

2018

CRI Systematically Important Financial Institution (CriSIFI) White Paper

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ABSTRACT

On January 16th, 2018, the Credit Research Initiative (CRI) re-publishes its CriSIFI—the CRI Systemically Important Financial Institution. The CriSIFI is a novel way of assessing and ranking the systemic importance of the exchange-listed banks and insurers around the world. It is available for each month from January 2000 onward, and it is updated monthly on the CRI website (www.rmicri.org). Viewers can use the CriSIFI to track and monitor the riskiness of each institution to the global financial system over time. In this release, the CRI has incorporated 12 pairs of Credit Cycle Indices (CCIs), to reflect probability of default and probability of other corporate exits, in the methodology as opposed to 11 pairs in the last release and improved the robustness of the CriSIFI results¹.

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¹ The results are arguably similar to those in the last release. For instance, the rank correlation for the August 2008 CriSIFI between the two releases is 0.64.

I. OVERVIEW

The global financial crisis during 2007-2009 has highlighted the interconnected nature between the financial institutions. It has also demonstrated the catastrophic impact of a few failures on the global financial system. Using the tendency of firms defaulting together and along with the firms' respective asset sizes, the CriSIFI identifies the banks and insurers that are closely connected with and impose significant risk to the global financial system. Simply put, the CriSIFI identifies the “too big to fail” and “too connected to fail” financial institutions.

The CriSIFI is displayed on the CRI website in ranking tables that are available for each month starting from January 2000 and onwards. The CriSIFI rankings till March 2018 are back-calculated, while the ones afterwards use information that becomes newly available in each following month. The tables contain 1200-1600 banks and 300-600 insurers, depending on the point in time. A firm with a higher ranking (e.g. 10 is a higher ranking than 20) is likely to impose more risk to the financial system and therefore has a higher systemic importance.

Besides the CriSIFI, viewers can also search the CriSIB (CRI Systemically Important Bank) and CriSII (CRI Systemically Important Insurer) globally, or within a local community defined by region (e.g. North America, Asia-Pacific Developed economies, etc.) and economy (e.g. US, Singapore, etc.). For example, one can view the rankings for all listed banks in the US by selecting “Bank” for firm type, “North America” for region and “United States” for economy. This function aims to help users monitor a particular portfolio. All rankings are available for download.

II. METHODOLOGY

The computation of the CriSIFI follows the methodology introduced by Chan-Lau et al. (2018)². The procedure comprises:

Step 1: Identifying the PD correlations between entities

The CRI team uses the default correlation model of Duan and Miao (2016)³ to produce a forward-looking Probability of Default (PD) total correlation matrix⁴, which is then transformed into a **partial correlation matrix** by applying the CONCORD algorithm. The PD, simulated at the time of prediction, are 1-month ahead PD for the 1-year prediction horizon. The partial PD correlation, used for the CriSIFI, disentangles the direct connection between two parties from many indirect relationships, to obtain a much clearer network of financial institutions. The CONCORD algorithm regularizes the partial correlation matrix such that it is sparse, i.e. only account for significant correlations, but that no entity herein is completely isolated from the others.

Step 2: Creating a network centrality indicator

The next step involves the creation of a **network centrality indicator**, based on the previously extracted regularized partial correlation matrix, to measure each firm's systemic importance. Let P_t be the partial correlation obtained with the information up to time t . Setting its diagonal elements to 0, e.g. removing the effect of each firm's on itself, yields a matrix denoted $P_{X,t}$. To remove the excessive noise in generating month-to-month $P_{X,t}$, this matrix is converted into $|\bar{P}_{X,t}|$ by taking an absolute value of entries in its 12-month moving average. Finally, let q_i be the relative size of a financial institution (measured by its total assets in USD) over the total assets of the sample, and Q be a diagonal matrix filled with q_i as its i^{th} diagonal element.

² Chan-Lau, J.A., Chuang, C., Duan, J.C. and Sun, W. (2018). "Financial Network and Systemic Risk via Forward-Looking Partial Default Correlations", *National University of Singapore Working Paper*.

³ Duan, J.C., and Miao, W. (2016). "Default Correlations and Large-Portfolio Credit Analysis", *Journal of Business and Economic Statistics*, 34(4), 536-546.

⁴ For more implementation details of this model in the case of CriSIFI, please refer to the NUS-RMI Credit Research Initiative Technical Report, Version 2017 Update 1 Addendum 1*.

$Q|\bar{P}_{x,t}|Q$ is a non-negative matrix. According to the Perron-Frobenius theorem, the eigenvector corresponding to its largest eigenvalue can be made to have all non-negative elements. The i^{th} element in the eigenvector represents the centrality of the i^{th} firm.

In a nutshell, the CriSIFI is the centrality indicator from the size-weighted partial correlation matrix $Q|\bar{P}_{x,t}|Q$, intending to combine the node and edge characteristics of a network. It is a comprehensive measurement of a firm's size and connectedness to other firms, or systemic risk by the CRI definition, in the global context.

Step 3: Analyzing local communities

The CRI team conducts local community analyses to generate CriSIFI, CriSIB (for banks) and CriSII (for insurers) for various global/regional/country samples. For firms in a local community defined by a group (i.e. bank or insurer, region and/or economy), those financial institutions are added outside the group but connected to them to define the local community. Their rankings in the community are rescaled from their global rankings. For example, the two riskiest Brazilian banks ranked 50 and 200 globally may be ranked 1st and 2nd place in the Brazilian banking community. This treatment is to acknowledge the fact that a financial institution is potentially connected with other banks and/or insurers outside of a particular community but in the global system, and this global impact has to be taken into account even when its importance is being assessed in a local community.

III. APPLICATIONS

The CriSIFI can help one compare systemic risks among the world's financials at any point in time. It can also help monitor the evolution of the systemic importance of a financial institution over time. Some examples are demonstrated below for viewers to consider its potential applications:

Comparing Systemic Risk among FI at a Point in Time

Table 1 below shows the riskiest banks (Top 30 CriSIB) and insurance companies (Top 30 CriSII) as of August 2008, one month before the collapse of Lehman Brothers. Not shown in the table, Lehman Brothers was ranked #32 riskiest bank in the world at that time. The ranking may, in a way, justify the disastrous impact that Lehman Brothers' bankruptcy has brought to other financial institutions.

Table 1. CRI Top 30 systemically important banks and insurance

As of August 2008, one month before Lehman Brothers' collapse.

Top 30 CriSIB	Top 30 CriSII
Barclays PLC	Legal & General Group PLC
Royal Bank of Scotland Group PLC	Aviva PLC
Lloyds Banking Group PLC	Friends Life FPG Ltd
Deutsche Bank AG	Ageas
HBOS PLC	CNP Assurances
Credit Agricole SA	Prudential PLC
Alliance & Leicester PLC	Old Mutual PLC
Citigroup Inc	St James's Place PLC
ING Groep NV	Aegon NV
BNP Paribas SA	AXA SA
Morgan Stanley	Aon PLC
Merrill Lynch & Co Inc	Sun Life Financial Inc
Bradford & Bingley PLC	Zurich Insurance Group AG
Wells Fargo & Co	Allianz SE
Mitsubishi UFJ Financial Group Inc	Willis Towers Watson PLC
UBS Group AG	Genworth Financial Inc
Royal Bank of Canada	Tokio Marine Holdings Inc
TP ICAP PLC	Alleanza Toro SpA
CIC	Assicurazioni Generali SpA
Bank of Ireland	Societa Cattolica di Assicurazioni SCRL
Dexia SA	Storebrand ASA
China Minsheng Banking Corp Ltd	FBL Financial Group Inc
Banco Espanol de Credito SA	UNIQA Insurance Group AG
Natixis SA	Allianz Lebensversicherungs-AG
HSBC Holdings PLC	Principal Financial Group Inc
Hypo Real Estate Holding AG	AMP Ltd
Bankinter SA	Premafin Finanziaria SpA
KBC Group NV	Progressive Corp/The
Svenska Handelsbanken AB	Just Retirement Holdings Ltd
Hana Financial Group Inc	RSA Insurance Group PLC

Monitoring the Evolution of the Systemic Importance of a FI

The following figures display the evolution of the CriSIFI rankings for Lehman Brothers, a US investment bank, and Prudential PLC, a British life insurer. The two institutions' importance was ranked among the top 10% globally most of the time. Leading up to the global financial crisis, their systemic risk has significantly increased.

Fig 1a. CriSIFI ranking of Lehman Brothers Holdings Inc.
Compared to its size (Total asset). From January 2000 to August 2008.



Fig 1b. CrISIFI ranking of Prudential PLC.
 Compared to its size (Total asset). From January 2000 to March 2018.



Evaluating the Systemic Importance of a Portfolio of FI

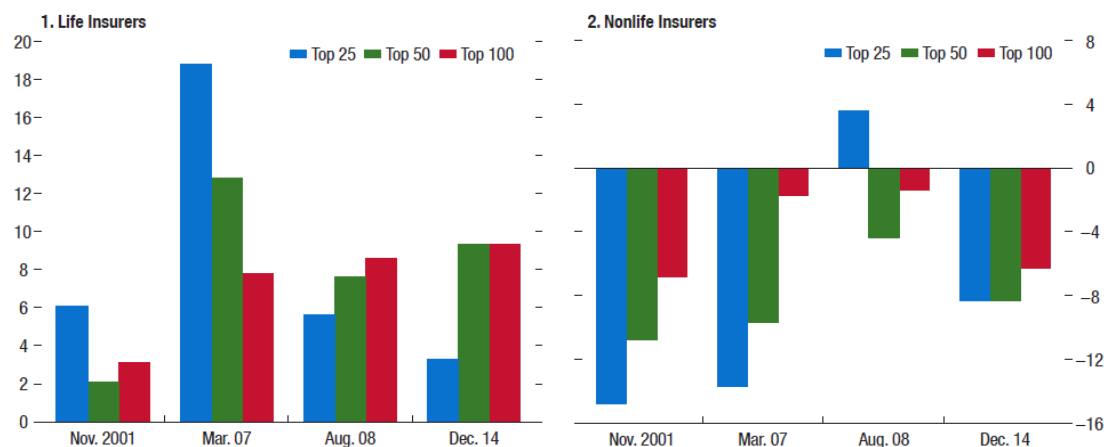
Figure 2 below is taken from the IMF Global Financial Stability report (2016).⁵ In that report, the IMF economists evaluated the systemic importance of the global insurance companies, using a similar but simpler measure than CriSIFI. Specifically, from the regularized partial correlation matrix obtained from Step II in the Methodology section of this white paper, they counted the number of linkages, or non-zero partial correlations, between each firm and the others in the global system. They found that life insurers contribute disproportionately higher risk to the global financial system over time. This is likely because their business lines become increasingly diverse and interconnected with other financial institutions as time passes.

Fig 2. Forward-looking default correlation networks

Percent over/under representation of insurers.

Sources: Risk Management Institute (2015) and IMF staff calculations.

Figure shows over or under representation of life and nonlife insurer, in the top 25, 50, and 100 firms included in the forward-looking default correlation network. For example, a 5 percent value for the top 100 indicates that there are 5% more insurance firms among the top 100 than justified by their sample share. Total sample size ranges between 1,263 and 1,679 firms, including 310 to 410 insurers. Owing to the large number of firms, a regularization adjustment was required to generate fully connected networks, where no firm is an orphan.



⁵ International Monetary Fund (2016). "Global Financial Stability Report, April 2016: Potent Policies for a Successful Normalization", IMF reports.

IV. COMPARISON WITH ALTERNATIVE MEASURES

In this section, the CriSIFI ranking is compared with the following two systemic importance measures: [1] the Global Systemically Important Banks (G-SIBs) of the Financial Stability Board (FSB) and [2] the SRISK of the NYU V-Lab. The FSB puts together a list of 28-30 G-SIB each year from 2011 and requires them to hold higher but different loss absorbency ratios depending on the risk buckets they are in. The SRISK measures the amount of capital a financial institution needs if the economy is in crisis, i.e. the broad market index declines by 40% in 6 months. It ranks the riskiness for around 1,000 financial institutions worldwide every month from January 2000 onward.

The Spearman rank correlation is used to compare the similarity across different ranking methods. For example, for the list of G-SIB published in 2016 (using data up to December 2015), rankings from 1 onward to the 30 banks are assigned, allowing for ties when some of them fall into the same bucket. For the CriSIFI ranking, the list as of December 2015 is taken, giving 1-30 to the highest ranked firms and 31 to the rest. Subsequently, the Spearman rank correlation (on the two sets of rankings) is computed on the banks that are common in both lists. The rank correlation between the SRISK and CriSIFI is computed in a similar way. Table 2 below demonstrates the rank correlations between the CriSIFI and alternatives using year-end data for a number of years.

Table 2. Rank correlations between CriSIFI and alternative measures

Comparison studies performed from 2011 to 2017.

	Rank Correlation with SRISK	# companies in computing rank correlation w/ SRISK*	Rank Correlation with FSB G-SIB	# companies in computing rank correlation w/ FSB G-SIB
2011	0.44	657	0.63	28
2012	0.47	652	0.31	29
2013	0.40	644	-0.14	30
2014	0.40	636	0.36	30
2015	0.38	629	0.31	30
2016	0.26	620	0.27	30
2017	0.21	621	NA	NA

* The SRISK data are taken from the V-Lab website as of January 2018. The data points are from December each year.

This table seems to show that the FSB G-SIB has lower correlation with the CriSIFI, suggesting two fundamentally different approaches to systemic risk in applications albeit both attempt to identify “too big to fail” and “too connected to fail” financial institutions. SRISK is likely closer to the CriSIFI, however interpreting its methodology, it does not explore default correlations directly or utilize the network structure.

ABOUT THE CREDIT RESEARCH INITIATIVE

The Credit Research Initiative (CRI) was launched by Professor Jin-Chuan Duan in July 2009 at the Risk Management Institute of the National University of Singapore. Aiming at “Transforming Big Data into Smart Data”, CRI covers over 68,000 public firms and produces daily updated Probabilities of Default (1-month to 5-year horizon), Actuarial Spreads (1-year to 5-year contract) and Probability of Default implied Ratings on over 34,000 currently active, exchange-listed firms in 128 economies. CRI also distributes historical time series on over 34,000 inactive firms due to bankruptcy, corporate consolidation or delisting for other reasons. In addition, CRI produces and maintains the Corporate Vulnerability Index (CVI), which can be viewed as stress indicators, measuring credit risk in economies, regions and special portfolios.

CRI also converts smart data to actionable data to meet the demand for customized usage and offers bespoke credit risk solutions leveraging on its expertise in credit risk analytics. A concrete example is our development of the BuDA (Bottom-up Default Analysis) toolkit in collaboration with the IMF. BuDA is an automated analytic tool based on the CRI PD system, enabling IMF economists to conduct scenarios analyses for the macro-financial linkage.

CRI publishes Weekly Credit Brief and Quarterly Credit Report, highlighting key credit-related events, offering insights that utilize the CRI PDs on the entities involved, and providing useful statistics on credit risk of economies and sectors.

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