PROSPECTS FOR GLOBAL FINANCIAL STABILITY

Robert Engle
Volatility Institute at NYU Stern
Franco Modigliani's Legacy in the World Economy: Conference, University of Brescia 6/23/2018

HOW MUCH RISK IS TOO MUCH?

Google

vlab

All News Books Videos Images More Settings Tools

About 686,000 results (0.40 seconds)

V-Lab: Real-time Financial Volatility, Correlation, And Risk ...

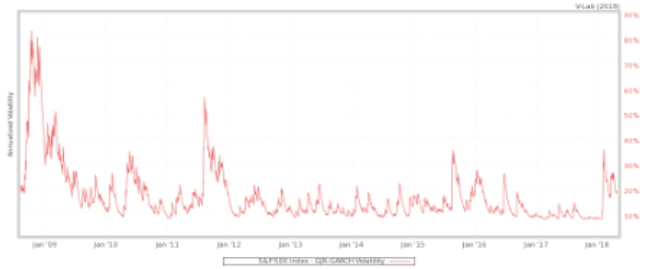
https://vlab.stern.nyu.edu/en/

The Volatility Laboratory (V-Lab) provides real time measurement, modeling and forecasting of financial volatility, correlations and risk for a wide spectrum of assets. V-Lab blends together both classic models as well as some of the latest advances proposed in the financial econometrics literature. The aim of the website is to ...

Correlation Analysis · Fixed Income Analysis · Liquidity Analysis · Volatility Analysis

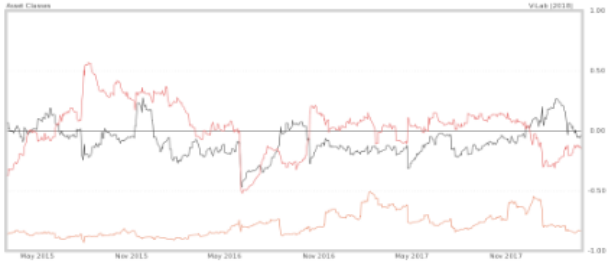
Volatility Analysis

There are few guarantees in financial markets. However, we do know that volatility clusters and mean-reverts. But how long will it take to mean revert and, on average, to what level? Where are the 'host spots' of volatility in the world and in what sectors? We attempt to answer these questions and more in our Volatility Analysis section of V-Lab. Come see the many models meant to explain volatility and explore volatility dynamics.



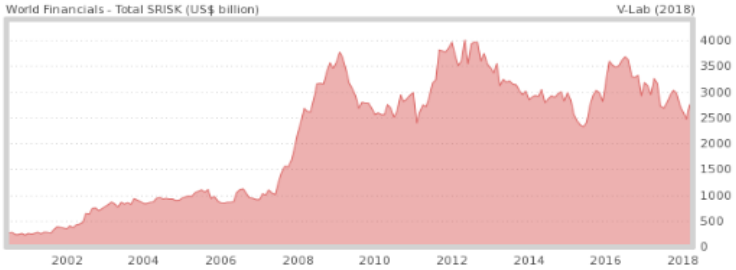
Correlation Analysis

The co-movement of asset prices is important in many financial market decisions, such as portfolio allocation, diversification, and hedging. In our Correlation Analysis section, we use econometric models to determine how these time series co-move, which assets are particularly correlated, and which are diverging in direction.



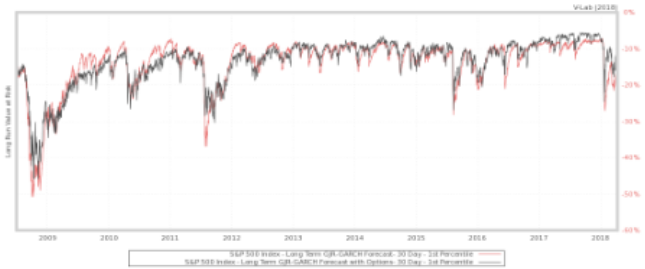
Systemic Risk Analysis

The Global Financial Crisis of 2008 revealed the degree of interconnectedness and fragility of the global financial system at the time. How badly would the equity values of financial institutions decline if there were another crisis today? What degree of capital shortfall would financial institutions suffer? Our Systemic Risk Analysis section of V-Lab simulates crises in domestic markets, as well as another global financial crisis, in an attempt to answer these questions.



Long-Run VaR Analysis

Often, volatility is assumed to grow with the square root of time. However, this assumes independence between observations each day (i.e. today's volatility has no bearing on what volatility will be tomorrow). Since this is not the case, one must defer to more sophisticted methods in order to estimate long-run volatility. Our Long-Run Value-at-Risk section simulates the 1 month and 1 year risk of holding financial assets, both using only returns and also conditioning average future volatility on current options market data.

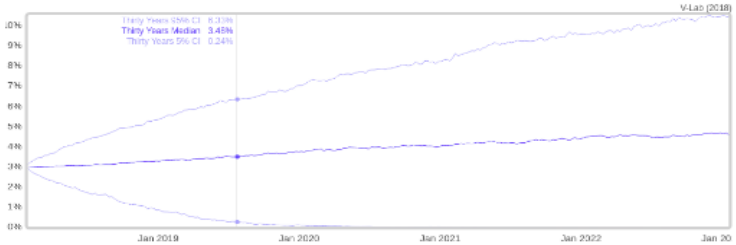


Liquidity Analysis

The liquidity of a financial asset reflects transaction costs and the ability to unwind large trades at reasonable prices. 'Liquidity spirals' often exacerbate stock market declines, such as what we saw in the last Global Financial Crisis. In the liquidity section we estimate and forecast the liquidity of a broad spectrum of financial assets.

Fixed Income Analysis

The future direction of interest rates has large implications for the the determination of discount rates, asset pricing, and firm capital structure. In addition, interest rates and their term structure are often used to infer economic forecasts of inflation, recession, and other key indicators. But where are rates headed in the long term? We forecast the distribution of treasury rates up to 5 years ahead from a 6-month bill to 30-year bond in the Fixed Income Section. We show upper and lower confidence intervals for future rates.

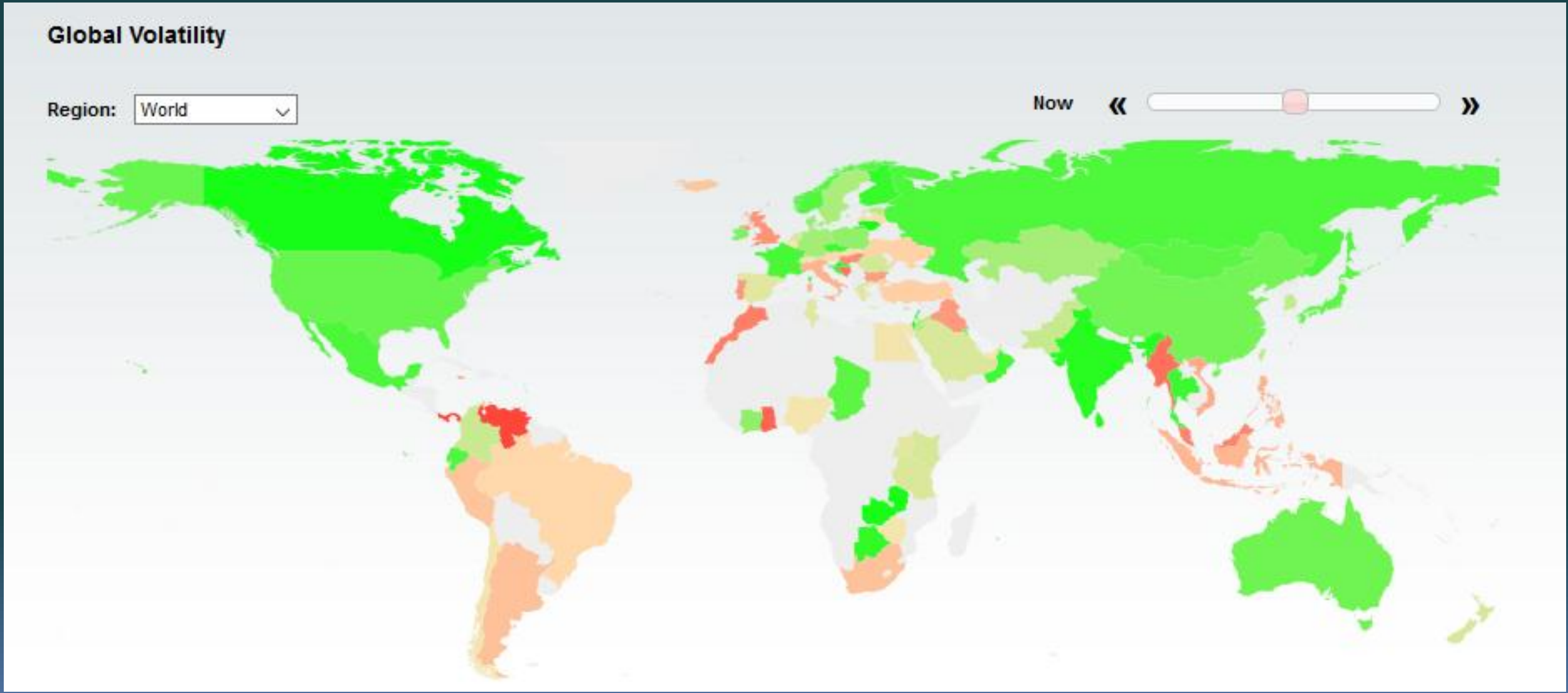


Climate Risk Analysis

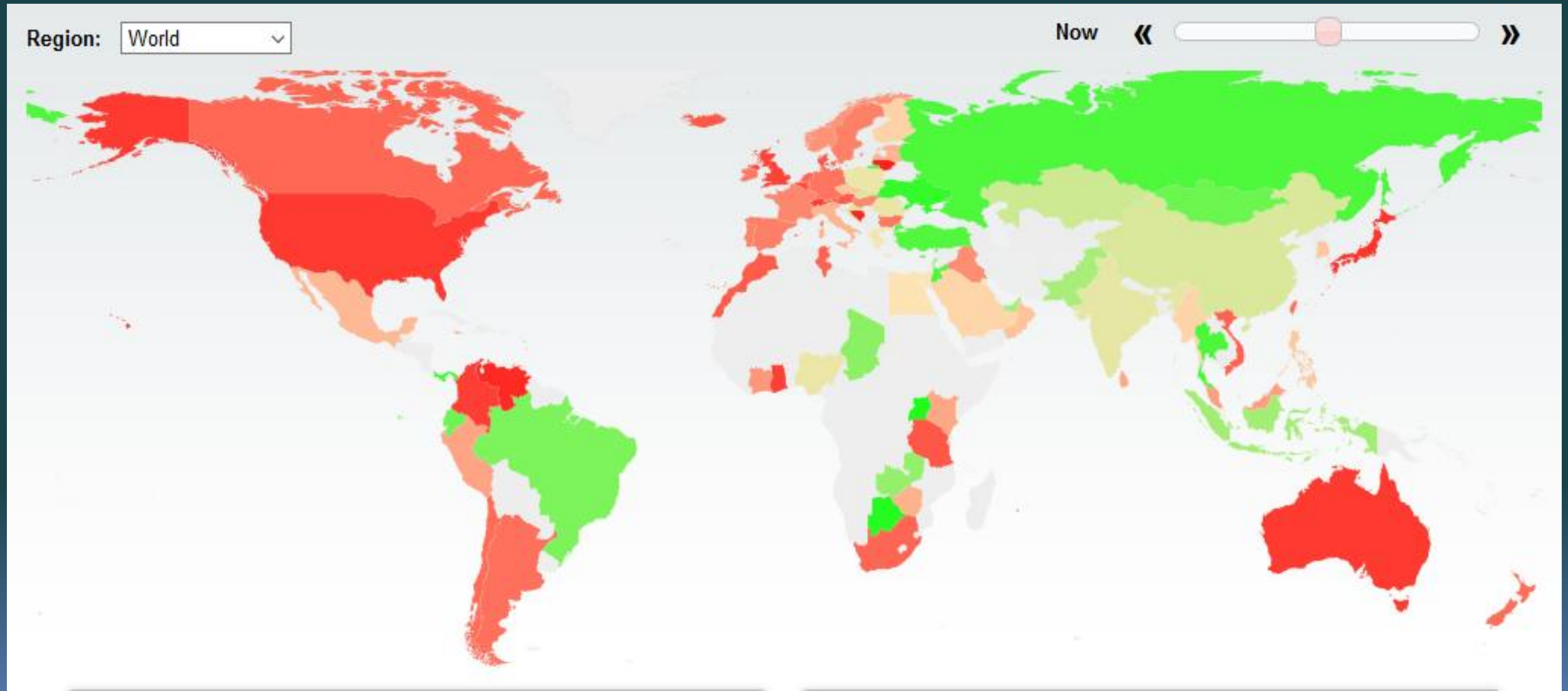
Climate change is effecting the world via stronger, more severe weather events, rising sea levels, and in many other ways. Are these events and the risks imposed by climate change properly reflected in asset prices? Environmental risks can be thought of as long run risks which influence portfolio decisions. In our Climate Risk Analysis section. We examine the performance of publicly traded environmental portfolios, which can serve as a measure of the new information on environmental risk and a mechanism to hedge these risks.

VOLATILITY MAP JUNE 18 2018

GREEN MEANS PREDICTED VOLATILITY IS LOW RELATIVE TO PAST.



V-LAB VOLATILITY MAP FOR FEB 9,2018



HOW MUCH SRISK IS TOO MUCH?

ROBERT ENGLE AND TIANYUE RUAN

DIRECTOR VOLATILITY INSTITUTE OF NYU STERN

video

HOW DO WE CONCEIVE OF THE RISK OF A FINANCIAL CRISIS?

- When the banking sector is undercapitalized, it is vulnerable to external shocks. We measure this by regulatory stress tests and by market measures such as SRISK. External Shocks

- However, when banks are undercapitalized, the recapitalization may be exactly what causes a financial crisis. Internal Shocks.
- In this case, the probability of a financial crisis depends on how extreme are the economic conditions.

EXCESSIVE CREDIT GROWTH

1. It is widely believed that excessive credit growth is the fundamental cause of financial crises.
2. See for example Reinhart and Rogoff(2009) "This Time Is Different" or Borio(2012)"the financial cycle", Adrian and Shin(2011)"Leverage"
3. But credit growth is typically procyclical as increased credit is a natural component of growth.
4. Schularick and Taylor argue that a financial crisis is a "credit boom gone bust." How can we see this in data?

A MORTGAGE EXAMPLE

- Here is an example of excessive credit growth: A bank may issue mortgages to underqualified borrowers or overvalued houses.
- These mortgages will have market values that may be less than the accounting value and if the housing market declines, their market values will fall further as the collateral weakens.
- The bank may have to allocate some of its capital to cover these losses.
- If it does not have a sufficient capital cushion, then it will face bankruptcy or will seek a bailout.
- *Credit growth is excessive if the financial sector does not have sufficient capital to cover losses in a downturn.*

DEFINITION of SRISK

- *How much capital would a financial institution need to raise in order to function normally if we have another financial crisis?*
- **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, 2017**

SRISK or Systemic Risk

$$
\begin{aligned}
SRISK_{i,t} &= Median_t\left(Capital\ \ Shortfall_i \middle| Crisis\right) \\
&= Median_t\left(k\left(Debt_{t+n} + Equity_{t+n}\right) - Equity_{t+n} \middle| Crisis_{t+n}\right) \\
&= kDebt_{t+n} - (1-k)\,Median_t\left(Equity_{t+n} \middle| Crisis_{t+n}\right)
\end{aligned}
$$

- *And equity in a crisis is expected to fall by (beta*market decline)*

$$
\log\left(Equity_{t+n} / Equity_t\right) = \beta_t \log\left(WEquity_{t+n} / WEquity_t\right) + u_{t+n}
$$

$$
Median_t\left(Equity_{t+n} \middle| \frac{WEquity_{t+n}}{WEquity_t} = 1-\theta\right) = Equity_t \exp\left(\beta_t \log(1-\theta)\right)
$$

ESTIMATE BETA WITH DCB

- Beta is a correlation with the market times the ratio of the standard deviation of the firm over the market.
- Dynamic Conditional Beta (DCB) estimates these inputs and adjusts for noise and for asynchronous returns.
- Beta is different every day and is forecast from day t-1.

BETA

$$y = x\beta + \varepsilon$$

$$\beta = \frac{Cov(y,x)}{Var(x)} = \rho_{yx}\sqrt{\frac{Var(y)}{Var(x)}}$$

PUTTING IT ALL TOGETHER

For a set of asset returns, and a market return, we can compute volatilities and correlations

For these we can construct DCB from

$$\beta_{i,m,t} = \rho_{i,m,t}\sqrt{\frac{h_{i,t}}{h_{m,t}}}$$

Estimation of Dynamic Conditional Beta involves

- GJR GARCH model of the volatility of market returns
- GJR GARCH model of the volatility of firm returns
- DCC estimation of the correlation between these

IS BETA CONSTANT?

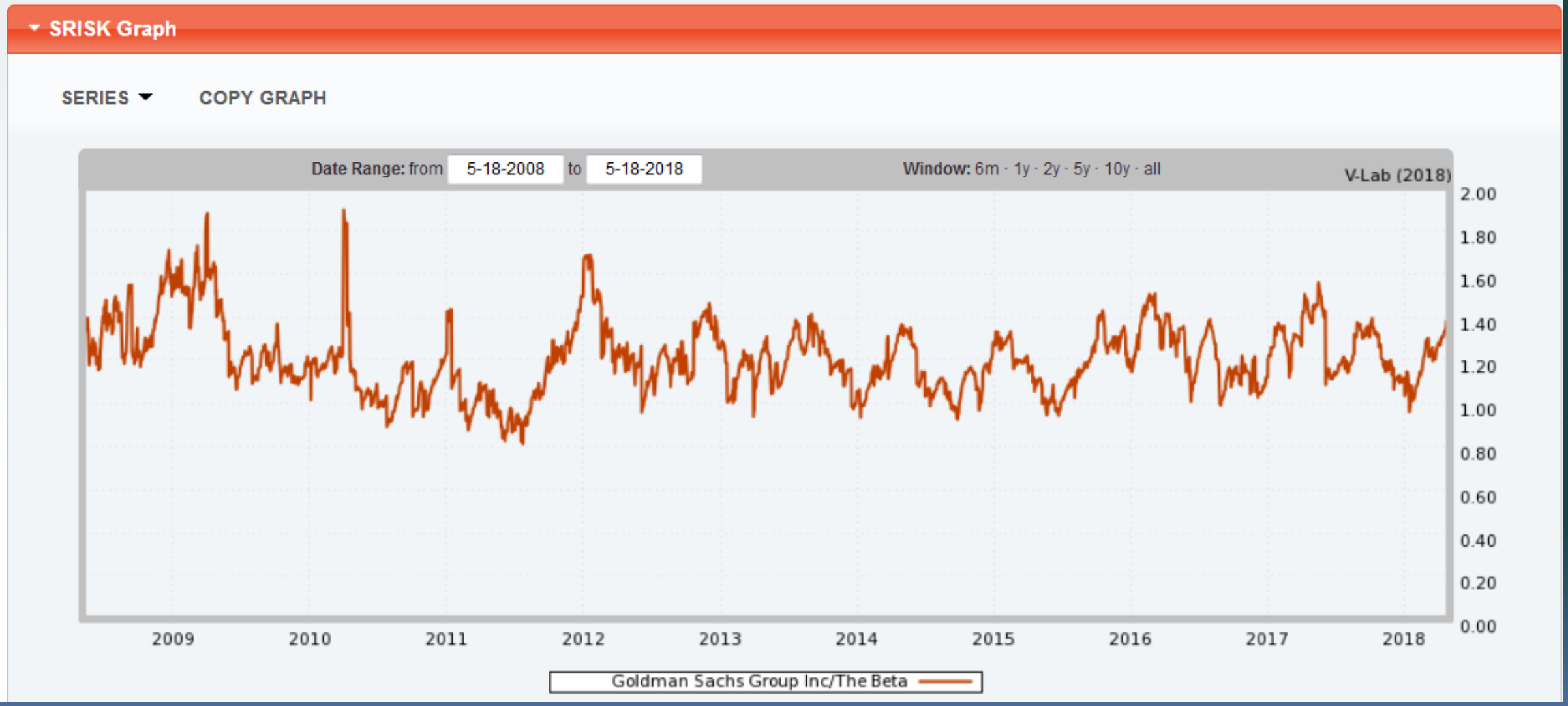
- Test beta=constant with artificially nested model

$$r_t^j = \phi r_t^m + \theta\left(\beta_t^j r_t^m\right) + \sqrt{h_t}\,\varepsilon_t^f$$

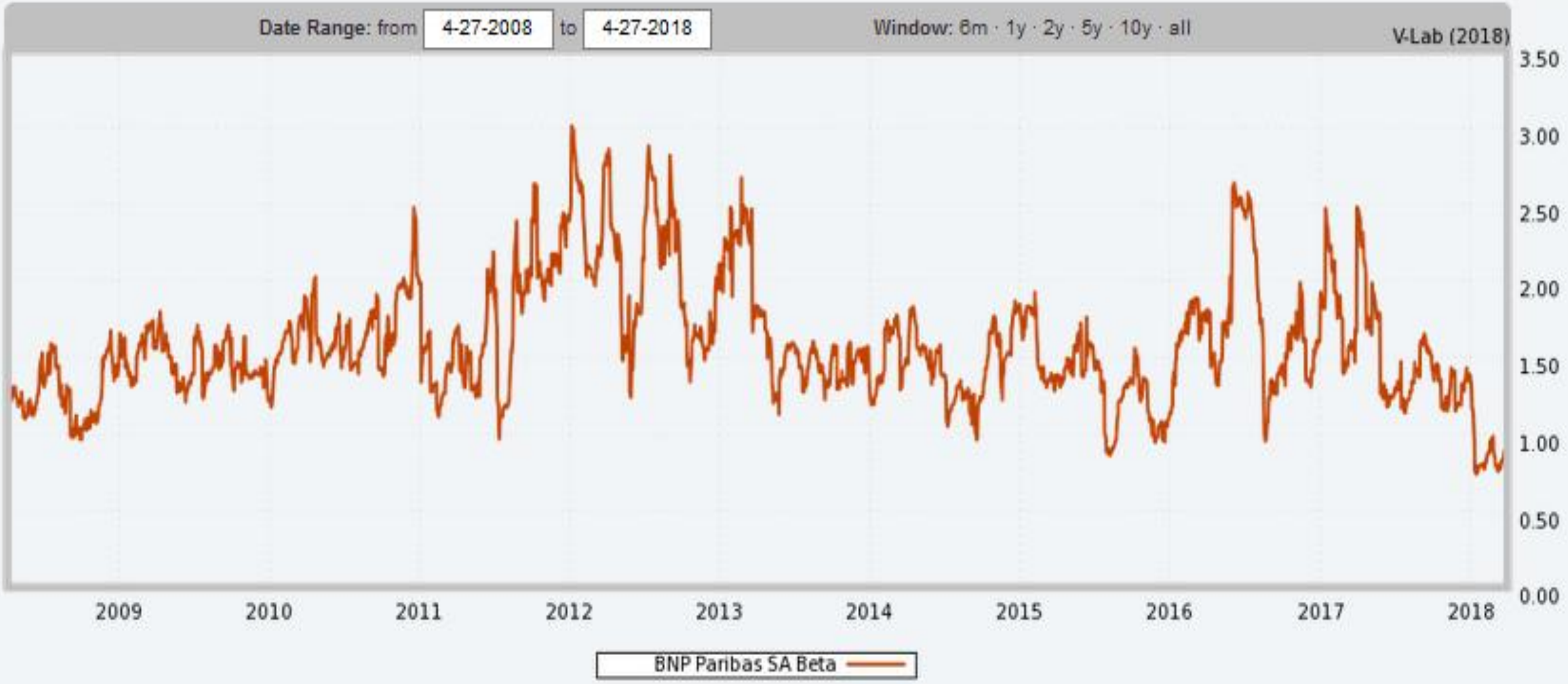
- Use $\hat{\phi} + \hat{\theta}\beta_t^j$ as the estimate of beta

BETA FOR CITIGROUP

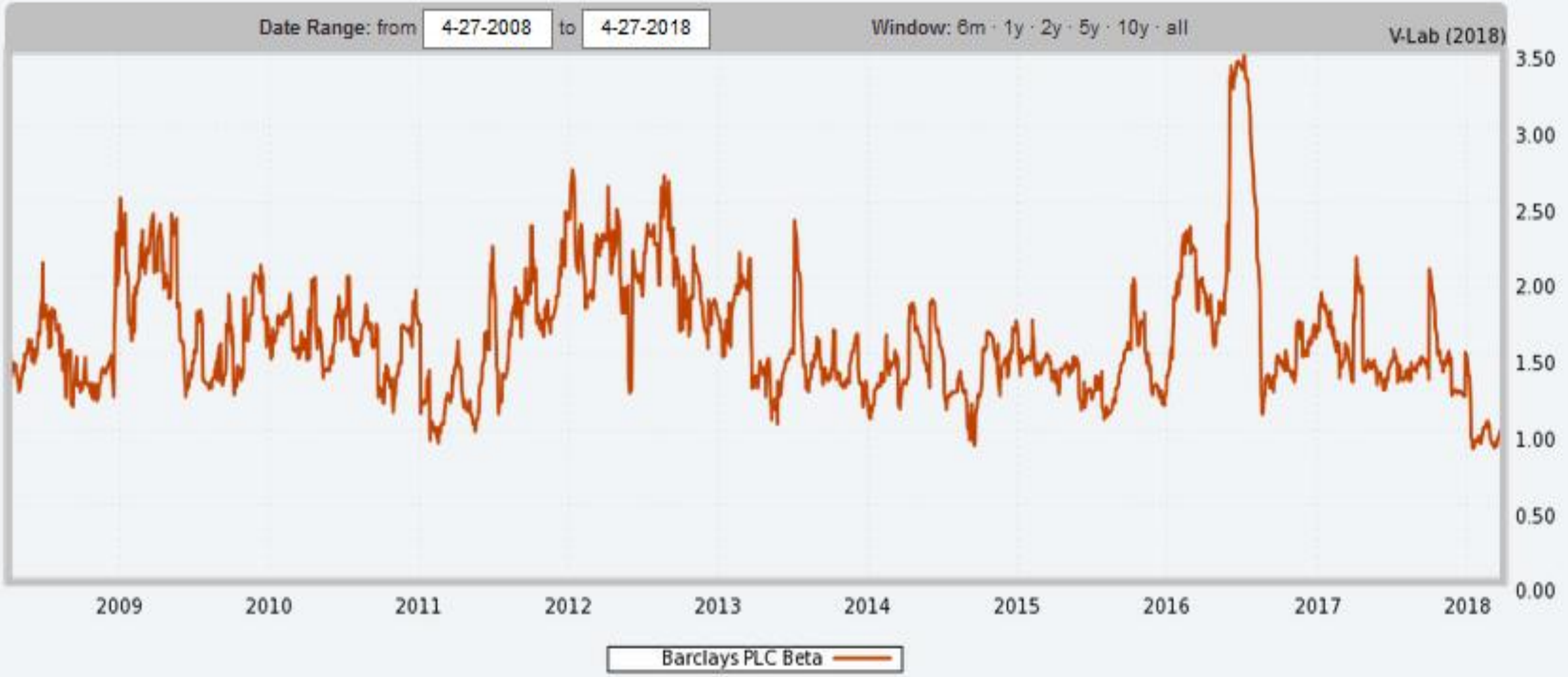
BETA FOR GOLDMAN SACHS



BETA FOR BNP PARIBAS

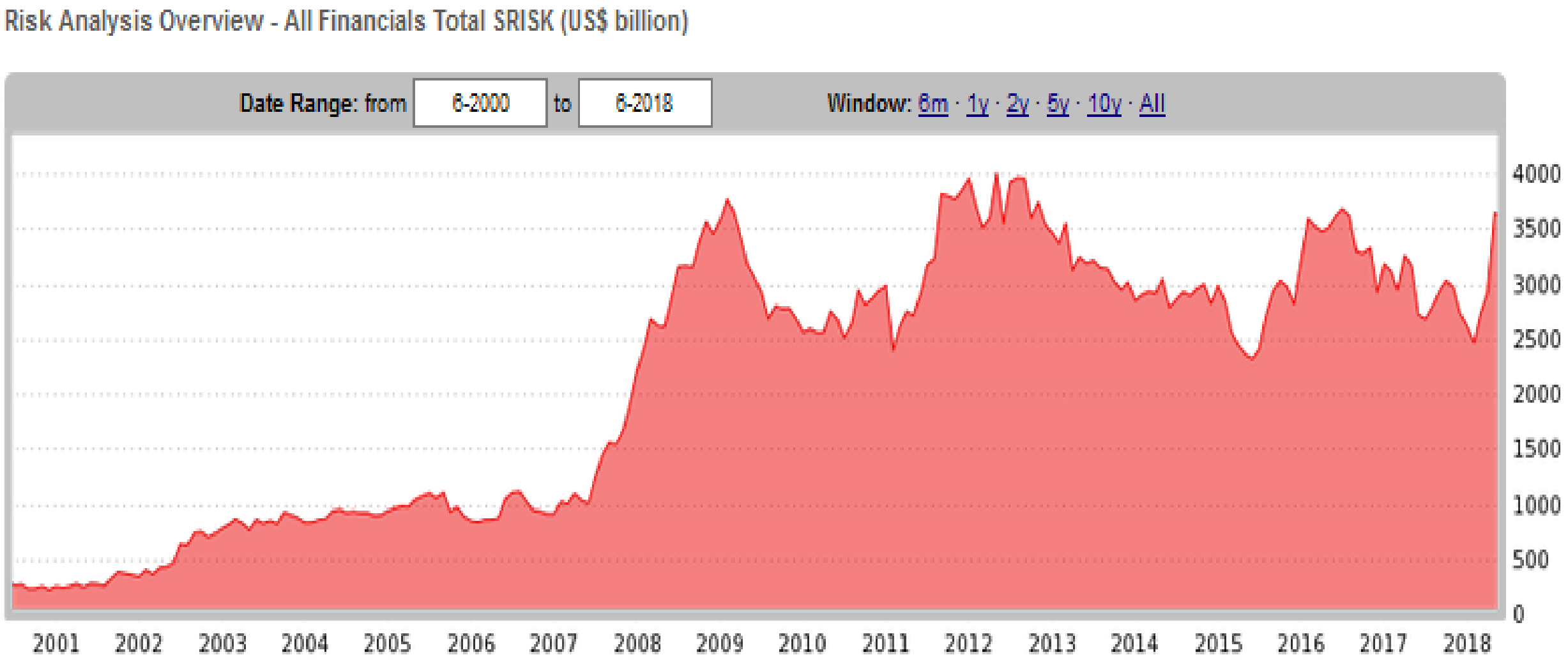


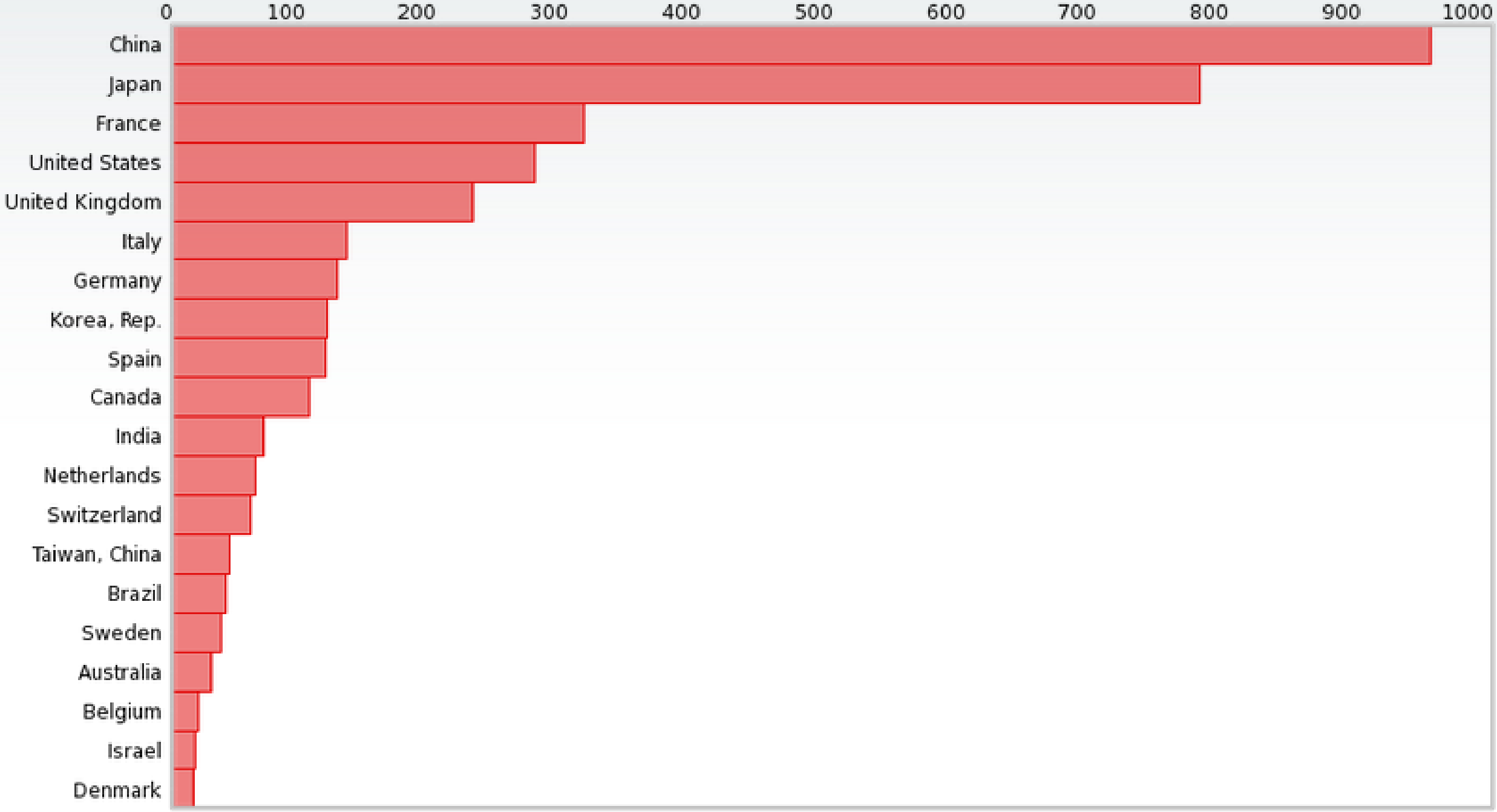
BETA FOR BARCLAY'S



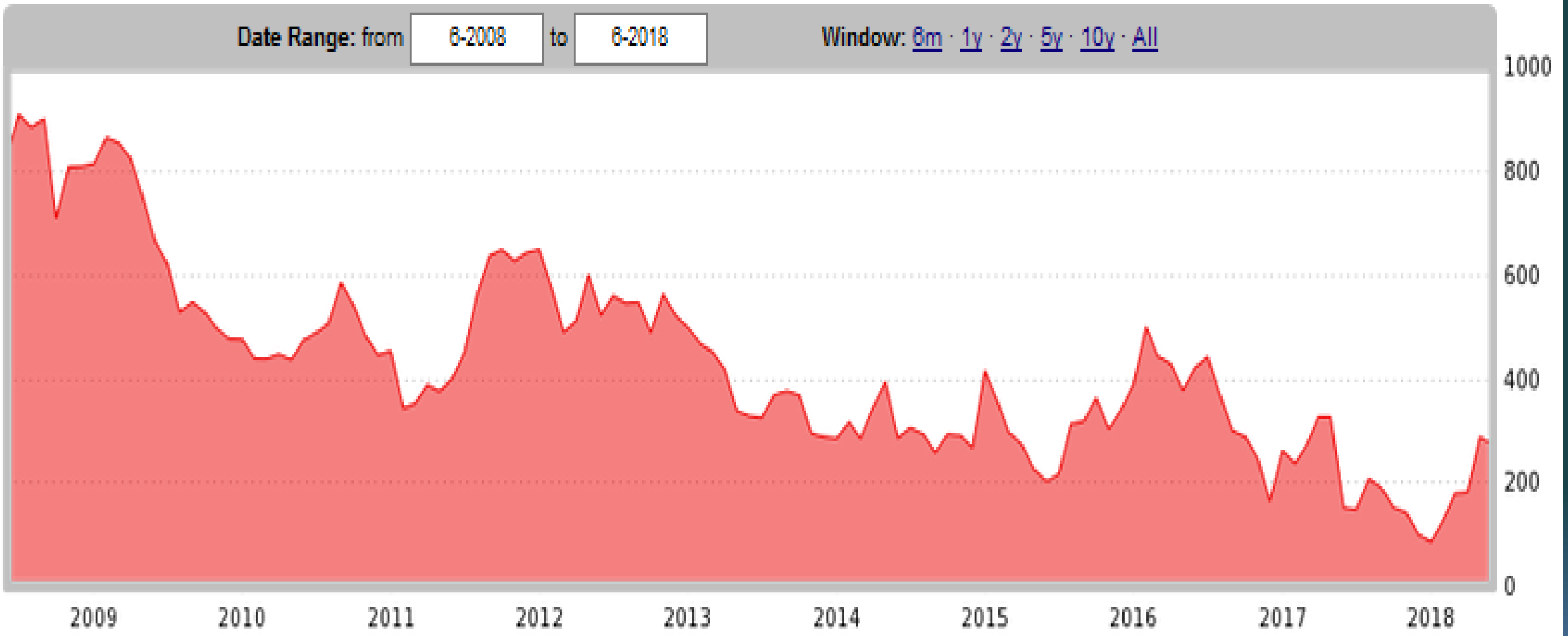

WHERE IS THE SRISK?

GLOBAL SRISK SINCE 2000




0
100
200
300
400
500
600
700
800
900
1000
China
Japan
France
United States
United Kingdom
Italy
Germany
Korea, Rep.
Spain
Canada
India
Netherlands
Switzerland
Taiwan, China
Brazil
Sweden
Australia
Belgium
Israel
Denmark

US 10 YEARS


Date Range: from 6-2008 to 6-2018
Window: 6m · 1y · 2y · 5y · 10y · All
1000
800
600
400
200
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

LOOKING BACK IN TIME:

AUGUST 29,2008 US

Systemic Risk Rankings for 2008-08-29 View changes

Institution	SRISK%	RNK	SRISK ($ m)	LRMES	Beta	Cor	Vol	Lvg
Citigroup Inc	12.79	1	138,091	80.00	2.61	0.79	63.4	19.99
JPMorgan Chase & Co	10.14	2	109,492	82.00	2.42	0.74	62.9	13.42
Bank of America Corp	8.97	3	96,900	79.00	2.90	0.74	75.0	11.94
Morgan Stanley	6.51	4	70,259	77.24	2.09	0.74	53.7	23.01
Freddie Mac	6.38	5	68,874	85.00	5.01	0.44	221.2	297.76
Merrill Lynch	6.31	6	68,124	84.00	3.43	0.78	83.8	22.45
Fannie Mae	6.21	7	67,088	93.00	5.51	0.51	205.4	115.68
American International Group Inc	6.13	8	66,211	80.00	3.47	0.69	97.0	17.62
Goldman Sachs Group Inc/The	5.34	9	57,654	58.00	1.70	0.75	43.3	16.99
Wachovia Bank	5.00	10	54,008	85.00	3.06	0.66	87.3	22.40
Lehman Brothers	4.41	11	47,613	86.00	4.99	0.74	130.2	55.88
MetLife Inc	2.78	12	30,044	67.00	1.42	0.79	34.4	14.56
Washington Mutual	2.00	13	21,616	88.00	2.71	0.45	119.8	41.50
Prudential Financial Inc	1.99	14	21,476	49.00	1.35	0.72	36.1	15.39
Hartford Financial Services Group Inc/The	1.83	15	19,766	68.00	1.70	0.74	43.9	17.68
Wells Fargo & Co	1.68	16	18,166	71.00	1.90	0.69	52.8	6.60

FEB 28, 2007 US

Systemic Risk Rankings for 2007-02-28 View changes

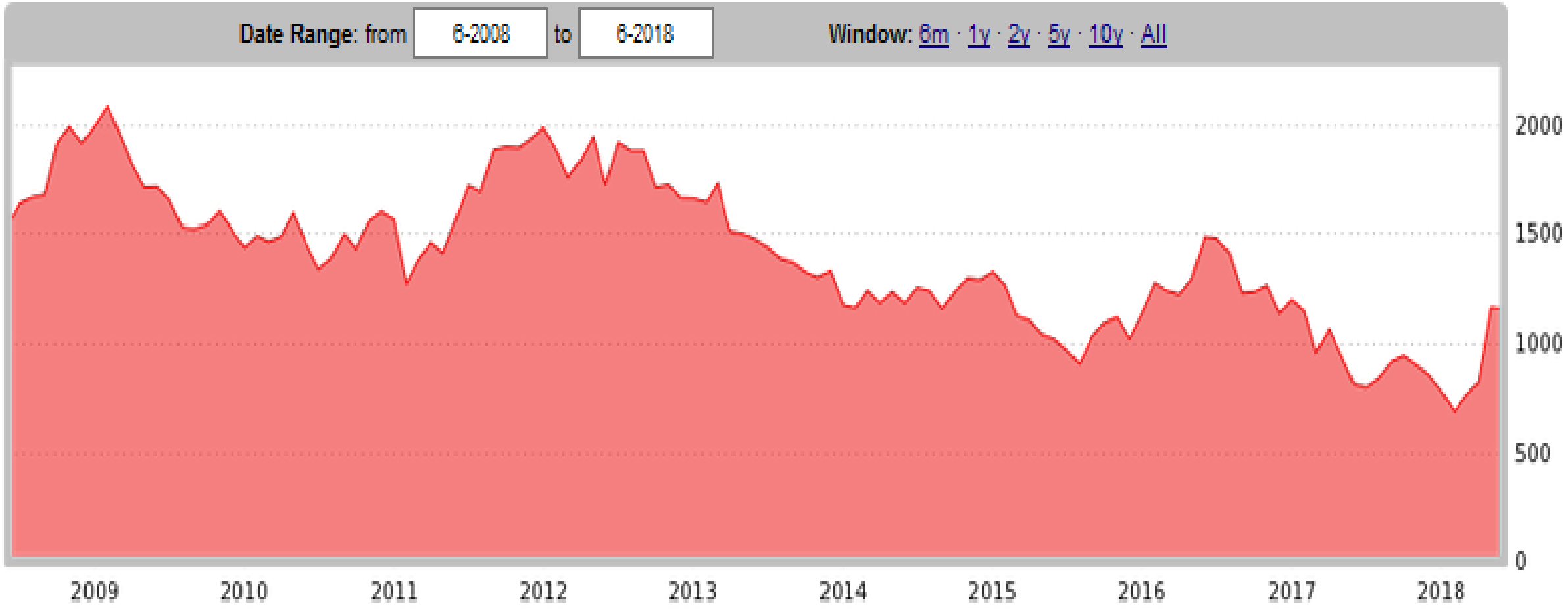
Institution	SRISK%	RNK	SRISK ($ m)	LRMES	Beta	Cor	Vol	Lvg
Morgan Stanley	20.32	1	67,314	67.00	1.57	0.74	41.9	15.34
Fannie Mae	10.61	2	35,161	43.00	0.76	0.66	22.9	15.50
Citigroup Inc	9.01	3	29,843	51.00	0.91	0.70	26.0	8.15
Merrill Lynch	8.89	4	29,460	49.00	0.95	0.68	27.8	11.84
Freddie Mac	8.53	5	28,276	17.00	0.44	0.59	14.8	18.50
Lehman Brothers	8.49	6	28,125	57.00	1.35	0.70	38.1	15.06
Goldman Sachs Group Inc/The	8.44	7	27,975	46.00	1.54	0.87	35.0	11.42
Bear Stearns	6.93	8	22,950	55.00	1.06	0.68	30.2	21.91
JPMorgan Chase & Co	5.15	9	17,065	48.00	0.71	0.71	19.6	8.23
MetLife Inc	4.29	10	14,222	43.00	0.88	0.64	27.5	11.26
Hartford Financial Services Group Inc/The	3.56	11	11,799	54.00	0.88	0.69	25.3	11.16
Prudential Financial Inc	2.42	12	8,009	33.87	0.58	0.58	19.9	10.90
Lincoln National Corp	1.55	13	5,137	53.00	1.10	0.75	29.2	9.80
Washington Mutual	0.64	14	2,123	38.00	0.57	0.48	23.9	8.78
Countrywide Financial	0.43	15	1,434	35.00	0.83	0.47	34.9	9.27
Wachovia Bank	0.39	16	1,279	49.00	0.87	0.66	26.5	7.02

JAN 31, 2005

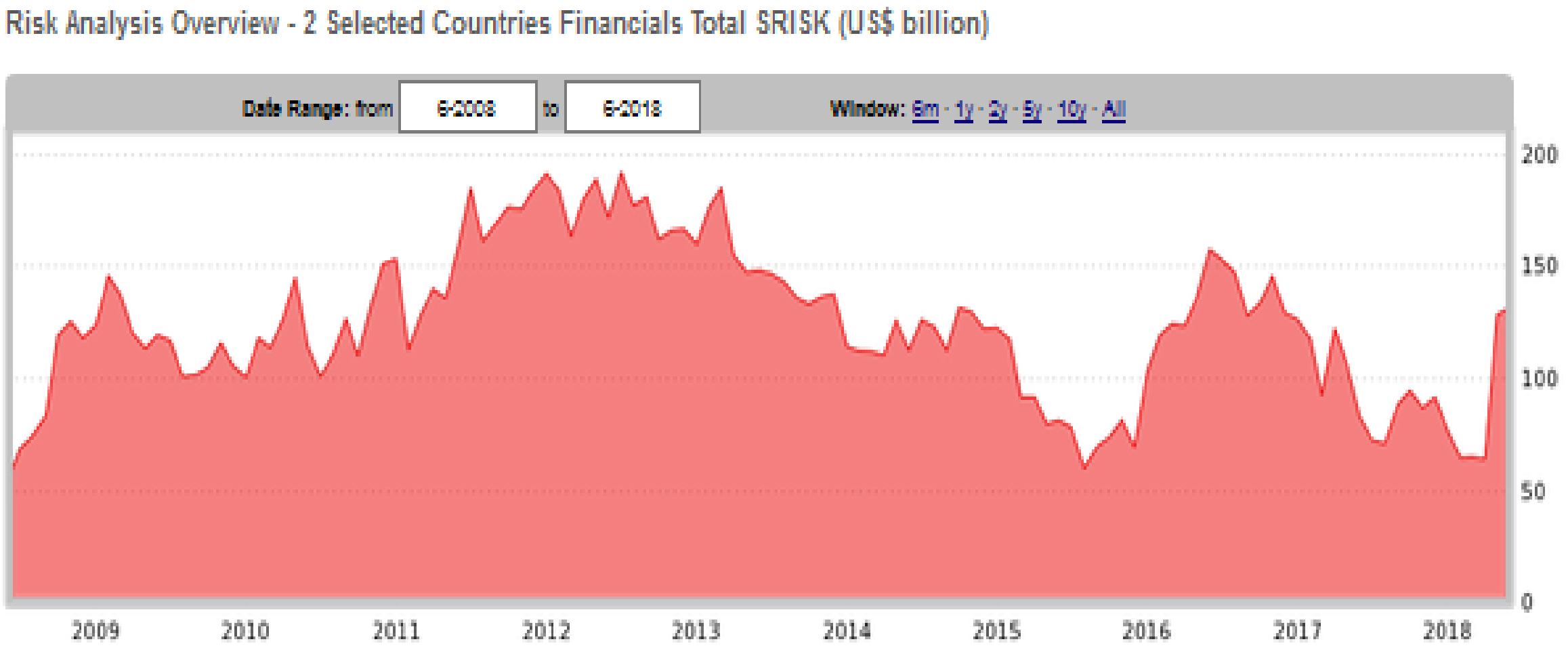
Systemic Risk Rankings for 2005-01-31 View changes

Institution	SRISK%	RNK ▲	SRISK ($ m)	LRMES	Beta	Cor	Vol	Lvg
Fannie Mae	19.60	1	49,242	49.00	1.02	0.43	25.9	16.72
Morgan Stanley	13.97	2	35,092	59.92	1.13	0.65	18.9	12.82
Freddie Mac	11.11	3	27,900	20.00	0.78	0.51	16.7	17.96
JPMorgan Chase & Co	8.69	4	21,840	49.00	1.00	0.70	15.5	8.92
Merrill Lynch	7.53	5	18,913	44.00	1.14	0.73	17.2	11.67
Lehman Brothers	6.23	6	15,648	49.00	0.94	0.62	16.3	14.69
Bear Stearns	5.99	7	15,053	51.00	0.82	0.50	17.4	24.67
Prudential Financial Inc	5.98	8	15,013	40.00	0.98	0.58	18.6	14.69
Hartford Financial Services Group Inc/The	4.92	9	12,367	60.00	1.18	0.57	22.2	13.42
MetLife Inc	4.64	10	11,656	45.00	1.09	0.54	22.1	12.25
Goldman Sachs Group Inc/The	4.25	11	10,689	38.00	0.81	0.52	17.1	10.70
Lincoln National Corp	2.24	12	5,617	57.00	1.23	0.63	21.4	14.66
Genworth Financial Inc	1.77	13	4,456	21.00	0.54	0.29	20.6	24.42
Washington Mutual	1.38	14	3,463	40.00	0.75	0.45	18.0	9.13
UNUM Group	0.83	15	2,084	70.00	0.73	0.30	28.0	9.57
State Street Corp	0.40	16	1,013	56.25	1.15	0.49	26.0	6.88

EUROPE 10 YEARS

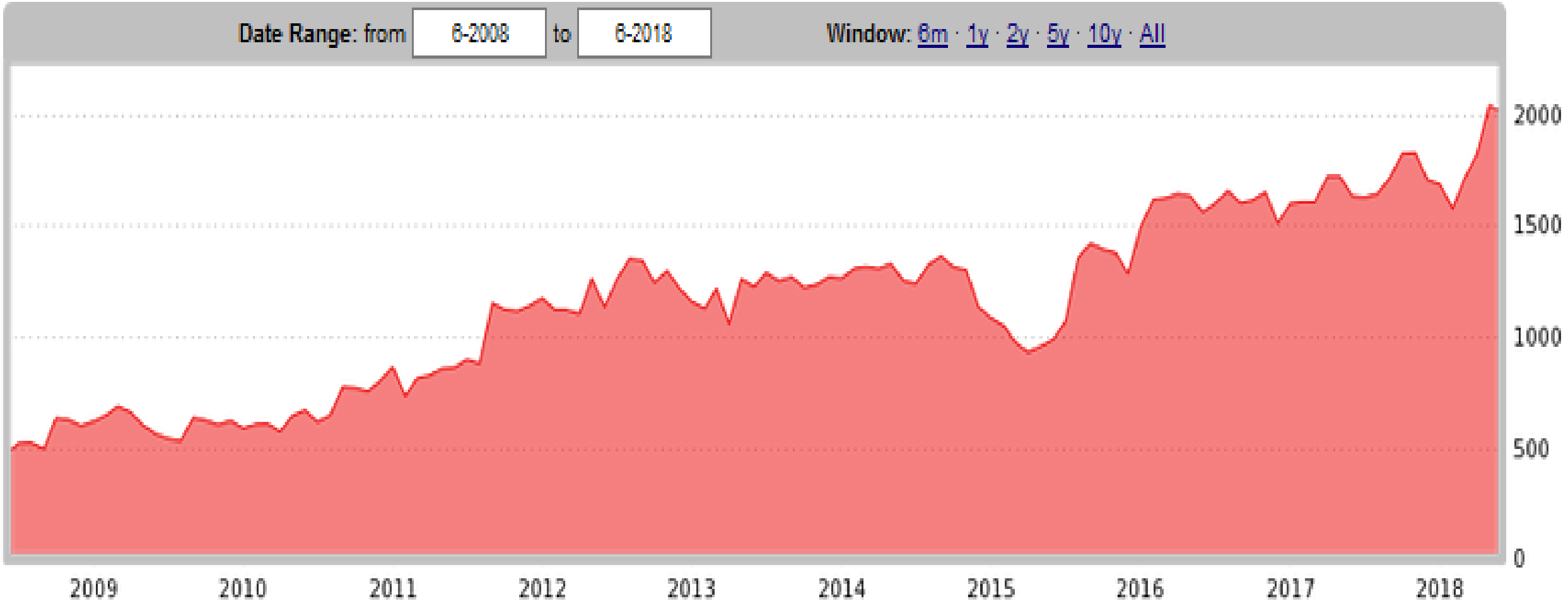


ITALY 10 YEARS SRISK



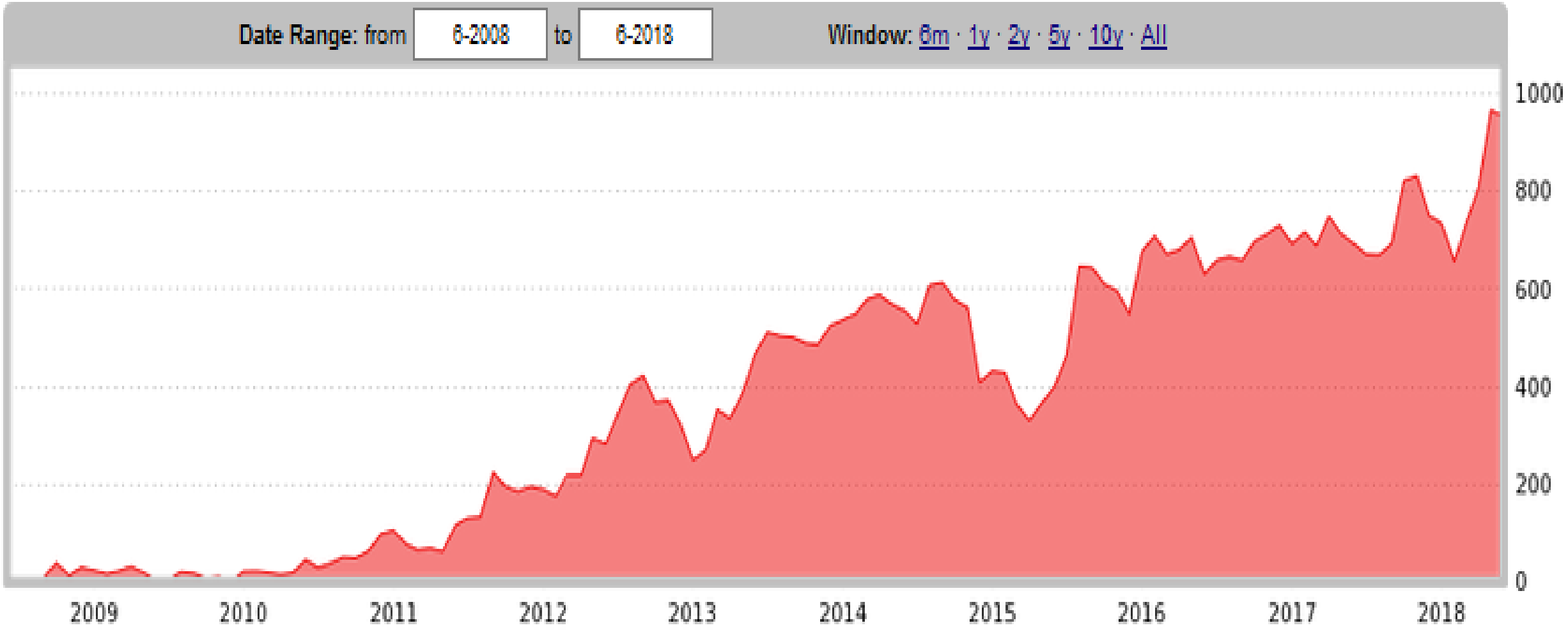
ASIA 10 YEARS

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



CHINA 10 YEARS

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



HOW MUCH SRISK IS TOO MUCH?

HOW MUCH SRISK IS TOO MUCH?

- When a country has a certain level of SRISK; what is the probability that it is in a crisis? Probability of Crisis

- Can we identify a level of SRISK_Capacity that keeps the probability of a crisis below 50%?

ENDOGENOUS FINANIAL CYCLES

Firms with high SRISK will begin to delever – and cause the internal shock

- Either because risk managers insist
- Or because regulators insist

THREE STRATEGIES

- They may do nothing and hope good luck or a bailout.
- They may sell new shares of stock.
- *They may sell assets and retire debt.*

MANAGING SRISK

- If SRISK is a large fraction of Total Assets, then asset sales will be costly and will be likely to lead to a fire sale spiral.

- Appropriate risk measure is : rSRISK/TA/K

ROMER AND ROMER(2016) CRISIS INDICATOR

- For 24 industrial countries a semi-annual indicator of crisis intensity is extracted from OECD Reports 2000-2012.
- Measure ranges from 0 to 15 as a measure of credit disruption.
- Below 4 is called "minor credit disruption."

- Computing each of the measures for this period, see which indicator is most correlated with crisis intensity.
- Include country and time fixed effects.

TOBIT ECONOMETRICS

- $$y = \begin{cases} yl & if \quad yl > 0 \\ 0 & otherwise \end{cases}$$
  $$yl = X\beta + \sigma\varepsilon \qquad \varepsilon \sim N(0,1)$$
- For some positive number q,
  $$P(y > q|X) = P(yl > q|X) = P\left(\varepsilon > \frac{q - X\beta}{\sigma}|X\right) = 1 - \Phi\left(\frac{q - X\beta}{\sigma}\right)$$
- Implement with six monthly moving average and extrapolate to the present.

SRISK_CAPACITY

$$P\left(y > 4 \middle| X\right) = 1 - \Phi\left(\frac{4 - X\beta}{\sigma}\right) = 50\% \ when \ 4 = X\beta$$

$$SRISK\_CAPACITY = SRISK + TA * k * \frac{4 - X\hat{\beta}}{\hat{\beta}_1}$$

- Compute for Country Model and Global Model

Table 4: **Equation 3b: Tobit Model (Checks)**

Standard errors are reported in parentheses. ***, ** and * represent 1%, 5% and 10% significance, respectively.

	Dep Var: CRISIS
	(1)
SRISK/(TA*k)	22.196***
	(1.837)
SRISK/GDP	-0.425***
	(0.116)
SRISK/MV	-0.938*
	(0.484)
var(e.CRISIS)	11.044***
	(1.259)
Country FE	Yes
Pseudo R^2	0.264
Observations	564

Table 5: **Equation 3c: Tobit Model (Using leave-one-out sum for world variables)** Standard errors are reported in parentheses. ***, ** and * represent 1%, 5% and 10% significance, respectively.

	Dep Var: CRISIS			
	(1)	(2)	(3)	(4)
SRISK/(TA*k)	18.179***	12.997***	12.681***	15.398***
	(1.209)	(1.375)	(1.315)	(1.392)
D.SRISK/(TA*k)	6.822***		4.118**	
	(1.947)		(1.894)	
World SRISK/(TA*k)		14.300***		
		(2.413)		
D.World SRISK/(TA*k)		8.245***		
		(2.808)		
World SRISK/MV			9.921***	
			(1.551)	
World log SRISK				1.845***
				(0.364)
D.World log SRISK				4.095***
				(1.012)
var(e.CRISIS)	11.185***	9.964***	9.924***	10.716***
	(1.273)	(1.123)	(1.119)	(1.214)
Country FE	Yes	Yes	Yes	Yes
Pseudo R^2	0.260	0.290	0.285	0.281
Observations	561	561	561	561

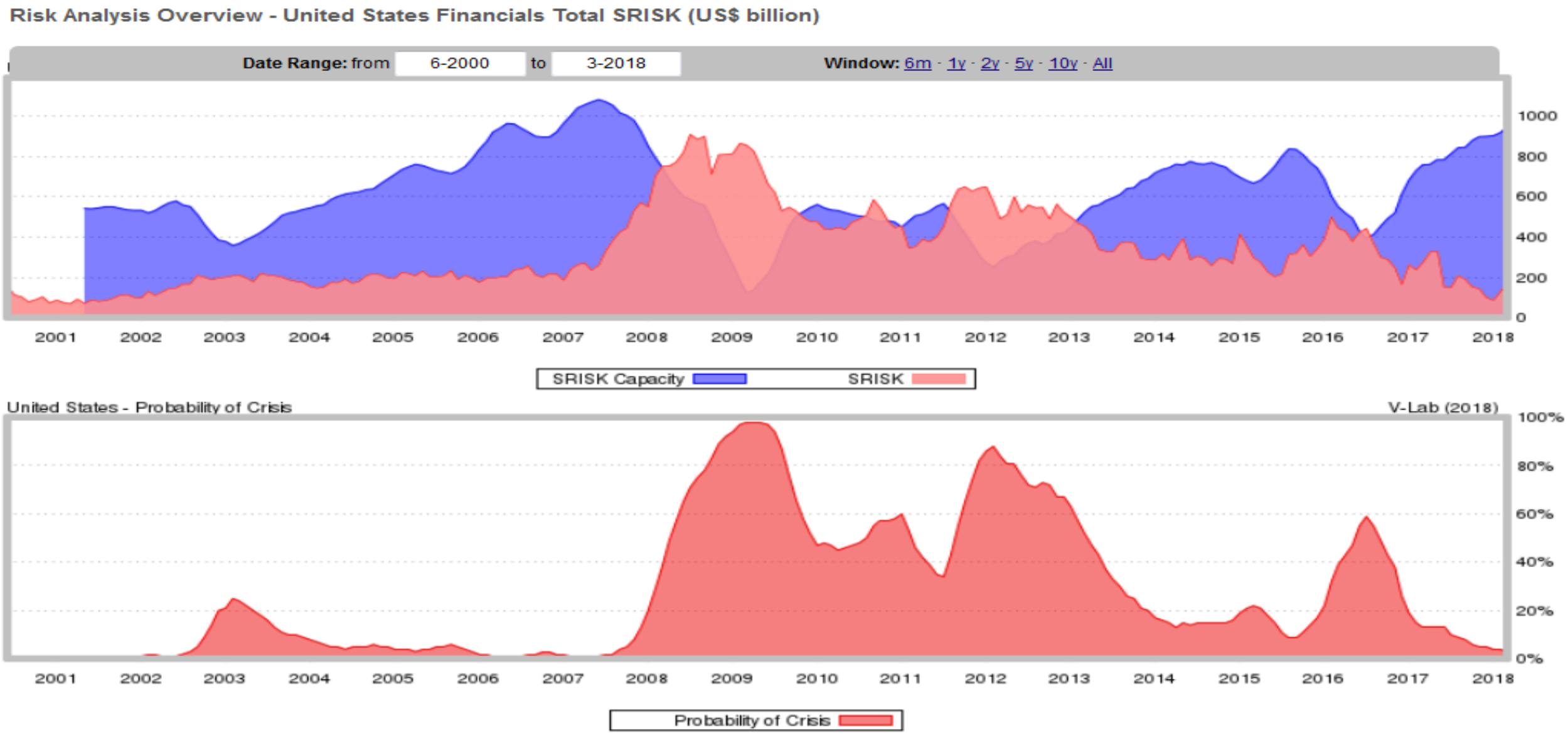
MODEL FEATURES TWO EXTERNALITIES

THE RISK OF AN UNDERCAPITALIZED FIRM DEPENDS UPON THE UNDERCAPITALIZATION OF OTHER FIRMS IN THE SAME COUNTRY

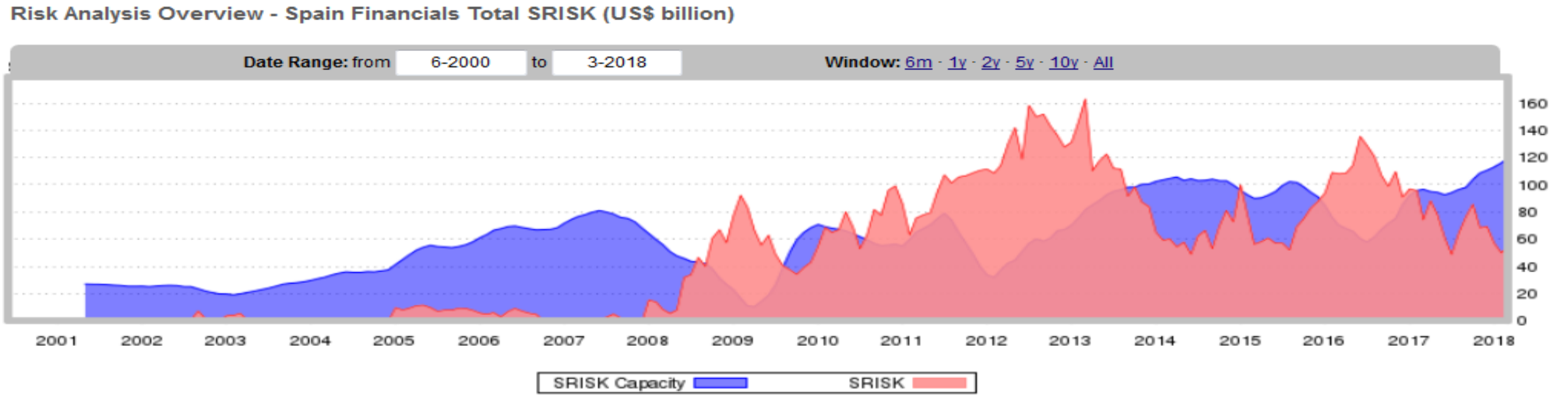
THE RISK OF AN UNDERCAPITALIZED COUNTRY FINANCIAL SYSTEM DEPENDS UPON THE UNDERCAPITALIZATION OF THE REST OF THE WORLD

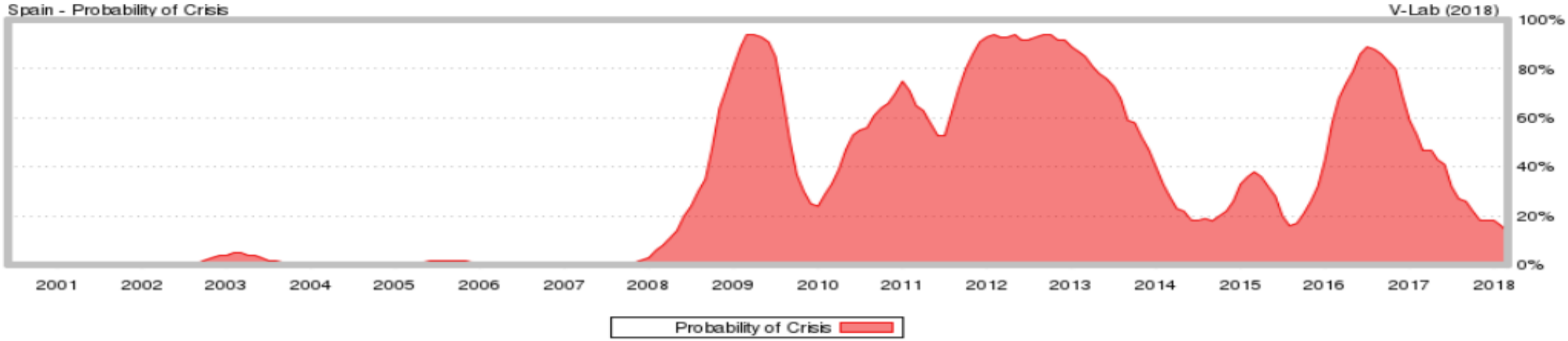
PROVIDES A MOTIVATION FOR COUNTRY AND GLOBAL COORDINATION AND REGULATION

US SRISK Capacity and Probability of Crisis

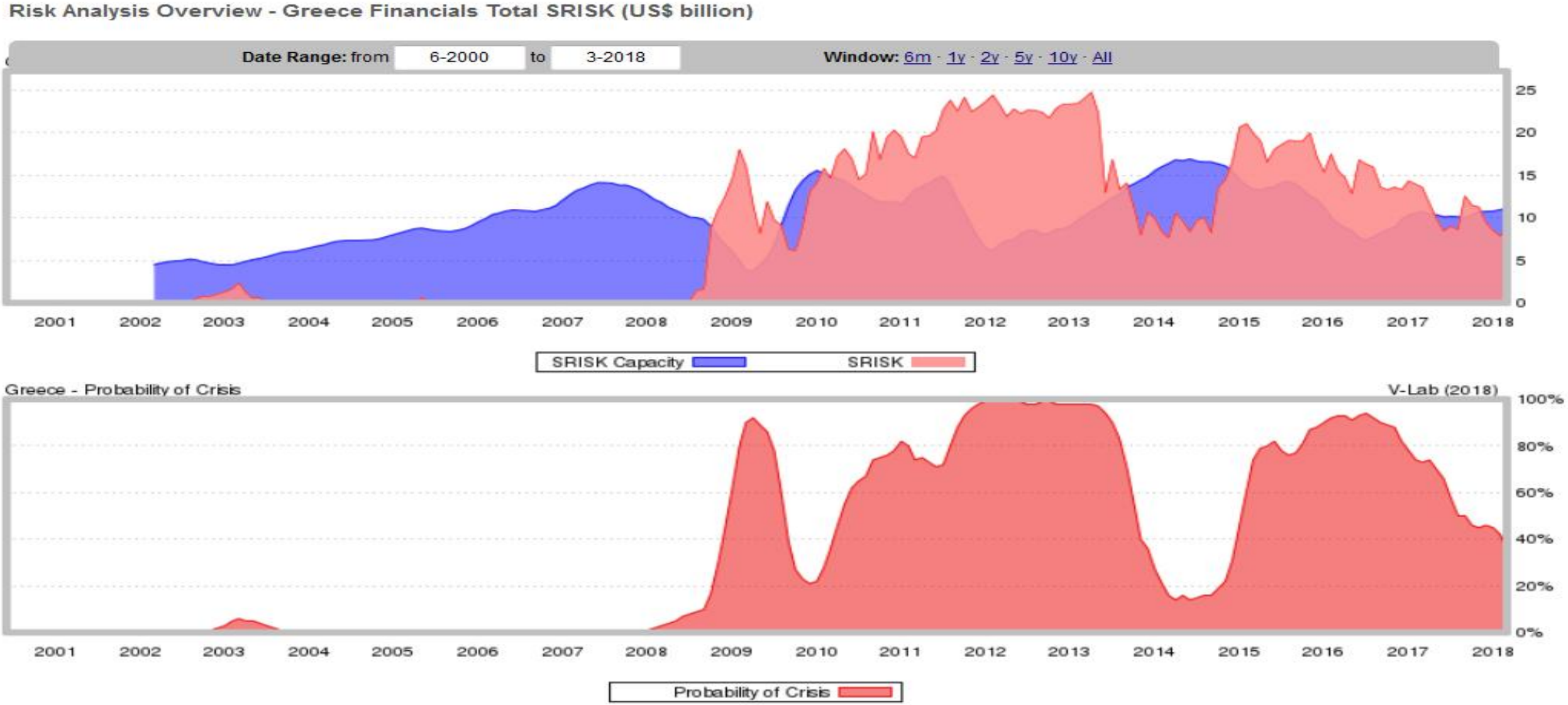


SPAIN SRISK Capacity and Probability of Crisis

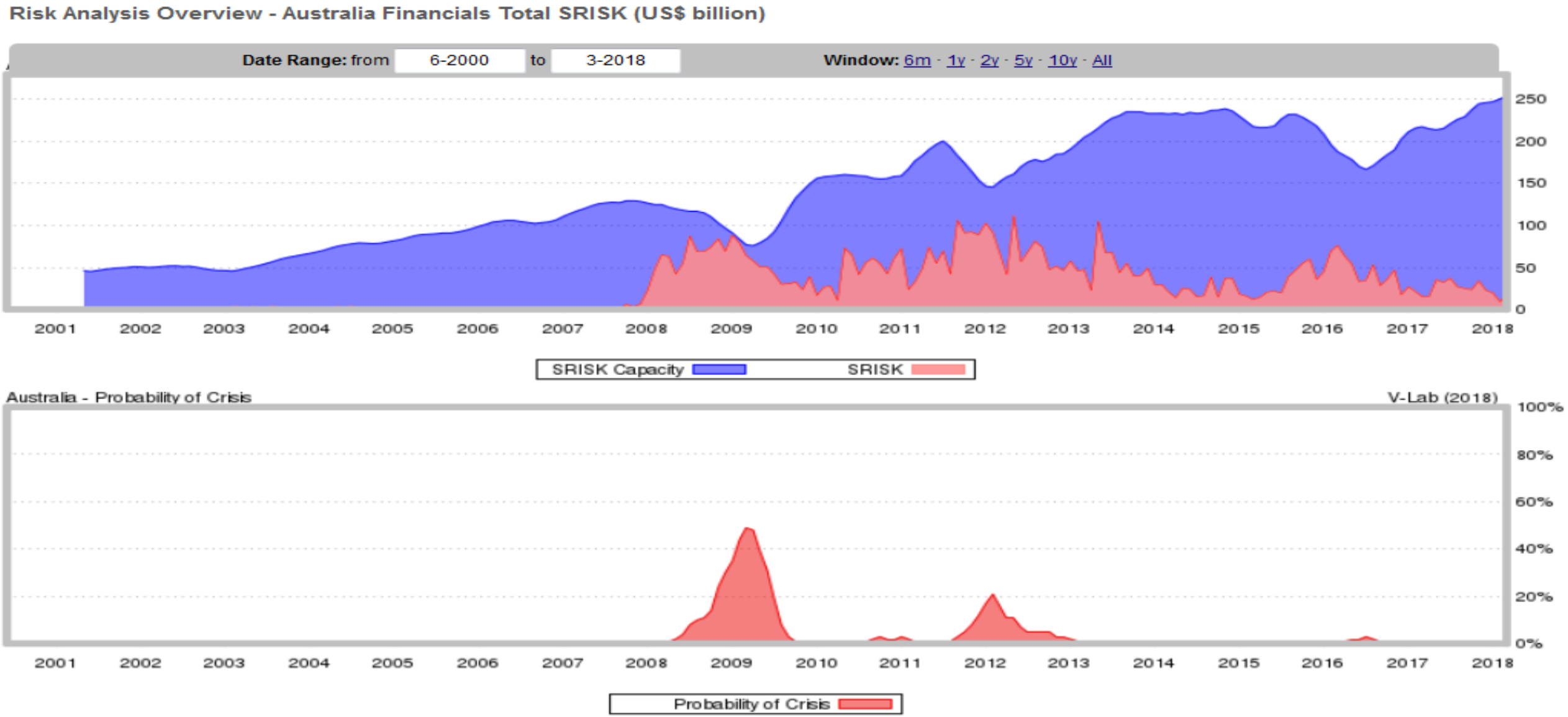




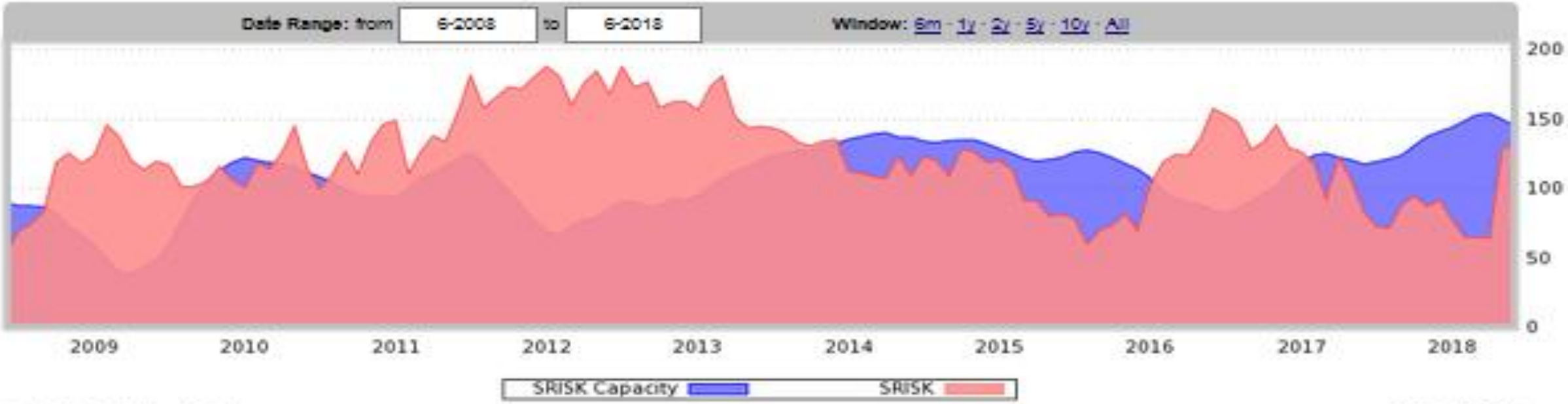
GREECE SRISK Capacity and Probability of Crisis

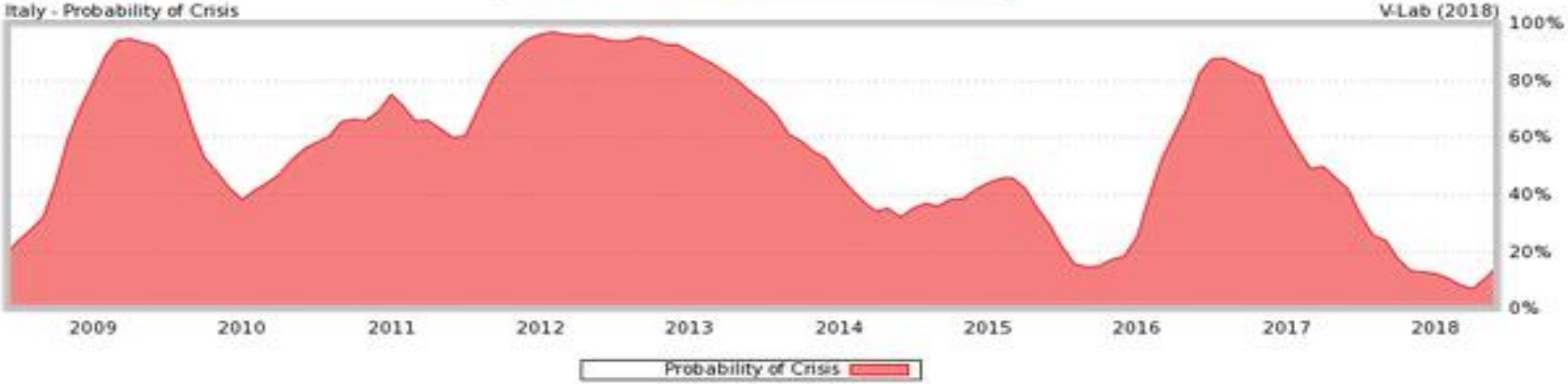


AUSTRALIA SRISK Capacity and Probability of Crisis



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





ROBUSTNESS CHECKS

1. Drop one country at a time and recompute the Tobit model on the remaining. Do the confidence intervals include zero?
2. The only result that is affected is due to Japan. When it is excluded, the SRISK/GDP variable becomes positive.
3. Changing the stress ratio and the capital requirement and separate account fraction, reestimate the model over a grid. It appears that a higher stress predicts the Crisis variable better.
4. The best version of the Global Model has stress=60%, capital ratio=4% and includes 20% of separate assets. However the differences are not great. These results are still preliminary.

CONCLUSION

HIGH LEVELS OF SRISK IN A COUNTRY CAN INCREASE THE PROBABILITY OF A FINANCIAL CRISIS.

HIGH LEVELS CAN BE COMPARED WITH TOTAL FINANCIAL SECTOR ASSETS

WHEN THE WORLD FINANCIAL SYSTEM IS WEAK IT MAKES EACH COUNTRY'S FINANCIAL SYSTEM MORE VULNERABLE TO CRISIS.

What is in their future?