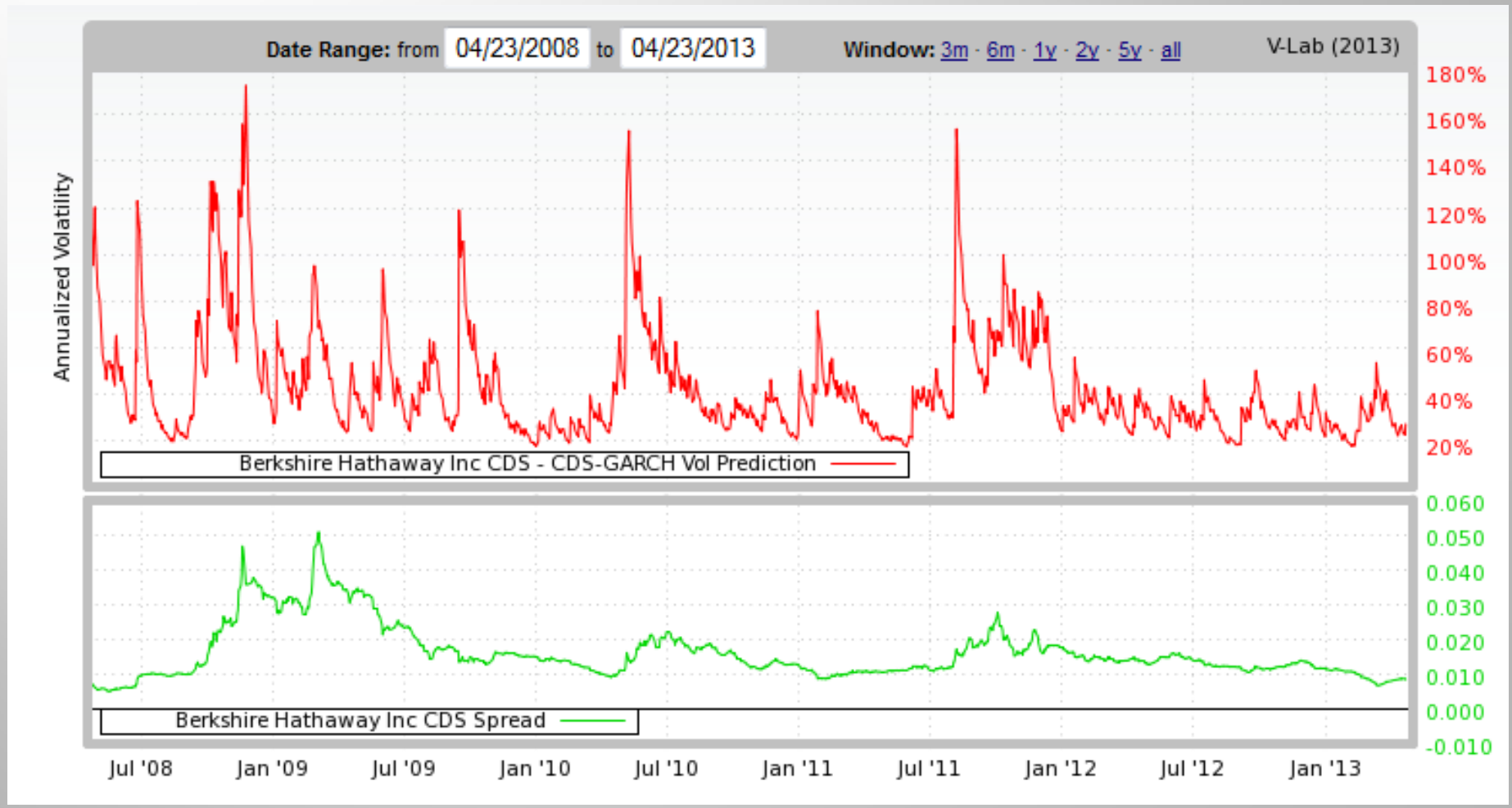


BIG BANK EQUITY VOLS

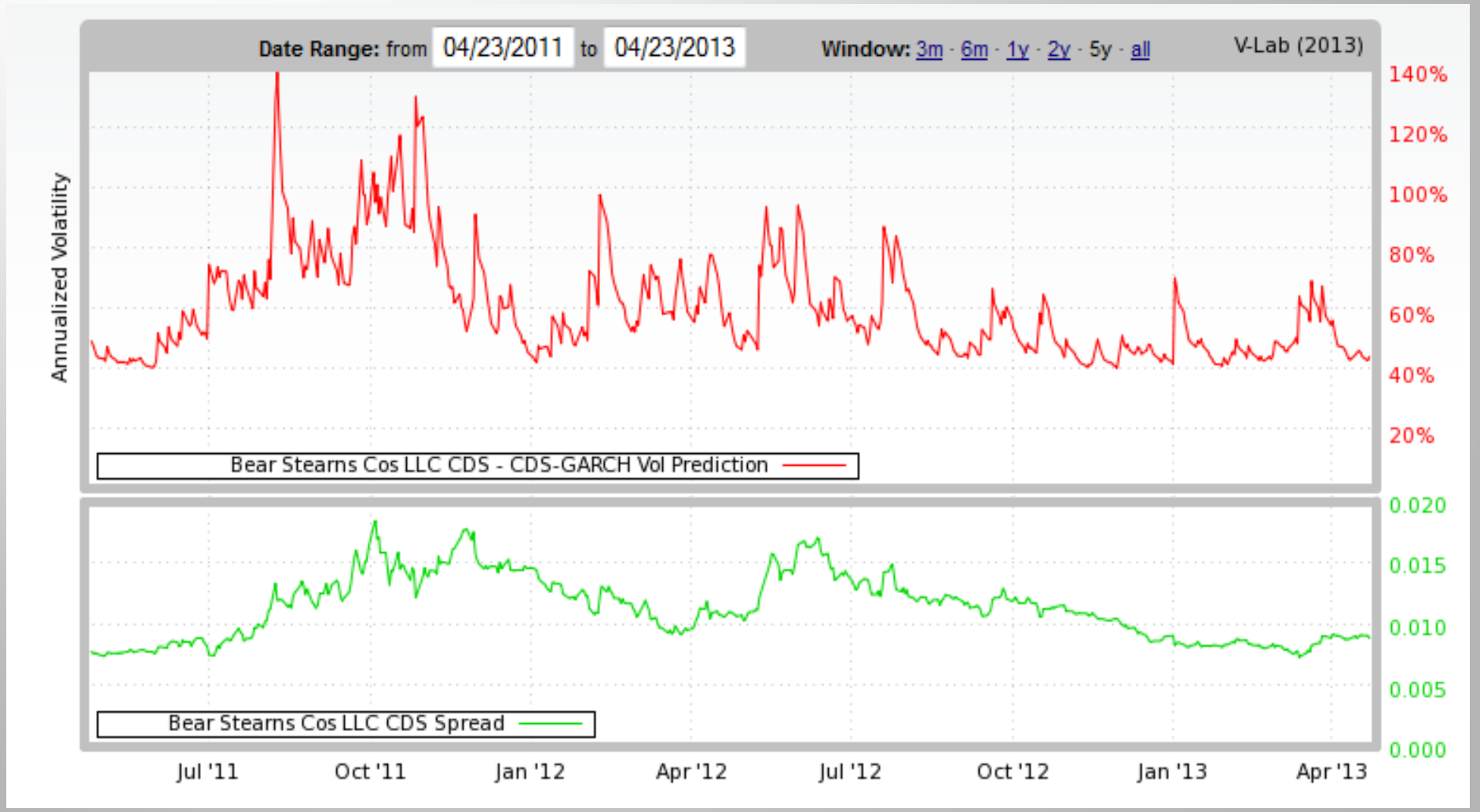
BARRICK GOLD CDS



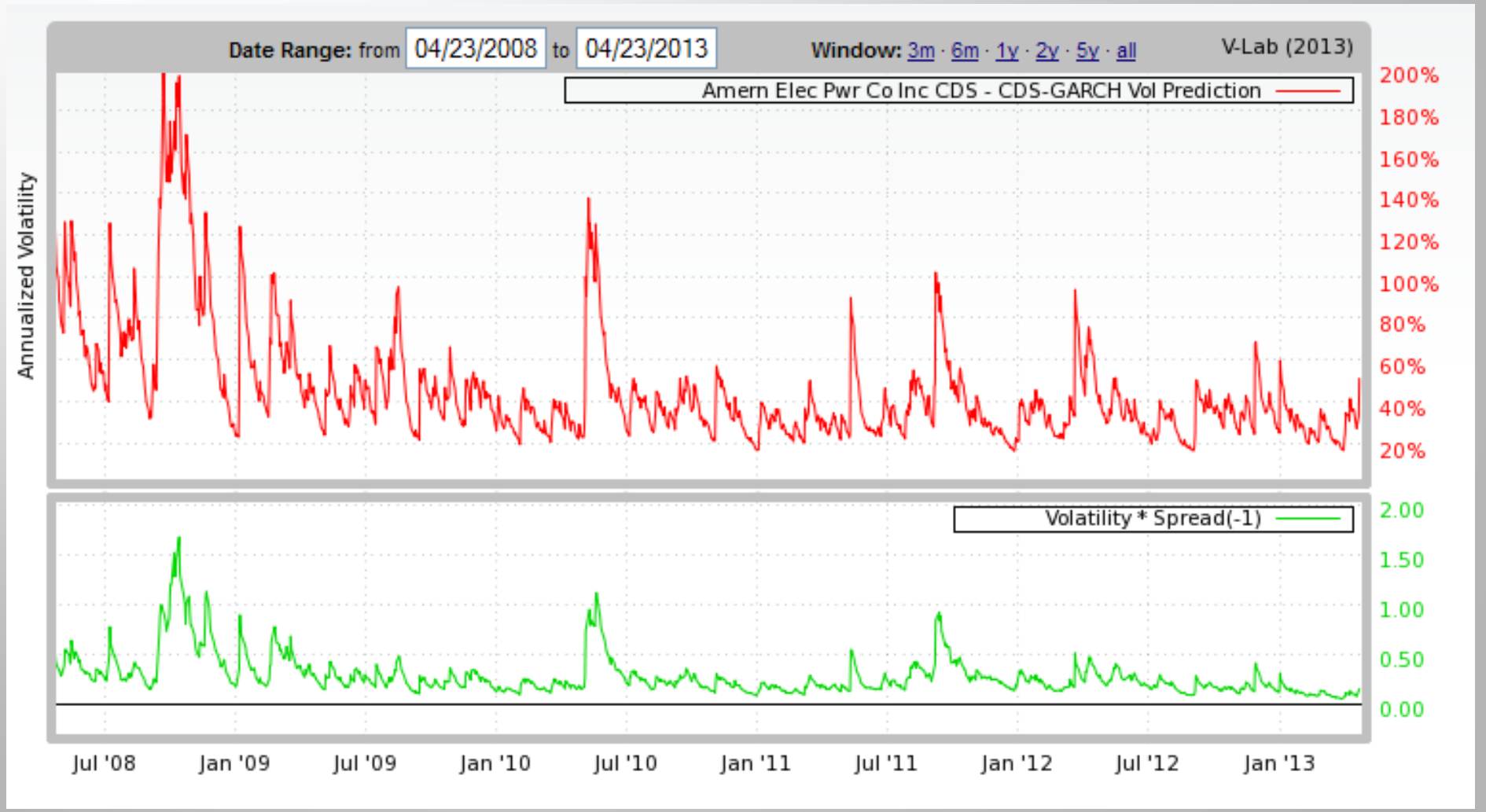
BERKSHIRE HATHAWAY CDS



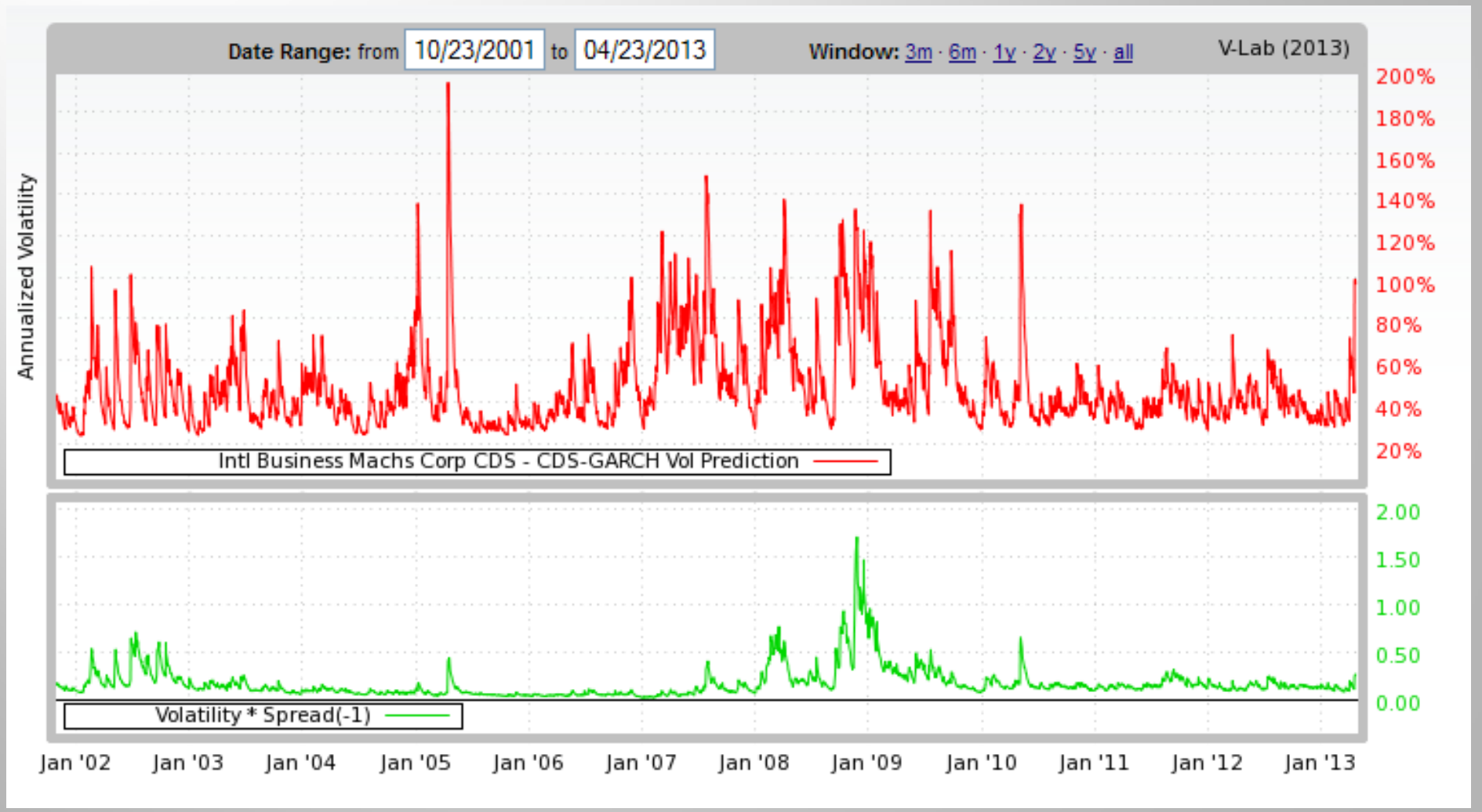
BEAR STEARNS CDS



VOLATILITY AND DELTA SPREAD VOLATILITY



IBM


Date Range: from 10/23/2001 to 04/23/2013
Window: 3m · 6m · 1y · 2y · 5y · all
V-Lab (2013)
Annualized Volatility
200%
180%
160%
140%
120%
100%
80%
60%
40%
20%
Intl Business Machs Corp CDS - CDS-GARCH Vol Prediction
2.00
1.50
1.00
0.50
0.00
Volatility * Spread(-1)
Jan '02
Jan '03
Jan '04
Jan '05
Jan '06
Jan '07
Jan '08
Jan '09
Jan '10
Jan '11
Jan '12
Jan '13

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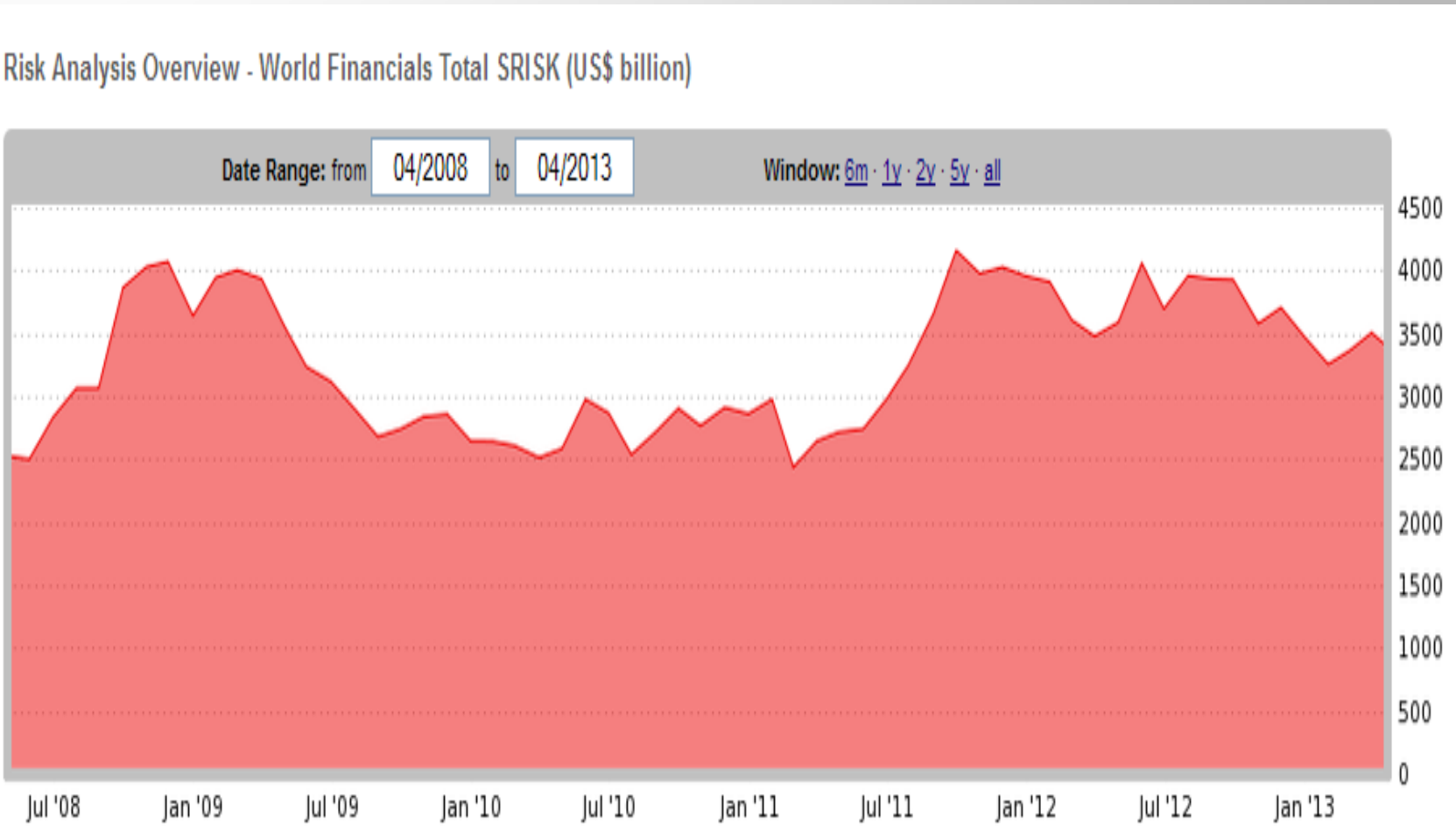
GLOBAL SYSTEMIC RISK

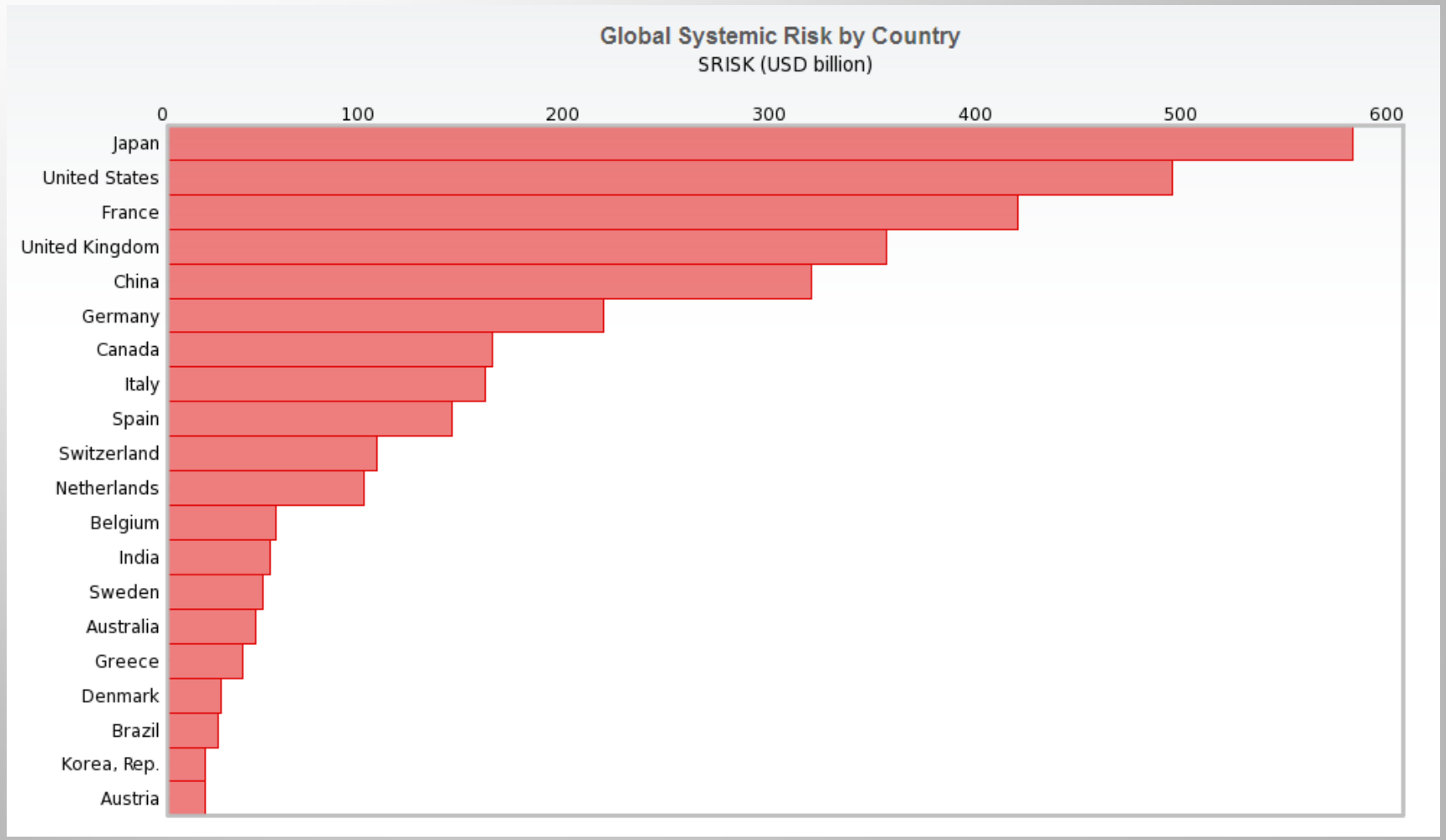
NEW FINDINGS AND ANALYSES

- SRISK is the amount of capital a financial institution would have to raise in order to function normally if we have another financial crisis.
- This is a stress test where the stress is that global equity markets fall 40% in six months. This stress does not require identifying the source.
- Bank assets will shrink as equity market falls. Beta reflects the magnitude of the decline.
- If many financial instutions are undercapitalized it will be difficult to raise capital without taxpayer help and the real economy will suffer.

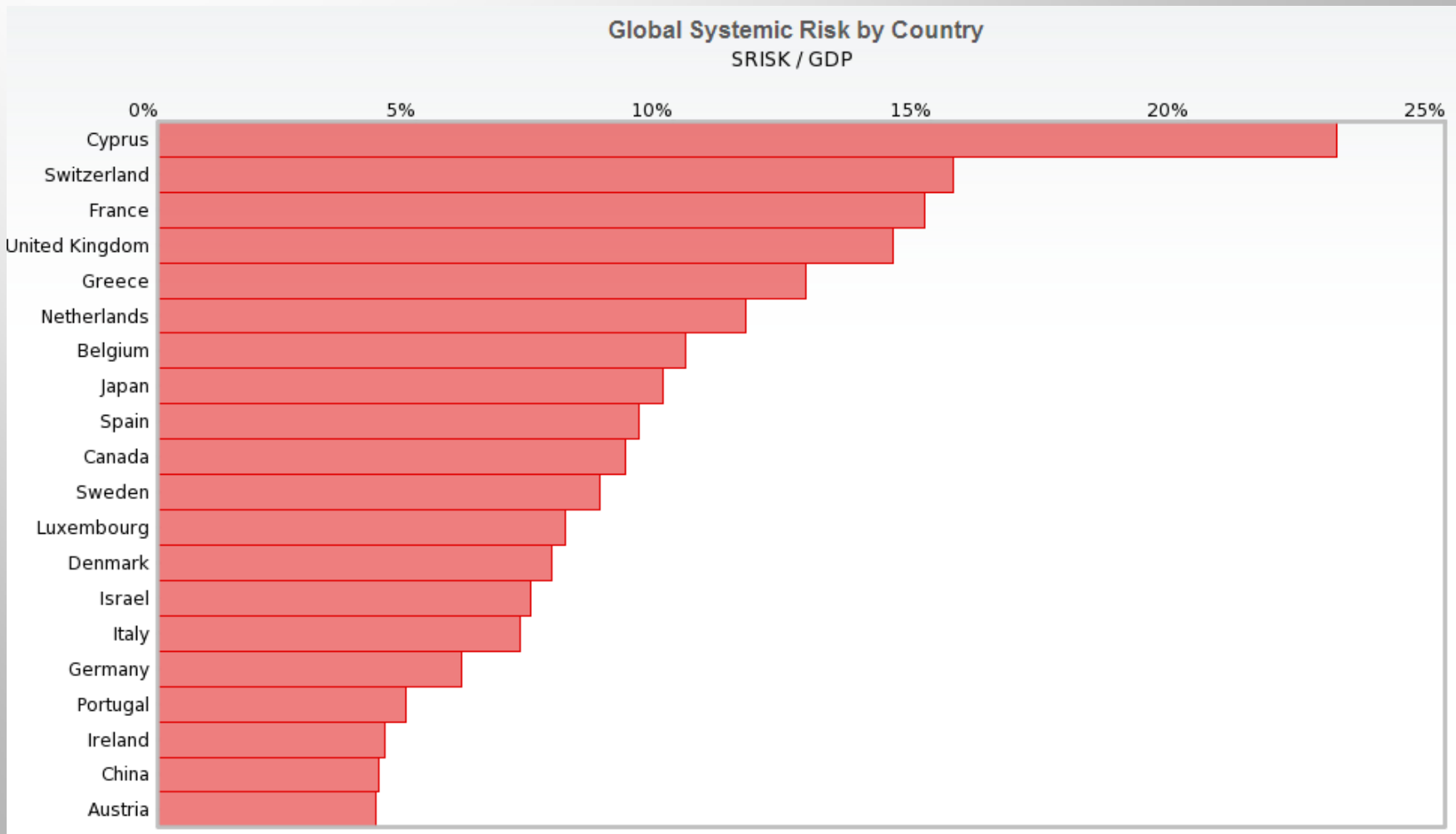
5 YEARS LATER



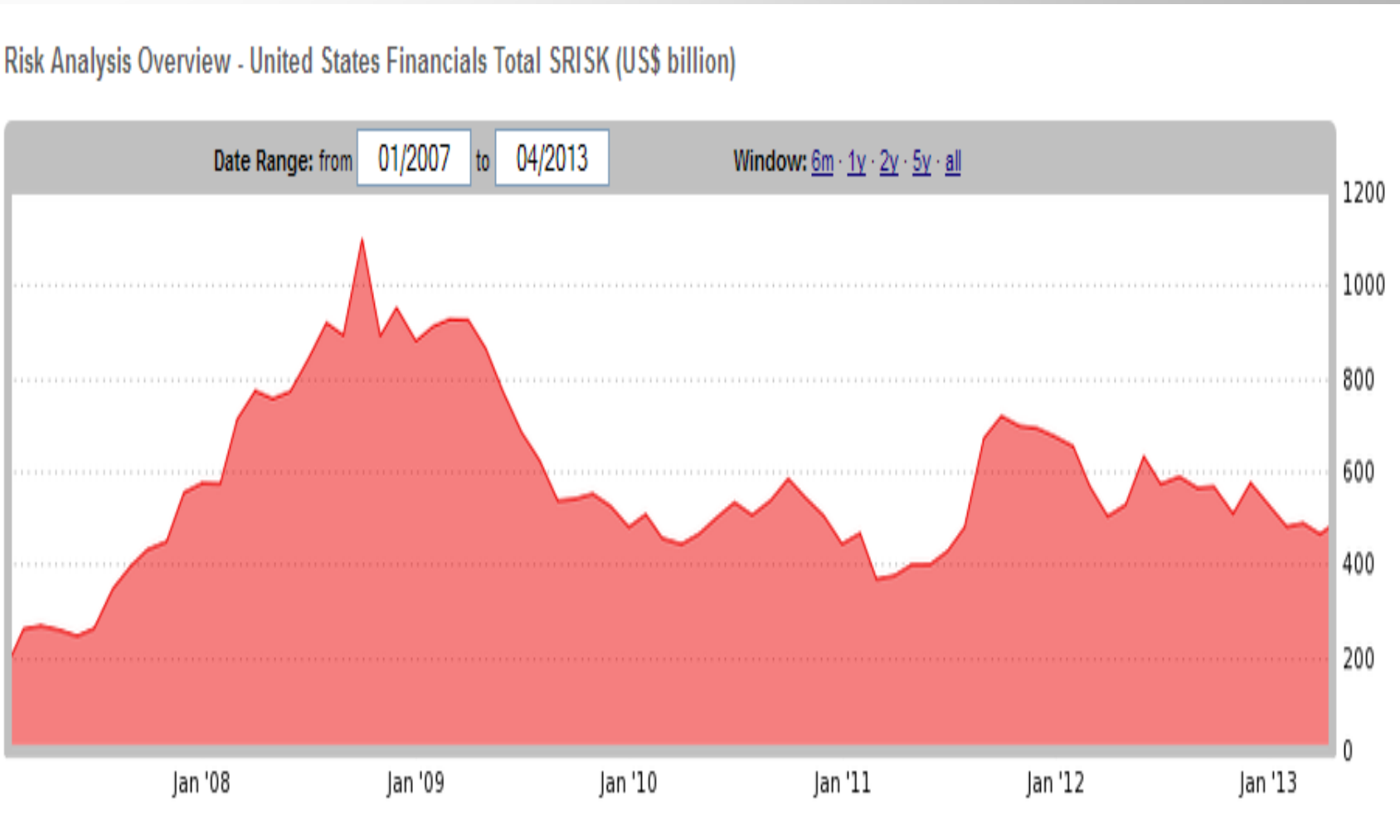
WHERE IS THE RISK?



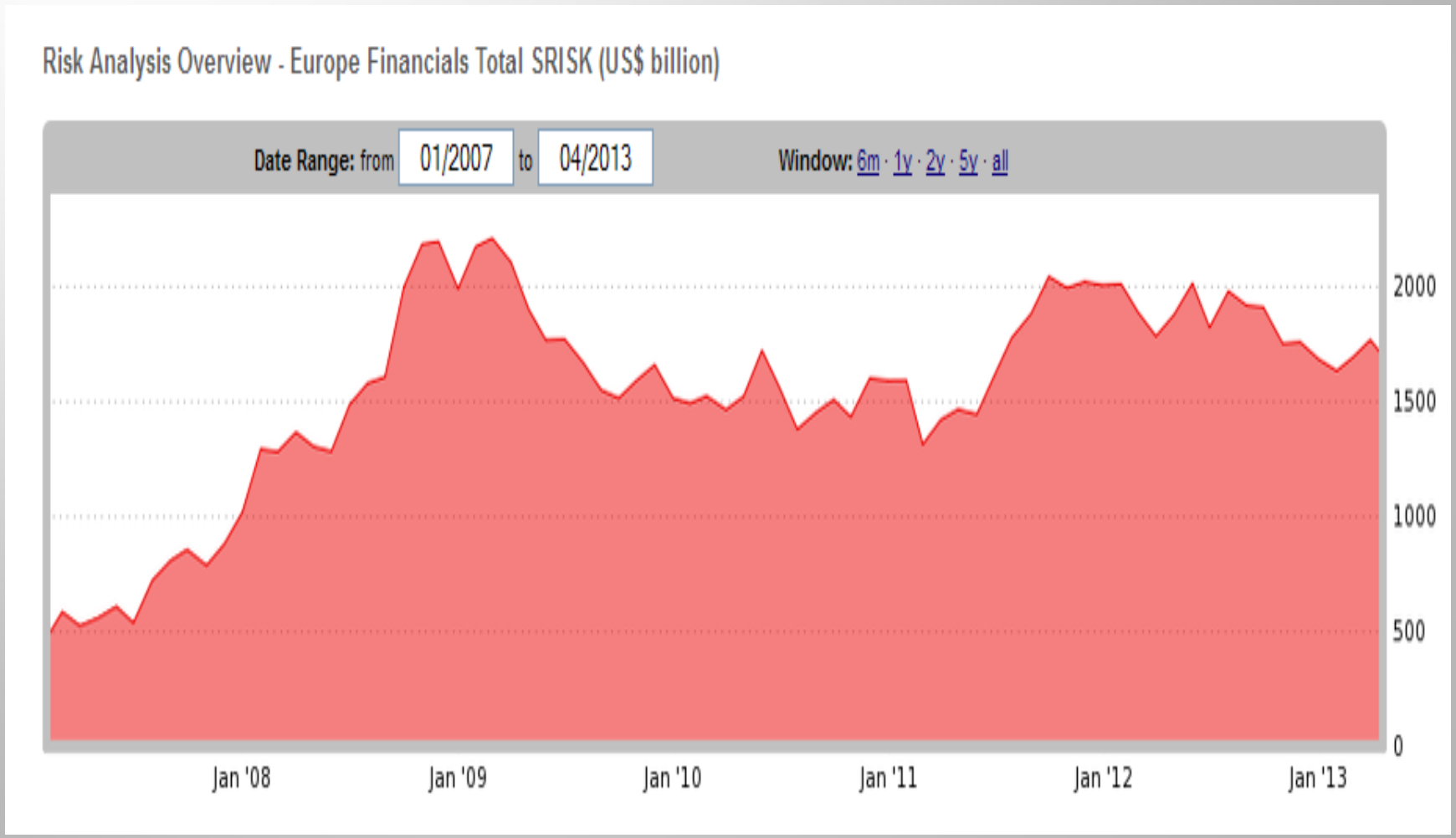
RELATIVE TO GDP



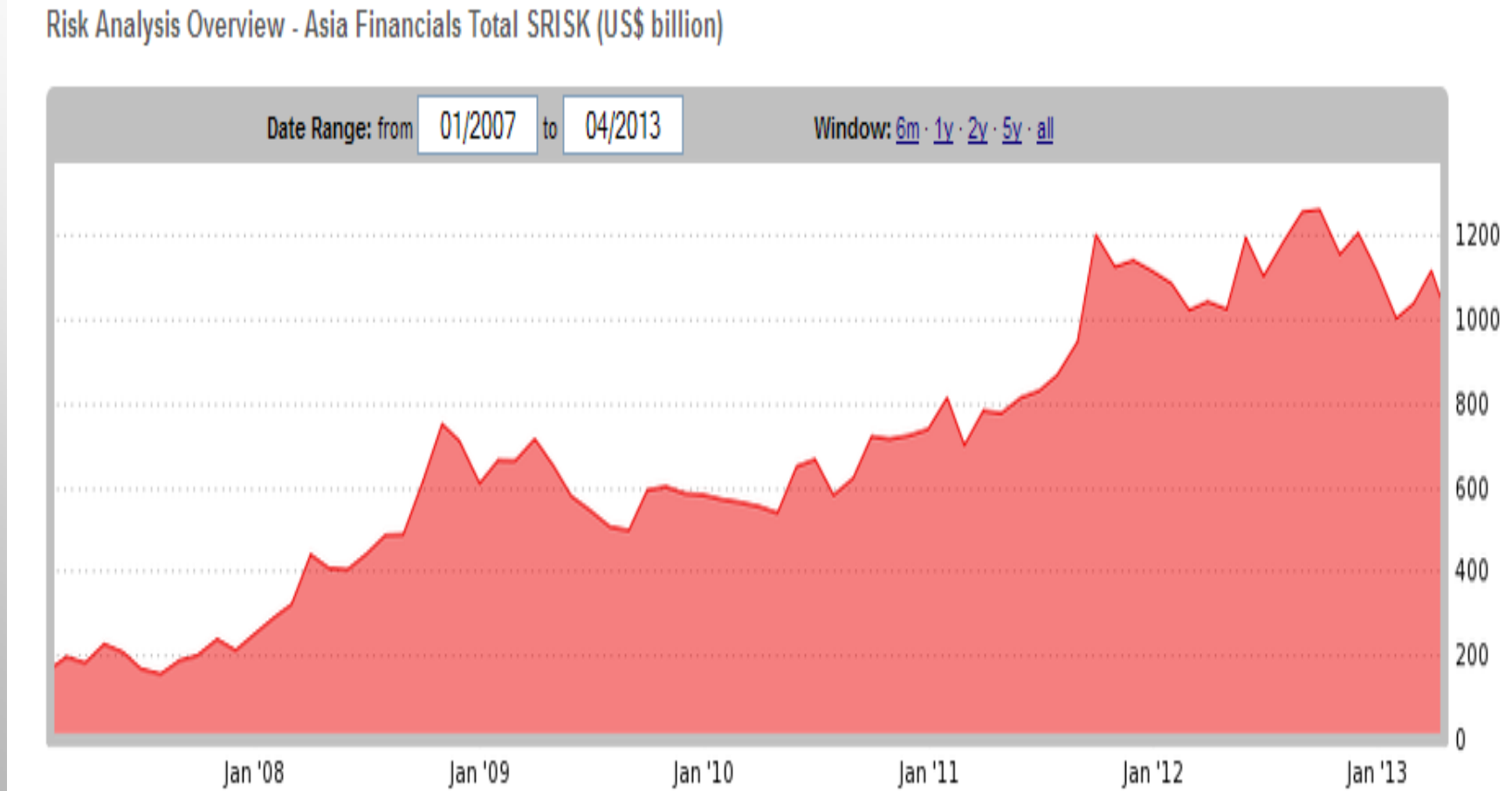
US SINCE 2007



EUROPE SINCE 2007



ASIA SINCE 2007



ACCOUNTING FOR CHANGE

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Systemic Risk Rankings for 2013-04-19 ☑ **View changes since:** 2012-04-30

Institution	SRISK (t) ▼	SRISK (t - 1)	Δ SRISK	Δ(DEBT)	Δ(EQUITY)	Δ(RISK)
Bank Of America	99,653.5	115,535.8	-15,882.3	-1,021.8	-17,456.2	2,595.6
JP Morgan Chase	71,730.3	79,638.2	-7,907.9	4,132.9	-8,298.8	-3,742.0
Citigroup	62,096.7	95,939.6	-33,842.9	-5,952.4	-19,964.4	-7,926.1
MetLife	42,670.2	39,850.3	2,819.9	907.4	-367.6	2,280.1
Prudential Financial	41,005.3	31,374.1	9,631.3	6,663.8	1,361.0	1,606.6
Morgan Stanley	34,940.9	40,697.4	-5,756.5	2,512.2	-2,910.8	-5,357.9
Goldman Sachs	31,677.9	36,847.9	-5,170.1	874.8	-3,267.8	-2,777.1
Hartford Financial Services	16,858.3	17,785.6	-927.2	-407.0	-1,290.7	770.5
Lincoln National Corp	13,034.8	11,648.3	1,386.5	1,212.3	-544.4	718.5
American International Group	10,475.0	-1,277.2	11,752.2	654.9	1,895.2	9,202.2
Bank Of New York Mellon Corp/The	8,398.4	5,230.6	3,167.8	4,314.2	-1,756.0	609.6
SLM Corporation	8,080.1	10,131.8	-2,051.7	-1,417.2	-1,079.7	445.2
Principal Financial Group	7,367.0	6,756.8	610.2	1,148.6	-856.2	317.8

A YEAR AGO IN EUROPE

NEW YORK UNIVERSITY NYU STERN LEONARD N. STERN SCHOOL OF BUSINESS

Systemic Risk Rankings for 2013-04-19 ☑ **View changes since:** 2012-04-30

Institution	SRISK (t) ▼	SRISK (t - 1)	Δ SRISK	Δ(DEBT)	Δ(EQUITY)	Δ(RISK)
Deutsche Bank AG	126,701.5	135,428.1	-8,726.6	-8,019.3	1,498.1	-2,205.4
Credit Agricole SA	123,107.4	116,025.3	7,082.1	11,098.4	-2,329.5	-1,686.8
BNP Paribas	108,077.2	121,613.4	-13,536.1	-2,394.6	-4,626.6	-6,515.0
Barclays PLC	103,113.8	113,498.5	-10,384.7	-299.3	-4,885.9	-5,199.5
Royal Bank of Scotland Group PLC	89,854.6	102,938.5	-13,083.8	-11,113.9	-1,826.7	-143.2
Societe Generale	77,949.2	76,284.0	1,665.2	6,283.7	-2,030.4	-2,588.2
ING Groep NV	70,416.9	81,405.6	-10,988.7	-6,955.3	-689.1	-3,344.2
Banco Santander SA	53,289.5	62,009.2	-8,719.7	-1,902.4	-6,641.5	-175.8
Lloyds Banking Group PLC	52,883.6	63,632.8	-10,749.2	-209.7	-7,539.2	-3,000.3
UniCredit SpA	50,161.5	56,332.8	-6,171.2	292.6	-1,546.2	-4,917.7
UBS AG-REG	42,741.5	59,311.2	-16,569.8	-7,057.1	-5,854.5	-3,658.2
Commerzbank AG	40,279.8	41,547.3	-1,267.5	-1,210.5	1,328.9	-1,385.9
AXA SA	35,434.6	38,817.3	-3,382.7	2,821.0	-2,450.4	-3,753.3
Credit Suisse Group AG	32,363.0	46,848.0	-14,485.0	-5,388.5	-5,709.0	-3,387.5
Intesa Sanpaolo SpA	32,071.4	35,374.5	-3,303.1	3,079.9	-1,074.1	-5,308.9