

# **Financial Sector Health since 2007: A Comparative Analysis of the United States, Europe and Asia<sup>1</sup>**

**By**

**Viral V Acharya  
C V Starr Professor of Economics  
Department of Finance  
NYU Stern School of Business**

**November 2014, revised April 2015**

**Abstract:** This essay uses recent methodology for estimating capital shortfalls of financial institutions during aggregate stress to assess the evolution of financial sector health since 2007 in the United States, Europe and Asia. Financial sector capital shortfalls reach a peak in the end of 2008 and early 2009 for United States and Europe; however, they decline thereafter steadily only for the United States, with Europe reaching a similar peak in the Fall of 2011 during the southern periphery sovereign crises. In contrast, the financial sector in Asia had little capital shortfall in 2008-09 but the shortfall has increased steadily since 2010, notably for China and Japan. These relative patterns can be explained based on the regulatory responses in the United States, the lack thereof in Europe, stagnation in Japan, and the bank-leverage based fiscal stimulus in China.

---

<sup>1</sup> I am grateful to Michael Robles of NYU Stern VLAB for help with the computations and to Michael Barr for detailed comments on the first draft.

## Introduction

How should we assess the global financial sector health? Can we provide a comparative analysis of such health across different countries and regions? Where do the future sources of vulnerability in the global financial sector lie?

This article employs the recent advances in measurement of the systemic risk of financial firms to answer these questions. In particular, it exploits a theoretically well-founded notion of systemic risk contribution of financial firms – their *expected capital shortfall in a crisis* – and measures it using publicly available market and balance-sheet data. Using this measure, it provides a comparative analysis of the global financial sector health since early 2007, focusing on similarities and differences between the United States, the Europe and Asia.

The reason to focus on capital adequacy as a measure of systemic risk is simply that under-capitalized financial sectors lead to significant loss of economic output due to withdrawal of efficient intermediation services and possibly misallocation of resources. In particular, when a large part of the financial sector is funded with fragile, short-term debt (or conversely, is not funded with adequate equity capital) and is hit by a common shock to its long-term assets, there can be en masse failures of financial firms. In such a scenario, it is not possible for any individual firm to reduce its leverage or risk without significant costs since other financial firms are attempting to achieve the same outcome. Since de-leveraging and risk-reduction are privately costly to owners of the financial firms, they delay such actions, operating as under-capitalized firms that are averse to expanding efficiently the provision of intermediation to households and corporations and keen to pursue risky strategies (gambling for resurrection)

that offer them some chance of recovering but at the cost of a greater chance of further stress. If further stress develops, there can be a complete disruption of payments and settlement services, which can cause trade and growth to collapse as witnessed for several years during the Great Depression as well as in the Fall of 2008 during the Great Recession.

The adverse impact of undercapitalized financial sectors on allocation of economic resources has been the focus of an important body of empirical research. Peek and Rosengren (2005), Caballero, Hoshi, and Kashyap (2008), and Hoshi and Kashyap (2010) show for the Japanese banking crisis of the 1990s that undercapitalized banking sector continued to operate as “zombie banks” that directed credit to non-performing existing borrowers rather than directing this credit to efficient newer sectors of the economy. This theme has been confirmed again in the European countries following the financial crisis of 2007-2009. The lack of adequate recapitalization and cleaning-up of European banks’ balance sheets has prevented an efficient allocation of credit for an extended period of time. Popov and van Horen (2013) report that it has taken European banks much longer to recover in terms of their global syndicated lending than other banks. Acharya and Steffen (2015) demonstrate that under-capitalized European banks put on “carry trades” by using short-term funding to purchase risky government bonds of southern periphery, a bet that did not pay off and resulted in a combined sovereign and banking crisis for Europe in the Fall of 2011.

Given these adverse consequences of undercapitalized financial sectors, it is natural to focus on expected capital shortfall of the financial sector as a way of measuring its systemic risk or vulnerability to a future crisis. Section 1 introduces the measure we employ, *SRISK*, based on the work of Acharya, Pedersen, Philippon and Richardson (2010a, b, c) and Acharya, Engle and

Richardson (2012). Section 2 assesses global financial sector health since 2007 using *SRISK* as the measure of systemic risk. Section 3 provides a discussion of the divergence observed in the United States, the Europe and the Asia, in terms of the evolution of financial sector health since 2007. Section 4 concludes.

### 1. *SRISK* – a measure of financial sector health

Acharya (2009) and Acharya, Pedersen, Philippon and Richardson (2010a, b, c) argue that systemic risk should not be described in terms of a financial firm’s failure per se but in the context of a firm’s overall contribution to system-wide failure. The intuition is that when *only* an individual financial firm gets distressed, i.e., its equity capital becomes low relative to its promised debt- or debt-like liabilities, there are minimal economic consequences because healthier financial firms can fill in for the failed firm’s void in intermediation services. When capital is low in the aggregate, however, it is not possible for other financial firms to step into the breach. This breakdown in aggregate financial intermediation is the reason there are severe consequences for the broader economy such as credit crunch and fire sales of assets.

Acharya, Engle and Richardson (2012) implement this intuition by proposing a measure of systemic risk contribution of a financial firm, called *SRISK* and measured as the expected capital shortfall of a firm in a crisis. In particular, *SRISK*, of firm *i* at time *t* is defined as the capital that the firm is expected to need (conditional on available information up to time *t-1*) to operate “normally”, i.e., not face a “run” of its creditors, if we have another financial crisis. Symbolically it can be defined as

$$SRISK_{i,t} = E_{t-1} (Capital\ Shortfall_i | Crisis) \quad (1)$$

Brownlees and Engle (2011) (see also Engle, 2011) provides the econometrics of estimating *SRISK* by modeling the bivariate daily time series model of equity returns on firm *i* and on a broad market index using publicly available data. The results of this analysis are updated weekly and posted at New York University Stern School of Business Volatility Institute (NYU Stern VLAB) website <http://vlab.stern.nyu.edu/welcome/risk>. Results are posted both for approximately 100 US financial firms and for 1200 global financial firms.

To calculate *SRISK*, we first need to evaluate the losses that an equity holder would face if there is a future crisis. To do this, volatilities and correlations of individual financial firm's equity return and the global market-wide return are allowed to change over time and simulated for six months into the future many times. Whenever the broad index falls by 40% over the next six months, a rather pessimistic scenario that captures the kind of market collapse witnessed during the Great Depression in 1930's and the Great Recession in 2007-09, this is viewed as a crisis. For these scenarios, the expected loss of equity value of firm *i* is called the Long Run Marginal Expected Shortfall or *LRMES*. This is just the average of the fractional returns of the firm's equity in the crisis scenarios.<sup>2</sup>

The capital shortfall can be directly calculated by recognizing that the book value of debt will be relatively unchanged during this six-month period while equity values fall by *LRMES*. Assume a prudential capital ratio is considered to be *k* which we take as 8% (and 5.5% for Europe to adjust for the differences between the European IFRS and US GAAP accounting

---

<sup>2</sup> In versions of the model where the simulation is not yet implemented on VLAB, *LRMES* is approximated as  $1 - \exp(-18 * MES)$  where *MES* is the one day loss expected if market returns are less than -2%.

standards in the treatment of netting of derivatives). Then we can define *SRISK*, of firm *i* at time *t* as:

$$\begin{aligned} SRISK_{i,t} &= E_{t-1} \left( (k(Debt + Equity) - Equity) | Crisis \right) \\ &= k(Debt_{i,t}) - (1-k)(1 - LRMES_{i,t}) Equity_{i,t} \end{aligned} \quad (2)$$

where  $Equity_{i,t}$  is the market value of equity today,  $Debt_{i,t}$  is the notional value of non-equity liabilities today, and  $LRMES_{i,t}$  is the long-run marginal expected shortfall of equity return estimated using available information today. This measure of the expected capital shortfall captures many of the characteristics considered important for systemic risk such as size and leverage. These characteristics tend to increase a firm's capital shortfall when there are widespread losses in the financial sector. But a firm's expected capital shortfall also provides an important addition, most notably the *co-movement* of the financial firm's assets with the aggregate market in a crisis.<sup>3</sup>

Before we employ estimates of *SRISK* to provide a comparative analysis of the global financial sector health, few points are in order.

First, *SRISK* can be considered as the capital shortfall estimate for a financial firm based on a market-data based "stress test". Stress tests have now become a standard device used by regulators to determine the capital that an institution will need to raise if there is a

---

<sup>3</sup> In this sense, *SRISK* is based on a notion of systemic risk in which a "tsunami"-type shock hits the global economy rather than a "contagion"-type shock in which an individual financial firm's interconnectedness causes losses elsewhere in the financial system. The latter would, however, also be statistically picked up in a co-movement of a financial firm's assets with the aggregate market providing that the contagion does have market-wide impact.

macroeconomic shock.<sup>4</sup> Regulatory stress tests employ book value of equity capital, estimate losses using models that map macroeconomic stress into asset losses, and require book values of capital to be sufficiently high based on regulatory *risk-weighted assets*.<sup>5</sup> In contrast to regulatory stress tests, *SRISK* is based on the market value of equity capital, estimates losses using market-data based estimate of downside risk of market equity or its vulnerability to a crisis, and requires market values of capital to be sufficiently high relative to *quasi-market value of assets* (measured as market value of equity plus the book value of non-equity liabilities). As a result, while the regulatory notion of leverage corresponds to risk-weighted assets divided by a measure of book value of equity of a financial firm, the notion of leverage captured in *SRISK* is *quasi-market leverage*, which is quasi-market value of assets divided by the market value of equity.

Second, as argued by Calomiris and Herring (2013) (see their Figures 3 and 4, in particular), an important advantage of using the market value of equity and its exposure to a crisis or

---

<sup>4</sup> Acharya, Engle and Pierret (2014) summarize the adoption of stress tests by regulators in the United States and the Europe: “*An annual supervisory stress test of the financial sector in the United States has become a requirement with the implementation of Dodd-Frank Wall Street Reform and Consumer Protection Act (Pub.L. 111–203, H.R. 4173) of 2010. Macroprudential stress tests have also been used by U.S. and European regulators to restore market confidence in financial sectors during an economic crisis. As a response to the recent financial crisis, the 2009 U.S. stress test led to a substantial recapitalization of the financial sector in the U.S. In Europe, the 2011 stress test also served as a crisis management tool during the European sovereign debt crisis. The European exercise lacked credibility in this role, however, due largely to the absence of a clear recapitalization plan for banks failing the stress test.*”

<sup>5</sup> Again quoting Acharya, Engle and Pierret (2014): “*The current approach to assessing capital requirements is strongly dependent on the regulatory capital ratios defined under Basel Accords. The capital ratio of a bank is usually defined as the ratio of a measure of its equity to a measure of its assets. A regulatory capital ratio usually employs book value of equity and risk-weighted assets, where individual asset holdings are multiplied by corresponding regulatory ‘risk weights’.* The regulatory capital ratios in stress tests help regulators determine which banks fail the test under the stress scenario and what supervisory or recapitalization actions should be undertaken to address this failure.”

aggregate downturn is that market-based signals of financial sector distress have been found to be much better as early-warning signals than regulatory measures of financial sector risk (risk-weighted assets to total assets) and book values of equity.

Third, and related to the second point, regulatory risk weights for asset classes are inherently static in nature whereas the true economic risk of asset classes fluctuates over time. Indeed, combined with shifts in financial leverage, the “change that risk will change” can be considered an essential cause of financial crises. Acharya, Engle and Pierret (2014) demonstrate that market-based risk assessments of financial firm balance-sheets, in particular, using the *SRISK* measure and its components, captured better the actual stress of financial firms in Europe during 2011, relative to the regulatory risk assessments, which relied on static risk weights, notably zero risk-weights for risky sovereign bonds of countries in the southern European periphery.

Fourth, since it is based on market data, one limitation of *SRISK* is that it can be computed only for financial firms whose equity is publicly traded. In other words, it cannot be computed readily for privately held financial firms. Hence, all assessment of global financial sector health and comparative analysis across countries that follows is subject to this important caveat.

Finally, given the simple formulaic structure for *SRISK*, we can also understand changes in *SRISK* over time as coming from changes in its components, the book value of non-equity liabilities, the market value of equity, and the market value of equity times the *LRMES*, as follows:

$$\begin{aligned}
 \Delta SRISK_i &= SRISK_{i,t} - SRISK_{i,t-1} \\
 &= \Delta Debt_i + \Delta Equity_i + \Delta Risk_i, \text{ where} \\
 \Delta Debt_i &= k (Debt_{i,t} - Debt_{i,t-1}), \\
 \Delta Equity_i &= -(1-k) (Equity_{i,t} - Equity_{i,t-1}), \text{ and} \\
 \Delta Risk_i &= (1-k) (LRMES_{i,t} Equity_{i,t} - LRMES_{i,t-1} Equity_{i,t-1})
 \end{aligned} \tag{3}$$

where the changes in *Debt*, *Equity* and *Risk* are measured over the period from  $t-1$  to  $t$ , and together with the appropriate weights from the *SRISK* formula in (2), these changes combine to explain the change in *SRISK* over the period from  $t-1$  to  $t$ .

This decomposition highlights that increases in non-equity liabilities and expected losses in a crisis increase *SRISK* over time whereas increases in market value of equity decrease *SRISK* over time.

## **2. Assessing Global Financial Sector Health using *SRISK***

In order to operationalize *SRISK* and compare it across countries and regions, NYU Stern VLAB includes all publicly listed financial firms in a country with active trading in common equity that are in top 10% of firms in a year by size (see Appendix for sample size distribution by year). In order to identify firms with capital shortfall, firms with positive *SRISK* are identified. All positive values of *SRISK* for a country or region in a given year are aggregated to obtain the overall *SRISK* for that country or region. In what follows, all references to the current or the present moment refer to 10 Oct 2014.<sup>6</sup>

Figures 1-8 and Table 1 summarize our overall findings for aggregate *SRISK* across the three regions (United States, Europe and Asia with emphasis on China):

(1) Figure 1 plots the aggregate *SRISK* for the three regions and China and is the central figure of this essay.

---

<sup>6</sup> While this article focuses entirely on *SRISK* that is aggregated at the level of a country or region, prior research has shown that it indeed has the right cross-sectional properties in capturing the systemic risk of individual financial firms. Acharya, Pedersen, Philippon and Richardson (2010a, c) provide such firm-level evidence for 2007-08 for the United States financial sector, and Acharya, Engle and Pierret (2014) provide such evidence for Europe during the period of the sovereign debt crisis in 2011.

In case of United States, systemic risk appears to have peaked in Fall 2008 and early 2009, with the estimated capital shortfall of the financial sector at over \$1 trillion. This is of the order of magnitude of the capital injections and other forms of federal support for the financial sector following the collapse of Lehman Brothers, in the form of TARP, FDIC guarantees and Federal Reserve liquidity provision. Since then, the systemic risk appears to have steadily come down since Spring 2009, with current levels being as low as in Jan 2007. The one exception is Aug 2011 when the systemic risk in the United States rises again around the debt-ceiling political crisis in the United States and the Eurozone sovereign debt and financial sector crisis.

Similar to the United States, the systemic risk of the European financial sector also reaches its peak in Fall of 2008 and early 2009 (at about \$2.25 trillion), but reveals an important difference: it reaches another peak of \$2 trillion in August 2011, coincident with the Eurozone sovereign debt crisis. In other words, Europe appears to have witnessed serial episodes of dramatic capital shortfalls in the financial sector. While systemic risk has come down since this second peak, its current levels remain at more than twice those in Jan 2007, another striking difference with the United States.

The picture of systemic risk estimate for Asia is, however, quite different than that for the United States and the Europe. The estimate capital shortfalls for the Asian financial sector show a steady trend upward all the way from Jan 2007 to date with some local peaks but overall having risen by close to \$1 trillion from a quarter trillion to currently around \$1.25 trillion. China, which in addition to Japan, is the largest financial sector in Asia mirrors this trend as show in the figure. The Chinese financial sector shows little estimated capital shortfall until middle of 2010, but since then it has had a meteoric rise, with present estimate at over a half trillion dollars.

(2) One limitation of comparing the absolute values of estimated capital shortfalls is that larger countries would have larger financial sectors, and all else equal, would therefore have greater absolute values of estimated capital shortfalls in a future crisis. To confirm that inference from Figure 1 is not driven by such size differences, Figure 2 plots the systemic risk for the regions that is scaled by GDP. The patterns are essentially the same as in Figure 1. In case of the United States, estimated capital shortfalls reach a peak of close to 8% of GDP in Fall of 2008 and early 2009, reaching another local peak in August 2011 of 4% of GDP, but are currently at less than 2% of GDP as in Jan 2007. For Europe, the crises of 2008-09 and Fall 2011 appear to have been much worse with estimated capital needs being close to 12% and 10% of GDP, respectively, and even presently being high at 6% of GDP relative to the Jan 2007 level of 2% of GDP (as in the case of United States). This illustrates well that the European financial sector is far less healthy at present than the United States and also relative to itself prior to the global financial crisis of 2007-08. Finally, for Asia the estimated capital shortfalls have trended steadily upward from under 2% of GDP in Jan 2007 to presently close to 6% of GDP, and in case of China from being zero to over 6% of GDP.

(3) Figure 3 helps understand the diverging patterns of systemic risk for the United States, Europe and Asia in terms of leveraging or de-leveraging of the financial sector by plotting the aggregate quasi-leverage of the respective financial sectors. It illustrates succinctly that the leverage time-series for these financial sectors tracks closely the evolution of the estimated systemic risk of these financial sectors. In other words, the United States financial sector experienced significant leverage increase until Spring 2009, and since then has been de-leveraging at a rapid pace; the European financial sector experienced leverage rises until Summer

2009 but also in the period close to and leading up to Fall 2011, and de-leveraging to some extent since then but not to Jan 2007 levels; in contrast, the Asian (and Chinese) financial sectors have been ramping up leverage at a steady pace all along from 2007 to date. It is interesting that at present the leverage in the United States financial sector is down to 5 (that is, 5 units of assets for one unit of market value of equity), lower than 10 for Asia, and around 15 for China and Europe. Equally interestingly, the leverage of the financial sector in Europe has been pervasively greater than that of the financial sectors in United States and Asia.

(4) Figure 4 illustrates that in case of United States, the top three banks contribute to over half of the total capital shortfall of \$250 billion, reflecting the increasing concentration in the financial sector owing in part to the acquisitions structured during 2007-08 to resolve distressed financial firms. Interestingly, the top ten contributors include five insurance firms, whose systemic risk is increasingly coming under scrutiny, notably at the Financial Stability Oversight Council (FSOC) put in place by the Dodd-Frank Act in the United States to identify and prevent systemic risk emergence. While the insurance sector has relatively stable liability structure compared to the banking sector, recent empirical evidence has suggested that life insurance firms in the United States have been (i) “reaching for yield” (Becker and Ivashina, 2013) by looking for highest-risk (and therefore, highest-yield) assets within a regulatory risk bucket; (ii) reducing statutory capital requirements by engaging in “shadow insurance” which transfers liability risks to captive reinsurance firms economically linked to the parent insurance firms (Koijen and Yogo, 2013); and, (iii) expanding their asset base of sub-investment grade structured products in residential real-estate mortgages while shrinking at the same time pool of investment-grade

products in this asset class (Becker and Opp, 2014). These changes appear to have been priced in by the market in terms of the greater economic risk and leverage of the life insurance sector.

Similarly, Figures 5 and 6 help understand the contributors (at country level) to current systemic risk assessment in Europe. In terms of absolute contributions to the estimated capital shortfalls (Figure 5), France leads the way at \$350 billion, over a fourth of the current shortfall estimate for Europe. Even on a per GDP basis (Figure 6), France leads the way with its estimated capital shortfall being around 13% of its GDP, a rather sizeable fraction of GDP to put aside to recapitalize the banking sector should future stress require public injections of capital. While Switzerland and United Kingdom are expected to rank highly on a per GDP basis given the relatively large balance-sheets of their financial sectors compared to the national balance-sheets, France topping this list is somewhat surprising and highlights the relative under-capitalization of its banking sector (in terms of its quasi-market leverage). Notably, while Germany ranks high in Figure 5 in terms of absolute size of estimated capital shortfalls, on a per GDP basis it looks much healthier than France.

And Figures 7 and 8 help understand countries that contribute to the systemic risk in Asia at the present date. China and Japan together constitute most of the estimated capital shortfall in Asia (Figure 7). On per GDP basis, however, Japan is substantially higher at over 11% shortfall relative to GDP, whereas China is somewhat smaller at over 6%.

(5) Finally, while China's systemic risk relative to its GDP appears manageable, particularly given its vast reserves, it is intriguing what explains its dramatic rise seen in Figures 1 and 2, from being practically zero to now being half a trillion dollars or six percent of GDP. Table 1 provides an intuitive understanding of this rise using the decomposition of change in *SRISK* between end

of 2009 and 10 Oct 2014 for the highest *SRISK* contributors in the Chinese financial sector into its three components ( $\Delta Debt$ ,  $\Delta Equity$ ,  $\Delta Risk$ ) as explained in the concluding remarks of Section 1.

The top four banks in the list are the largest state-owned commercial banks in China. Together, they contribute to over half of the estimated capital shortfall for China. However, all these banks had negative *SRISK* at end of 2009, i.e., they were in fact capital surplus. What is remarkable in Table 1 is that almost all of the change in *SRISK* can be attributed to the increase in debt liabilities ( $\Delta Debt$ ) for these banks. Indeed, while their debt liabilities have increased, equity valuations have suffered so that the increase in *SRISK* is also due to declines in equity (positive  $\Delta Equity$ ). Interestingly, their downside risk on per dollar of equity basis has improved, so that the risk contribution ( $\Delta Risk$ ) is negative. Together, this suggests massive *financial* leveraging of the largest banks in China from 2010 to date, which has increased the systemic risk of the financial sector to non-trivial levels, and way beyond for United States on per GDP basis.

### **3. What Explains the Divergence in Evolution of Global Financial Sector Health since 2007?**

In summary, the financial sector capital shortfalls reached a peak in the end of 2008 and early 2009 for United States and Europe; however, they declined thereafter steadily only for the United States, with Europe reaching a similar peak in the Fall of 2011 during the sovereign debt crises in the southern periphery of Europe. In contrast, the financial sector in Asia had little capital shortfall in 2008-09 but the shortfall has increased steadily since 2010, notably for China and Japan. What explains these relative patterns? I argue below briefly that these patterns can be explained based on the regulatory responses in the United States, the lack thereof in Europe, economic stagnation in Japan, and the bank-leverage based fiscal stimulus in China.

Following the collapse of Lehman Brothers, the United States put in place first a substantial rescue package in the form of TARP recapitalization of the financial sector up to \$750 billion, FDIC deposit and loan guarantee programs and Federal Reserve's liquidity support of financial sector as well as markets at large, in addition to the government conservatorship of the mortgage agencies, Fannie Mae and Freddie Mac. While these measures were not adequate to calm the volatility in markets which remained substantially high even in early 2009, the stress-test based recapitalization in Spring 2009 (the Supervisory Capital Assessment Program, SCAP) ensured that banks injected further \$200 billion capital into the balance-sheets (required capital raising by regulators was \$75 billion). These measures produced much calm about the health of the financial sector in the United States. Following this, the Dodd-Frank Act was enacted in 2010 and various measures put in place to rein in systemic risk, again notably an annual stress test of the Systemically Important Financial Institutions (SIFI's) identified by the newly created Financial Stability Oversight Council (FSOC). All of these measures have ensured substantial de-leveraging of the United States financial sector balance-sheets, as seen in Figures 1-3, to the point that they appear to be among the healthiest in the global economy at present.

In contrast to the United States, the regulatory response in Europe to the financial sector meltdown of 2007-08 was half-baked. While the governments and central banks were quick to assist the ailing financial sector with asset and liability guarantees as well as liquidity injection, there was no substantial recapitalization of the financial sector, on a scale similar to the TARP was for the United States financial sector. This lack of recapitalization, in presence of massive guarantees, meant that the financial sector had poor incentives during the recovery phase. Many under-capitalized banks invested in risky assets to rebuild equity capital,

transferring risks in the process to the government, by undertaking “carry trades” on southern periphery sovereign debt funded with retail and wholesale deposits (Acharya and Steffen, 2015). This created a rather unfortunate nexus between financial and sovereign credit risks in the Eurozone, bringing about twin crises in Fall of 2011, with the deteriorating macroeconomic and financial health in Spain and Italy (Acharya, 2014). This nexus of sovereign and financial sector credit risks --- first, the under-capitalized financial sector taking leveraged exposures to risky sovereigns, and second, further distress of risky sovereigns inflicting collateral damage on the financial sector --- appears to have had significant real consequences. Acharya, Eisert, Eufinger and Hirsch (2014) show that even relatively large borrowers in Europe whose lead banks have been from the southern periphery countries have been hoarding cash and cutting back investment and employment, behaving as though they are financially constrained, an effect that is not seen for borrowers whose lead banks are from the core European countries, which are, in turn, relatively better-capitalized.

The carry-trade strategies and the under-capitalization of banks that induced them were left unchecked, and in fact encouraged, by regulators who conducted stress tests with little bite compared to the SCAP exercise of the United States. As Acharya, Engle and Pierret (2014) document, the European stress tests granted zero risk weights to risky southern periphery sovereign debt so that effectively not much capital was raised by banks in response, and in fact, the worst banks such as Dexia in terms of risks were found to require the least capital in the stress tests. Acharya and Steffen (2014) document that the pattern was hardly different with the Asset Quality Review and Comprehensive Assessment of the European Central Bank in 2014. Nevertheless, there is some overall improvement in the health of the financial sector

relative to Fall of 2011 due to the extraordinary liquidity injection and promises to purchase securities from the market provided by the European Central Bank, starting in Dec 2011.

Finally, the case of Asia can be explained by the continuing economic malaise in Japan since the regulatory failure in 90's to recapitalize the banking sector, and the debt-based stimulus in China to ensure high growth rates in the short-run even as the global economy suffered in the wake of the crisis of 2007-08. In case of Japan, the financial sector leverage remains high or increasing in spite of the continued macroeconomic weakness, which has only had temporary relief from "Abenomics", explaining the continuing rise of systemic risk in Japan since 2007.

The case of China is relatively straightforward in contrast. Following the global financial and economic crisis of 2007-08, Chinese state-owned banks have leveraged massively, including in off-balance sheet liabilities (not captured in *SRISK* analysis), to fund real estate and infrastructure projects, many of which are at unsustainable price levels and subject to high non-performing rates. From 2008 to 2013, total credit outstanding the Chinese economy grew from 125% to 240%. Much of this increase came about from stimulus expenditures undertaken since 2008 by local municipal governments. These local governments, being prohibited from raising debt directly, set up special-purpose financing vehicles, which raised debt from shadow banks ("trusts") in China to invest in infrastructure and real estate development. The local government debt is backed mainly by revenues from land sales, but with house prices inevitably slowing down in past few years from their astronomical growth before, the shadow banks – many of whom are implicitly supported by parent state-owned banks – are exposed to significant losses that has created the possibility of "runs" as well as under-capitalized banks.

While China appears to have time and resources (large quantity of reserves and a high domestic savings rate) besides its tight control of its banks and housing markets, the question is whether like the United States in post-Lehman era, it will take tough recapitalization decisions for its banks before its own crisis comes to fruition, or whether like Japan in the 90's and Europe since the Great Recession, it will let under-capitalized banks continue to operate as zombie banks engaged in misallocation of economic resources.

#### **4. Conclusion**

This essay used recent methodology for estimating capital shortfalls of financial institutions during aggregate stress to assess the evolution of financial sector health since 2007 in the United States, Europe and Asia. Financial sector capital shortfalls reach a peak in the end of 2008 and early 2009 for United States and Europe; however, they decline thereafter steadily only for the United States, with Europe reaching a similar peak in the Fall of 2011 during the southern periphery sovereign crises. In contrast, the financial sector in Asia had little capital shortfall in 2008-09 but the shortfall has increased steadily since 2010, notably for China and Japan. These relative patterns can be explained based on the regulatory responses in these regions in terms of recapitalizing distressed banking sectors or letting them remain under-capitalized: the United States did not waste its crisis and its banking sector appears the best-capitalized of the lot; Europe has wasted two crises already to strengthen its banking sector; Japan has not yet fully recovered from consequences of its zombie-banking policy of 90's; and, China is potentially heading into a debt-fueled banking crisis, largely from its fiscal stimulus since 2008. Interestingly, economic outcomes in these regions appear to be mirroring the health of their financial sectors, as measured by capital adequacy against future stress.

## References

- Acharya, V. V., 2009, "A Theory of Systemic Risk and Design of Prudential Bank Regulation", *Journal of Financial Stability*, 5(3), 224-255.
- Acharya, V. V., 2014, "The Nexus Between Financial Sector and Sovereign Credit Risks", *forthcoming, Toulouse Lectures in Economics*, Princeton University Press.
- Acharya, V., Eisert, T., Eufinger, C., Hirsch, C., 2014. Real effects of the sovereign debt crisis in Europe: evidence from syndicated loans. Unpublished working paper. NYU-Stern.
- Acharya, V. V., Engle, R. and Pierret, D., 2014, "Testing Macro-prudential Stress Tests: The Risk of Regulatory Risk Weights", *Journal of Monetary Economics*, 65, 36-53.
- Acharya, V. V., Engle, R. and Richardson, M. P., 2012, "Capital Shortfall: A New Approach to Ranking and Regulating Systemic Risks", *American Economic Review Papers and Proceedings*, 102(3), 59-64.
- Acharya, V. V., Pedersen, L. H., Philippon, T. and Richardson, M. P., 2010a, "Measuring Systemic Risk", in *Regulating Wall Street: The Dodd-Frank Act and the New Architecture of Global Finance*, Acharya, V. V., Cooley, T., Richardson, M, and Walter, I. (Eds), John Wiley & Sons.
- Acharya, V. V., Pedersen, L. H., Philippon, T. and Richardson, M. P., 2010b, "Taxing Systemic Risk", in *Regulating Wall Street: The Dodd-Frank Act and the New Architecture of Global Finance*, Acharya, V. V., Cooley, T., Richardson, M, and Walter, I. (Eds), John Wiley & Sons.
- Acharya, V. V., Pedersen, L., Philippon, T., and Richardson, M., 2010c, "Measuring Systemic Risk", Technical report, Department of Finance, NYU Stern School of Business.
- Acharya, V. V. and Steffen, S., 2015, "The Greatest Carry Trade Ever? Understanding Eurozone Bank Risks", *Journal of Financial Economics*, 115, 215-236.
- Acharya, V. V. and Steffen, S., 2014, "Benchmarking the European Central Bank's Asset Quality Review and Stress Test – A Tale of Two Leverage Ratios", Center for European Policy Studies.
- Becker, B. and M. Opp, 2014, "Regulatory Reform and Risk-Taking: Replacing Ratings", Working Paper, University of Berkeley Haas School of Business.
- Becker, B. and V. Ivashina, 2013, "Reaching for Yield in the Bond Market", *Journal of Finance*, forthcoming.
- Brownlees, C. and Engle, R., 2011, "Volatility, Correlation and Tails for Systemic Risk Measurement", *Working Paper*, New York University.
- Caballero, R.J., Hoshi, T., Kashyap, A.K., 2008. Zombie lending and depressed restructuring in Japan. *American Economic Review* 98 (5), 1943–1977.

Calomiris, C. and R. Herring, 2013, "How to Design a Contingent Convertible Debt Requirement That Helps Solve Our Too-Big-To-Fail Problem", *Journal of Applied Corporate Finance*, 25(2), 66-89.

Engle, R., 2011, "Dynamic Conditional Beta", Volatility Institute manuscript, NYU

Hoshi, T., Kashyap, A.K., 2010. Will the U.S. bank recapitalization succeed? Eight lessons from Japan. *Journal of Financial Economics* 97, 398-417.

Koijen, R. and M. Yogo, 2013, "Shadow Insurance", Working Paper, London Business School.

Peek, J., Rosengren, E.S., 2005. Unnatural selection: perverse incentives and the misallocation of credit in Japan. *American Economic Review* 95, (4), 1144–1166.

Popov, A., van Horen, N., 2013. Exporting sovereign stress: evidence from syndicated bank lending during the Euro area sovereign debt crisis, Working Paper.

# Aggregate SRISK Comparison

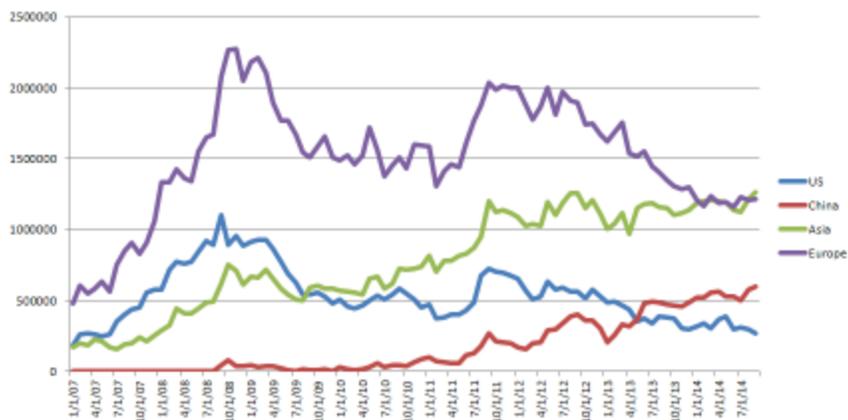


Figure 1: This figure plots the sum of *SRISK* in USD million for publicly traded financial firms (see inclusion criteria in Appendix) for the United States (US), China, Asia (including China) and the Europe. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)) from 1<sup>st</sup> Jan 2007 until end of Sep 2014.

## SRISK Normalized by GDP Comparison

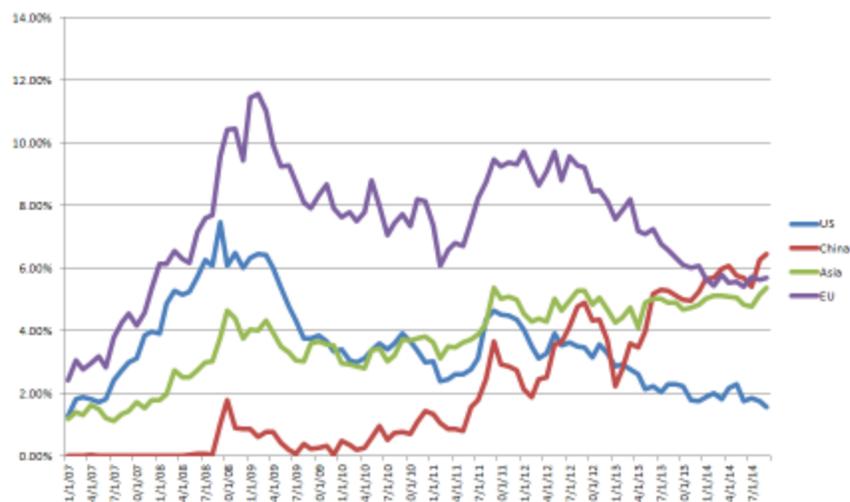


Figure 2: This figure plots the sum of *SRISK* for publicly traded financial firms (see inclusion criteria in Appendix) in a given week, scaled by the country's (or sum of the countries') latest GDP figure available that week, for the United States (US), China, Asia (including China) and the Europe. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)) from 1<sup>st</sup> Jan 2007 until end of Sep 2014. The country GDP data are from Bloomberg.

## Aggregate Leverage Comparison

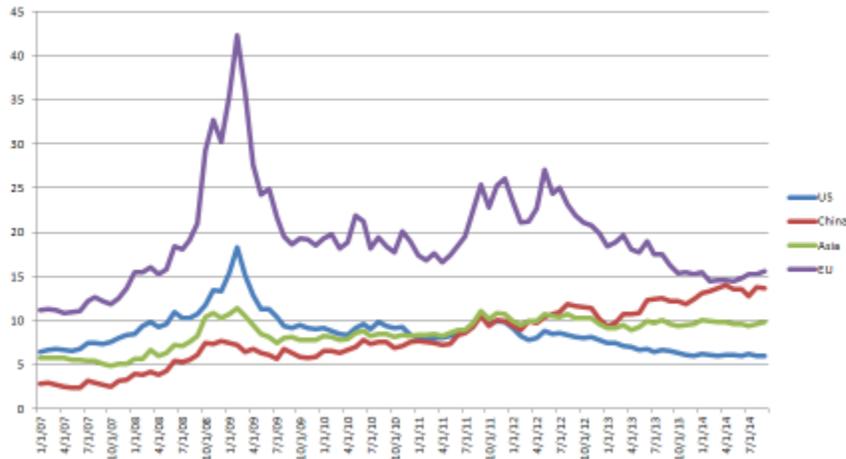


Figure 3: This figure plots the aggregate (quasi-) leverage for publicly traded financial firms (see inclusion criteria in Appendix) for the United States (US), China, Asia (including China) and the Europe. Quasi-leverage of a financial firm is its quasi-market assets (market value of equity + book value of non-equity liabilities) divided by the market value of equity. Quasi-leverage of financial firms in a region is weighted by the market value of equity of financial firms to obtain the aggregate quasi-leverage. The leverage data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)) from 1<sup>st</sup> Jan 2007 until end of Sep 2014.

# US (10/10/2014)

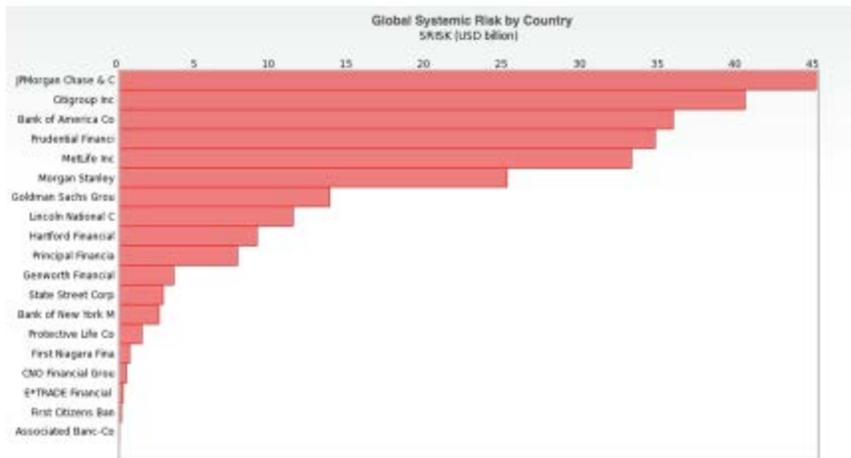


Figure 4: This figure plots the top 19 values of *SRISK* in USD billion for publicly traded financial firms (see inclusion criteria in Appendix) for the United States (US) as of 10 October 2014. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)).

# Europe

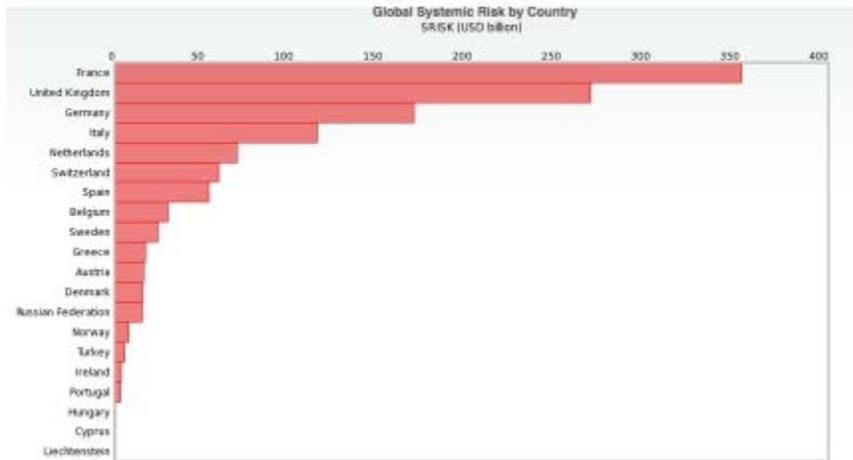


Figure 5: This figure plots the top 20 country-level values in Europe of the sum of *SRISK* in USD billion for publicly traded financial firms (see inclusion criteria in Appendix) in a country as of 10 October 2014. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)).

# Europe SRISK Normalized by GDP

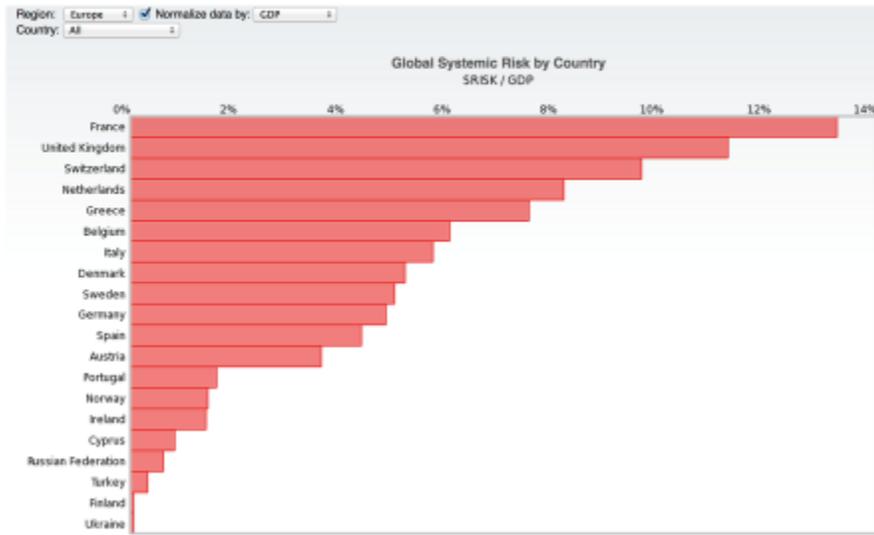


Figure 6: This figure plots the top 20 country-level values in Europe of the sum of *SRISK* for publicly traded financial firms (see inclusion criteria in Appendix) in a country, scaled by the country's latest GDP figure available as of 10 October 2014. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)). The country GDP data are from Bloomberg.

# Asia

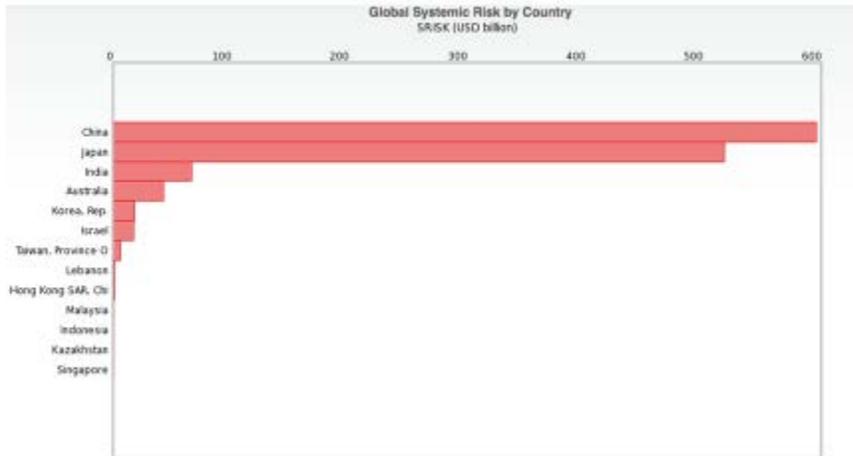


Figure 7: This figure plots the top 13 country-level values in Asia (including Australia and New Zealand) of the sum of *SRISK* in USD billion for publicly traded financial firms (see inclusion criteria in Appendix) in a country as of 10 October 2014. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)).

# Asia SRISK Normalized by GDP

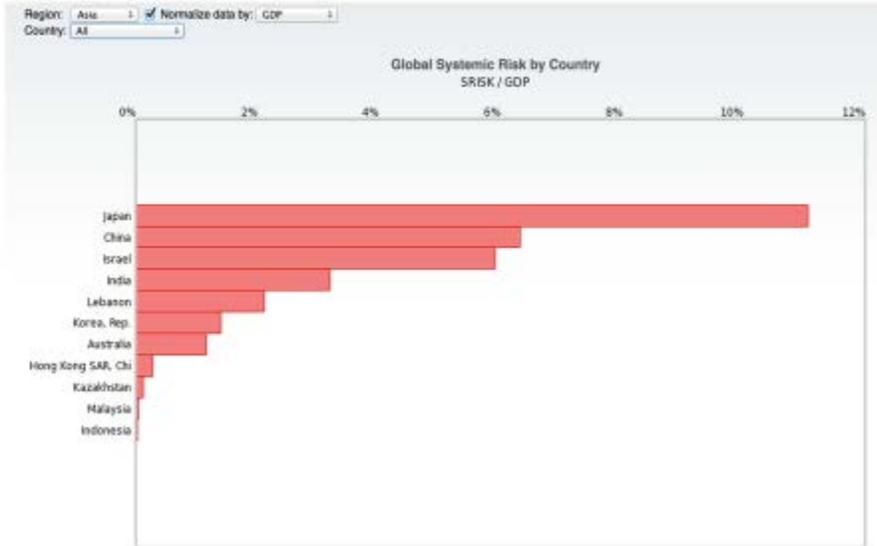


Figure 8: This figure plots the top 11 country-level values in Asia (including Australia and New Zealand) of the sum of *SRISK* for publicly traded financial firms (see inclusion criteria in Appendix) in a country, scaled by the country's latest GDP figure available as of 10 October 2014. The *SRISK* data are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)). The country GDP data are from Bloomberg.

## Decomposition of Change in SRISK

Systemic Risk Rankings for   View changes since:

Institution	SRISK (t) ▼	SRISK (t-1)	Δ SRISK	Δ(DEBT)	Δ(EQUITY)	Δ(RISK)
Bank of China Ltd	105,580.9	-4,396.9	109,977.8	90,325.2	20,038.1	-385.5
China Construction Bank Corp	84,956.1	-12,500.5	97,456.6	90,456.5	15,262.1	-8,261.9
Industrial & Commercial Bank of China Ltd	77,991.2	-71,501.9	149,493.1	114,137.7	48,781.9	-13,426.4
Bank of Communications Co Ltd	44,484.7	-678.7	45,163.4	38,475.8	6,314.8	372.7
China CITIC Bank Corp Ltd	33,828.5	-3,342.2	37,170.7	32,863.6	5,290.3	-983.2
China Merchants Bank Co Ltd	29,608.3	-14,607.5	44,215.8	38,062.1	5,430.3	723.4
Shanghai Pudong Development Bank	25,899.8	-4,037.5	29,937.3	29,607.2	-1,414.7	1,744.8
Industrial Bank Co Ltd	24,856.8	-8,643.1	33,499.9	33,119.3	-1,822.7	2,203.2
China Minsheng Banking Corp Ltd	17,584.8	-4,891.7	22,476.5	27,422.5	-6,765.6	1,819.6
Huaxia Bank Co Ltd	11,742.1	2,068.4	9,673.7	12,193.5	-2,690.4	170.6

Table 1: This table shows the change in *SRISK* between the beginning of 2010 (t-1) and 10 October 2014 (t) in USD billion for publicly traded financial firms (see inclusion criteria in Appendix) in China with the top 10 values of *SRISK* as of 10 October 2014. The change in *SRISK* is decomposed further into change due to changes in book value of non-equity liabilities (Debt), in market value of equity (Equity), and in market value of equity times *LRMES*, the measure of downside beta of the firm's equity to a global market correction of -40% (Risk). The *SRISK* data and its component changes are from NYU Stern Volatility Lab ([vlab.stern.nyu.edu/welcome/risk](http://vlab.stern.nyu.edu/welcome/risk)).

## Number of Total Firms Per Region

Year	US	China	Asia	EU	
2007	155	30	336	353	
2008	159	39	373	389	
2009	148	52	409	395	
2010	148	58	429	397	
2011	156	66	453	405	
2012	157	70	458	404	
2013	156	70	457	394	
2014	153	70	451	385	

Appendix: Using publicly listed financial firms in each country with active trading in common equity that are also in top 10% of financial firms by size (market equity), the number of total firms included in SRISK calculations in each year and geography are as above.