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Ms. Muffet, the Spider(gram) and the Web of Macro-Financial Linkages

Ricardo Cervantes, Phakawa Jeasakul, Joseph F. Maloney and Li Lian Ong

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Monetary and Capital Markets Department

Ms. Muffet, the Spider(gram) and the Web of Macro-Financial Linkages[1]

Prepared by Ricardo Cervantes, Phakawa Jeasakul, Joseph F. Maloney and Li Lian Ong[2]

Authorized for distribution by Cheng Hoon Lim

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Abstract

The global financial crisis has underscored the importance of understanding macro-financial developments and spillovers in an increasingly interconnected and intricate system. At the IMF, staff is focusing on the linkages between the real economy and the financial sector, as well as the inter-relationships between global and individual-country risks. The Country Financial Stability Map provides an empirical framework for explicitly linking these various aspects of the IMF's surveillance of its member countries. It identifies potential sources of macro-financial risks particular to a country and also enables an assessment of these risks in a global context through comparisons with the corresponding Global Financial Stability Map from the *Global Financial Stability Report*. The authors have developed an Excel-based tool ("Ms. Muffet") to facilitate this analysis, which may be replicated by external users with access to the necessary databases, using the accompanying template.

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[2] Li Lian Ong is currently at GIC Pte. Ltd. This paper was written when she was a member of staff at the IMF.

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Appendix Tables

Little Miss Muffet
Sat on a tuffet
Eating her curds and whey
Along came a spider
Who sat down beside her
And frightened Miss Muffet away.

~ A Mother Goose Nursery Rhyme

I. INTRODUCTION

The global financial crisis (GFC) has underscored the importance of understanding macro-financial developments in an increasingly complex and interconnected world. In the course of the crisis, countries have experienced the spillover of risks from one segment of the economy to others, sometimes exacerbating existing vulnerabilities and amplifying stresses until they become systemic in nature. Relationships between capital flows and asset prices; between the availability of credit and liquidity and international trade; and among public debt levels, sovereign funding and the banking system, to name a few, have intensified as the crisis deepened, highlighting the need to monitor the changing risks to financial stability posed by macroeconomic developments, and vice versa.

At the International Monetary Fund (IMF), work on defining and understanding macro-financial linkages has intensified in recent years. The analysis is conducted at both the bilateral (individual-country) and the multilateral (global) levels. The former is being undertaken largely in the context of the IMF's Article IV surveillance of member countries (which also incorporates the Financial Sector Assessment Program at various intervals), while the latter is presented through several flagship publications, such as the *World Economic Outlook* (WEO), the *Global Financial Stability Report* (GFSR), the *Fiscal Monitor* (FM), the *Spillover Report* (SR) and the *External Sector Report* (ESR), in addition to recently-introduced Cluster Reports and other periodic reports on the international monetary system.

IMF staff is also working to improve the connection between bilateral and multilateral macro-financial stability analyses (Figure 1). The WEO has been and is a natural—and public— vehicle for bringing staff's bilateral inputs to bear on the IMF's multilateral analysis. More recently, the SR and ESR were introduced to assess the multilateral impact of economic and financial spillovers and also the bilateral implications from developments in the external sector. Internally, the IMF carries out the Vulnerability Exercises (VEs) for advanced economies (AEs) and emerging market and developing economies (EMDEs) as part of its multilateral surveillance (IMF, 2007a; 2011d). These VEs provide quantitative input into the confidential Early Warning Exercises (EWEs), which are conducted jointly by the IMF and the Financial Stability Board (IMF, 2010c). The county-specific results are discussed with country authorities in the context of the bilateral Article IV consultations.

Notwithstanding the progress to date, it has been recognized that more needs to be done in terms of improving the IMF's macro-financial analyses and integrating bilateral and multilateral surveillance. The 2012 Integrated Surveillance Decision (ISD) established a comprehensive framework covering both bilateral and multilateral surveillance (IMF, 2012b). The ISD lays out a conceptual link between the two and clarifies the importance of economic and financial stability in the context of multilateral surveillance, thus allowing the IMF to discuss spillovers from a country's policies that affect global stability.

Figure 1. Integrating Bilateral and Multilateral Macro-Financial Analysis in the IMF's Surveillance
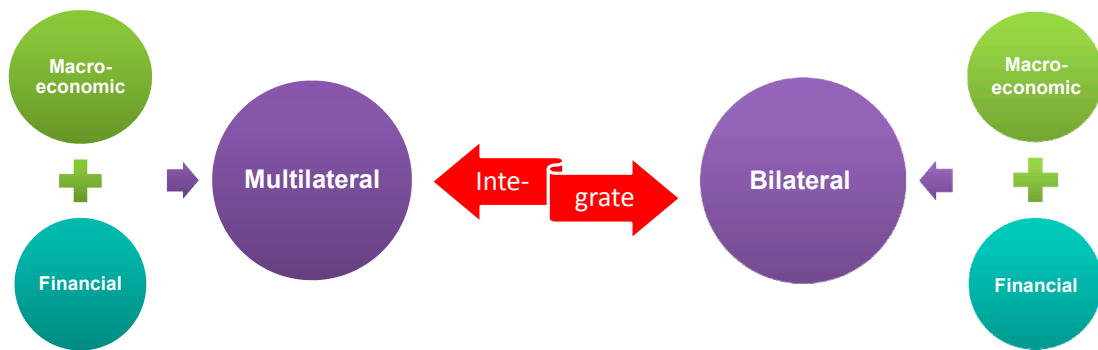
Source: Authors.

The objective of our study is to contribute to the effort by proposing an empirical framework for explicitly linking these various aspects of surveillance—macro with financial and multilateral with bilateral. Our concept for doing so is a relatively simple one and draws on an existing and established framework:

- *Our starting point is the Global Financial Stability Map (GFSM),* which was developed by the IMF's Monetary and Capital Markets Department (MCM) and introduced in the April 2007 GFSR (IMF, 2007b). The GFSM utilizes macro-financial variables to visually communicate changes in risks and conditions affecting global financial stability (see Dattels and others, 2010). It assesses four broad risks and two conditions affecting financial stability, namely, *macroeconomic*, *emerging market, credit*, and *market and liquidity* risks, plus *risk appetite* and *monetary and financial* conditions (Figure 2). Back-tests have shown the GFSM's performance to be largely satisfactory, both as an indicator of risks to the outlook and of actual stress during crises.

- *We develop the Country Financial Stability Map (CFSM) to complement the GFSM.* The framework consists of two components:

- *First, we map the various categories of macro-financial risks and conditions for* **individual countries** *along the lines of the GFSM, over two specified periods in time.* This provides a snapshot of the changing macro-financial risks and conditions in a particular country, with the aim of highlighting areas where more detailed analyses may be required. The CFSM also measures inward spillover risks from external sources.

- *Next, we juxtapose individual-country against corresponding global developments as reflected in the GFSM.* The comparison between the CFSM and the GFSM should show the relative direction of the former's macro-financial situation within a global context, providing an overlay to the country-specific assessment.

The CFSM can be produced for AEs and EMDEs, and should be especially useful for analyzing the latter group of countries given that fewer risk indicators are readily available for them. However, our goal of making the CFSM as inclusive of, and comparable across, as many countries as possible means that its construction is ultimately hostage to data gaps across countries and indicators (Figure 3). More generally, it should be emphasized that the CFSM is not a fail-safe technique and should be applied in conjunction with other methods and indicators—and complemented by expert judgment—whenever possible.

We have developed the **M**CM **S**pidergram: a **M**acro-**F**inancial **E**nvironment **T**ool ("Ms. Muffet") to facilitate the construction of the CFSM and its associated analysis, for internal IMF use. The Excel-based tool is designed to automatically generate financial stability maps of individual countries and their respective components from linked databases at specific points in time, as well as the related time series charts. It also juxtaposes the corresponding GFSMs from the GFSRs. Ms. Muffet could also be used to produce cross-country comparisons of individual risks or conditions and their respective components. The tool may be replicated by external users with access to the necessary databases, using the accompanying Excel template.

We find the CFSM to be robust in capturing the changing macro-financial risks and conditions over time. An examination of the time-series rankings of each CFSM aggregated indicator covering the period before the GFC shows the methodology to be broadly satisfactory. It appears to be robust, both as an indicator of rising risks to financial stability and as a measure of worsening stress. That said, enhancements to the CFSM should always be possible as countries continue to improve the coverage of their reported data in the future and even now, with the inclusion of more bespoke information or customized methodology particular to individual countries. As a next step, the analysis (and tool) could be enhanced by incorporating in the methodology (i) the ability to explicitly distinguish between risks and their mitigants, including the quality of financial regulation and supervision, crisis management and resolution; and (ii) thresholds to determine which risks and conditions require policy action.

Figure 2. The GFSM from the April 2007 GFSR
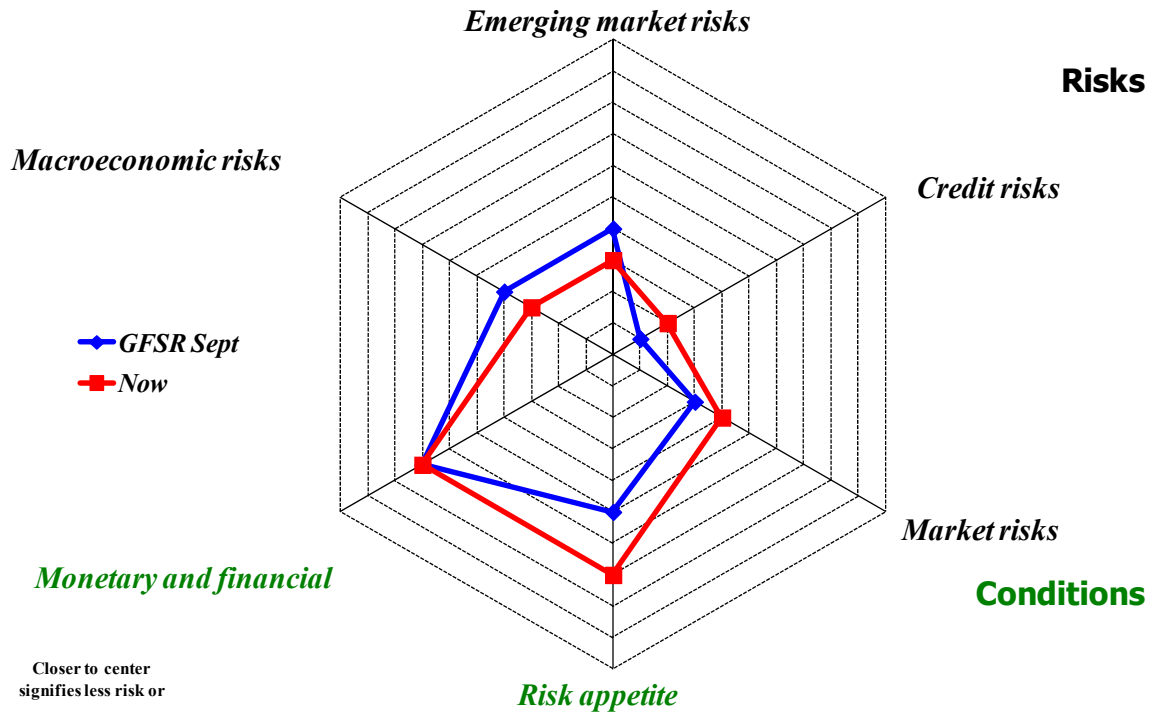
Source: IMF (2007b).

Figure 3. CFSM: Data Coverage
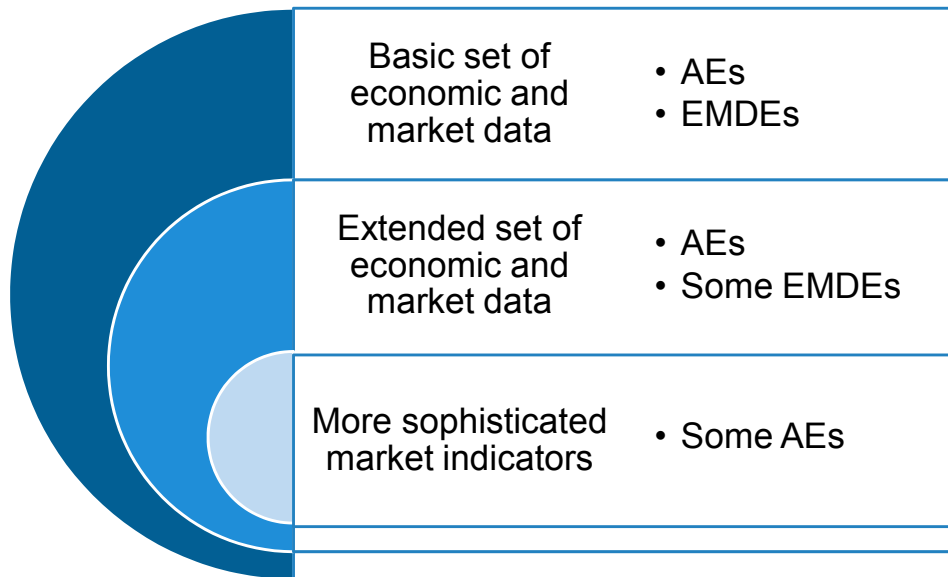
Source: Authors.

The paper is structured as follows. Section II explains the factors that should be taken into account in constructing the indicators for the CFSM and discusses the input variables needed to derive the various macro-financial risks and conditions. Section III follows with a presentation of the methodology, while Section IV offers an analytical framework for assessing the CFSM from a selection of individual-country, bilateral-multilateral and cross-country perspectives. Section V concludes.

II. CONSTRUCTING INDICATORS FOR INDIVIDUAL-COUNTRY MACRO-FINANCIAL RISKS AND CONDITIONS

A. Underlying Principles and Considerations

The CFSM attempts to emulate the GFSM in capturing a diverse range of sources of instability, contagion and interactions, but from an individual-country perspective. As much as possible, efforts are made to replicate the various macro-financial risks and conditions categories of the GFSM for the CFSM, and to use combinations of variables to derive the representative aggregated indicators, where relevant:

- *We apply key principles similar (albeit not identical) to the GFSM in constructing the CFSM.* Notably, we design the CFSM to:

  - *Capture risks over a 3–12 month horizon.* Underlying indicators should be of a relatively high frequency in order to capture changes in economic and financial conditions in a timely manner (quarterly, in this case). It should also be sufficiently forward-looking to highlight risks well ahead of time. However, forward-looking indicators (e.g., surveys of expectations, market prices) may not necessarily available for less-developed economies and markets.

  - *Cover a comprehensive set of risk categories that are separable, measurable and relevant.* The CFSM aims to cover the key sources of financial and related macroeconomic risks while trying to ensure that they do not overlap in any overt or significant manner so as to obscure or offset important information.

  - *Incorporate a sufficient but manageable number of indicators for each category.* Given the breadth of countries that are covered, a sufficiently wide array of indicators per risk category is necessary to ensure that at least one indicator is available for any country. This aspect contrasts with the GFSM in that it may not be possible to combine a broad range of indicators for a richer representation of a particular risk owing to data limitations.

- *We construct the aggregated indicators for individual countries with two considerations in mind,* that they are able to (i) capture the key risks to and conditions of the domestic economy, incorporating current developments and forward-looking indicators; but also (ii) take into account data constraints, namely:

- *The CFSM uses more granular country-specific information to derive the aggregated indicator representing each category.* This would enable more detailed assessments of a particular system. Moreover, many of the global risk and conditions indicators used in the GFSM are not necessarily applicable on an individual-country basis.

- *The desire for detail is balanced against consistency of indicators across countries.* Specifically, the greater granularity of information used to construct the indicators on an individual-country basis is balanced against the **common** availability of data across countries. One of our objectives is to facilitate cross-country comparisons at any one point in time.

- *There is flexibility to estimate a more sophisticated or basic indictor to represent each category, depending on the country under surveillance and data availability.* In some of the less developed economies/financial systems, fewer variables may be available for aggregation into sub-indicators and elements, which are then used to derive the aggregated indicators representing the various macro-financial categories.

- *There are a couple of important differences between the GFSM and the CFSM,* namely in the determination of long-term averages and the categorization of risks:

  - *We calculate the means and standard deviations for each data series used in the CFSM over the five-years up to the selected benchmark period; the GFSM uses all available data up to a particular point in time.* As noted earlier, our objective of generating CFSMs for as many individual IMF member countries as possible means that data constraints need to be taken into account in the design of our methodology (see below).

  - *We substitute the Emerging Market Risks category in the GFSM for a broader Inward Spillover Risks category in the CFSM.* The reason for this change lies in the fact that CFSMs are also generated for individual emerging market countries and a separate risk category for this group of countries could amount to a double-counting of the risk. Moreover, spillover risks from external developments have become an increasing important component of a country's financial stability assessment.

B. Indicators and Data

Thus, like the GFSM, the CFSM consists of four macro-financial risk categories and two macro-financial conditions categories. As shown in Figure 4:

- Each category is represented by an aggregated indicator (X_i);

- Each aggregated indicator (X_i) is developed from j elements (e_j^i);

- Each element (e_j^i) is derived from k individual or several economic and/or market sub-indicators (a_k^j); and

- Each sub-indicator (a_k^j) uses l variables (v_l^k) derived from m data series (s_m) as input.

Some overlap among the various variables is expected, since they feed into the different categories of risks and conditions in different ways. Macro-financial stability (*MFS*) is thus defined as:

$$MFS = f(X_1, X_2, \ldots, X_i),$$

where $X_i = f(e_1^i, e_2^i, \ldots, e_j^i)$,

where $e_j^i = f(a_1^j, a_2^j, \ldots, a_k^j)$,

where $a_k^j = f(v_1^k, v_2^k, \ldots, v_l^k)$.

The considerations for estimating the various risks and conditions of the CFSM are described in broad terms in the rest of this section. Appendix I (Appendix Table 1) explains the interpretation of individual variables within each risk and condition of the CFSM and details the calculations undertaken to estimate the aggregated indicators.

Data are largely drawn from key databases available to IMF staff. They include the Bloomberg, Direction of Trade Statistics (DOTS), Haver Analytics, Corporate Vulnerability Utility (CVU), Information Notice System (INS) on exchange rates, International Financial Statistics (IFS), Financial Soundness Indicators (FSI) and World Economic Outlook (WEO) databases. These data series are typically available either on an annual or quarterly frequency, and are interpolated where necessary to uniformly obtain quarterly observations. Given the constraints discussed earlier, we select series that have a higher frequency and longer time series where possible, as well as the greatest commonality across countries (which we define as "core variables"), which comprise macroeconomic, balance sheet and market information, and consist of a mix of price and quantity measures. The latest available data are used to construct the indicators at any particular point in time (see Appendix II).

Figure 4. CFSM: Deriving the Ranking for an Aggregated Indicator
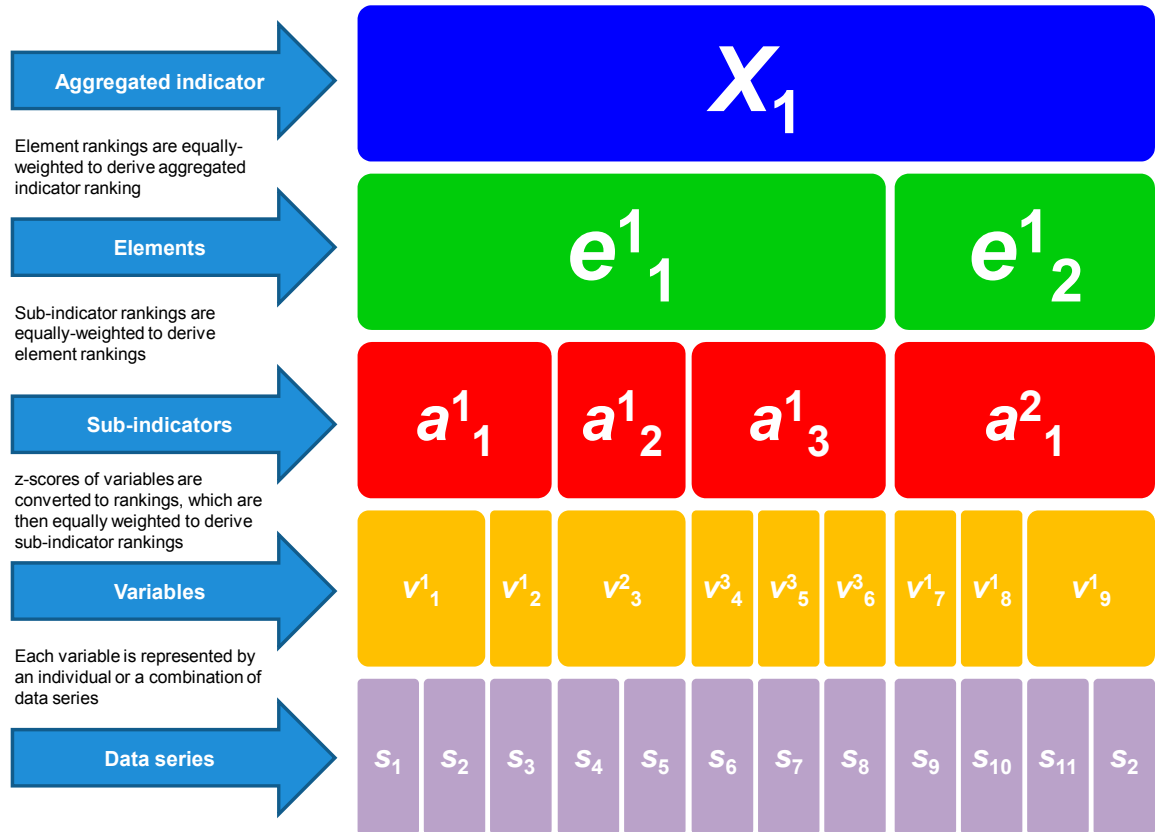
Source: Authors.

Risks

Macroeconomic risks

The risks to the overall economy are closely tied to its financial stability. Key aspects of a country's general economic situation are captured in the CFSM, through its overall macroeconomic performance, its outlook and market perceptions of the country. A country's economic growth affects household and corporate incomes and, consequently, the ability of borrowers to service their debt. Inflation/deflation can affect financial stability through its impact on real asset prices, fixed income markets and the debt burden, while fiscal policy and debt sustainability has important implications for sovereign risk (Corsetti and others, 2012). In the same vein, *expectations* for economic activity are closely tied to the *outlook* for financial stability; the latter may be derived from indicators on production, investment and trade activity (see Association for Investment Management and Research, 2003).

Meanwhile, feedback effects between the financial sector and the real economy could set off either a vicious or virtuous cycle. While excessive credit growth is known to be a strong

predictor of financial instability (Jordà, Schularick and Taylor, 2010; Elekdag and Wu, 2011; Gounrinchas and Obstfeld, 2012), deleveraging by lenders as a result of a deteriorating economic environment could further damage growth (Shirakawa, 2011), to the detriment of banks' asset quality (De Bock and Demyanets, 2012). Similarly, property prices play an important role in supporting household wealth and consequently, consumption and growth (Wilkerson and Williams, 2011); a downward spiral in the real estate market weakens banks' asset quality through the collateral channel. And ultimately, the market's overall perception of country risk—which is closely associated with the health of the financial system—determines the ease with which the sovereign is able to access funding, which is reflected in the cost of funding (Committee on the Global Financial System, 2011).

Inward spillover risks

Inward spillover risks arise from a country's exposure to developments elsewhere. Their manifestation could be a result of changes in overall global risk appetite or from events in an interconnected country or countries. The possible shock channels are through international trade, liquidity or capital flows (Backé, Gnan and Hartmann, 2010). The impact is typically observed in the pressure on the exchange rate to depreciate, the deteriorating current account balance and capital outflows. The amount of international reserves available to cover a country's overseas obligations represents a buffer against any external shock (IMF, 2011a).

Credit risks

Credit risks in a country stem from several sources. Given the usually strong bank-sovereign nexus, the risk to banks' balance sheets could translate to credit risk for the government if it is forced to bail out the former (Breton, Pinto and Weber, 2012; IMF, 2010a, 2010b, 2011b, 2011c and 2012a). This means that threats to banks' asset quality from stresses to the real sector (which would likely be manifest in corporate and household balance sheets) also represent a credit risk to the sovereign. Conversely, high sovereign indebtedness, which could be reflected in generally higher funding costs, could also affect bank profitability and solvency, with feedback implications for the sovereign.

Market and liquidity risks

Market and liquidity risks for financial institutions could be manifest in stresses in secondary capital markets. Developments in these markets tend to be mutually reinforcing (Diamond, 1997). Thus, we consider two sets of indicators, representing: (i) secondary market funding and liquidity, which is observable in debt and foreign exchange funding spreads as well as in the turnover in stock markets; and (ii) bank funding and liquidity, which measures institutions' vulnerability to a sudden pullback in funding and their ability to realize assets quickly and sufficiently to meet short-term liabilities.

Conditions

Monetary and financial conditions

Monetary conditions are related to monetary policy, while financial conditions relate to the willingness and capacity of banks to lend. From a macro-financial perspective, financial stability considerations are linked to monetary policy (Clouse, 2013); while financial conditions affect economic growth (Carabenciov and others, 2008; Hatzius and others, 2010). Considerations of the former would be reflected in the short term real interest rates and changes in the money supply, while financial conditions could simply be reflected in the growth in credit (from banks and non-banks) to the economy and lending attitudes.

Risk appetite

Investors' risk appetite towards a particular country is characterized by their pricing of risk and their investment decisions. Relevant indicators of the former include the premium that investors are prepared to accept to take on risk (e.g., Gai and Vause, 2006), spreads (e.g., Garcia-Herrero and Ortiz, 2005; Bakaert and others, 2009; Carceres and others, 2010), and the volatility of asset prices (González-Hermosillo, 2008). Meanwhile, investors' actual asset allocation decisions are reflected in capital flows to individual countries or markets, in the form of portfolio and foreign direct investments (e.g., Forbes and Warnock, 2012; Ahmed and Zlate, 2013).

III. Methodology

A. Derivation

Consistent with the GFSM, each of the six rays of the CFSM denoting a particular risk or condition is represented by an aggregated indicator. However, unlike the former, which employs a variety of more sophisticated techniques to derive each aggregated indicator, we use simple standardization and rating methodologies. Specifically, we construct normalized indicators of between zero and 10 for each category, where a score of zero reflects the lowest degree of risk, tightest monetary and financial conditions or lowest risk appetite, while a score of 10 reflects the extreme opposite (Appendix III). Our calculation of the ratings consists of the following steps:

1.   *Compute the selected variable for a particular country.* Some variables may need to be derived from more than one data series and the calculation of those variables represent the first step.

2.   *Compute the z-score for the selected variable (i.e., normalize the variable) for a particular country.* Each **variable** k (v_l^k) of the l number of variables associated with **sub-indicator** j (a_k^j) at time t may be gauged against its historical mean or a pre-defined norm and standard deviation with normalization, such that:

$$z_{v_{l,t}^k} = \frac{v_{l,t}^k - \mu_{v_{l,t}^k}}{\sigma_{v_{l,t}^k}},$$

where $\mu_{v_{l,t}^k}$ is the mean/norm and $\sigma_{v_{l,t}^k}$ is the standard deviation for v_l^k, both over the 5-year period to time t. When comparisons are made over two specified time periods, t and $t + s$, the mean/norm and the standard deviation applied in the calculation of the z-score at time $t + s$ are the same as those for time t to ensure comparability of outcomes.[3] A variable may be "one-way," "one-way, inverted" or "two-way," depending on the variable being considered; correspondingly, a z-score could also be either "one-way," "one-way, inverted" or "two-way."

3.   *Rank the normalized variable.* The **normalized variable** is subsequently ranked relative to the associated 5-year history and mapped on to a numerical ranking. We assume that the z-scores approximately follow a standard normal distribution so that each numerical ranking may then be interpreted as the probability of realization of the risk associated with the variable according to that distribution. Specifically, a ranking from 0–10 is assigned to each normalized variable for every period, such that:

- For *risks*: zero captures the lowest first percentile of risk, rank "10" is the 99th percentile and rank "5" broadly corresponds to the long-term average, calculated over the 5-year period to time t.

- For *conditions*: (i) zero captures the greatest risk aversion, rank "10" represents the most risk-seeking behavior and "5" corresponds to the long-term average risk appetite, all relative to the 5-year period to time t; (ii) zero represents the tightest monetary and financial conditions, rank "10 represents the loosest and "5" corresponds to long-term average conditions, all relative to the 5-year period to time t.

4.   *Compute the numerical ranking for each sub-indicator* (a_j^i). The score assigned to each **sub-indicator** is calculated as an equally-weighted average of the rankings assigned to the related l **variables**. Weights vary with the number of selected variables, such that:

$$a_k^j = \frac{1}{l} \sum_{n=1}^{m} \text{Rank}_t(z_{v_l^k}).$$

---

[3] For the domestic credit and house price variables used to calculate the macroeconomic risks aggregated indicator, the individual z-scores are derived from deviations from their respective time trends.

5.   *Compute the numerical ranking for each element* (e_j^i). Next, the score assigned to each **element** is calculated as an equally-weighted average of the rankings assigned to the related k **sub-indicators**. Weights vary with the number of sub-indicators, such that:

$$e_j^i = \frac{1}{k} \sum_{n=1}^{k} a_k^j.$$

6.   *Compute the numerical ranking for each aggregated indicator* (X_i). The score assigned to each **aggregated indicator** representing a particular risk or condition is then calculated as an equally-weighted average of j associated **elements**. Weights vary with the number of elements, such that:

$$X_i = \frac{1}{j} \sum_{n=1}^{j} e_j^i$$

Our derivation of the CFSM incorporates an additional step relative to the GFSM. Specifically, we further group the sub-indicators into elements within a particular macro-financial risk or condition and then combine the weighted elements into an aggregated indicator. Our aim in doing so is to allow for more detailed analyses of the composition of individual risks and conditions.

As an extension, cross-country maps enable the comparison of individual risks or conditions (or their components) across financial systems. In this case, it is important that the selected six countries share broadly similar characteristics so that the comparisons are useful. The construction of cross-country maps is based on z-scores derived from the "global" means and standard deviations of pooled individual variables for the G20 countries, such that:

$$\text{Global } \mu_{v_{l,t}^k} = \frac{1}{q} \sum_{n=1}^{q} v_{l_{G20},t,n}^k,$$

and

$$\text{Global } \sigma_{v_{l,t}^k} = \frac{1}{q} \sum_{n=1}^{q} \left(v_{l_{G20},t,n}^k - \left(\text{Global } \mu_{v_{l,t}^k} \right) \right)^2,$$

where q is the total number of quarterly observations (which may not be equal across countries) for variable v_l^k over the 5-year period to time t.

We deem the G20 countries to be an appropriate "global" benchmark for our cross-country comparisons. They represent the largest AEs and EMDEs that are relatively stable and are thus less likely to skew the sample compared to very small, less developed economies that

may be prone to significant economic and market volatility from year to year. Comparisons may also be made within a particular region, by applying means and standard deviations of pooled individual variables of all countries in the region, or by income level (i.e., AEs or EMDEs).

B. Caveats and Possible Extensions

As we emphasized earlier, our CFSM methodology is designed to capture the broadest set of countries using available data, which suggests that enhancements may be possible on an individual country basis. Specifically, we highlight some key areas where further work on calibrations may be useful, especially on an individual country basis:

- Our methodology necessarily assumes linearity in the relationship between individual variables and financial stability, given the broad country coverage. However, the literature suggests that the relationship between early warning indicators and financial stability may be non-linear. For example, increases in variables such as credit growth do not have a material impact on stability up to a point, but risks rise dramatically beyond certain "thresholds" (see Drehmann and others, 2011; IMF, 2011c; Dell' Ariccia and others, 2012; and Arregui and others, 2013). Hence, possible further work towards enhancing this analysis could be the application of thresholds to determine which risks and conditions require policy action.

- For any one risk, our methodology combines indicators that measure risk with those that represent buffers that mitigate risks, in essence, presenting a "net risk" framework. Distinguishing between the two could provide a better sense of the mitigating capacity within a financial system against existing risks. Other possible mitigants include the quality of financial regulation and supervision within a particular financial system, as well as the strength of its crisis management and resolution framework.

- Our methodology equally weighs the variables included in the derivation of each risk and condition, again, necessary for simplicity and practicality purposes given the broad country coverage. A more granular determination of the relative importance of each variable for a particular country might be obtained from applying techniques such as principle component or factor analyses.

- Our methodology focuses on variables that have a higher frequency and longer time series, as well as the greatest commonality across countries, again, owing to the breadth of country coverage. However, the incorporation of additional and more bespoke variables (e.g., the Tankan for Japan or Survey of Consumer Confidence for the United States) could enhance the definition of a particular risk or condition for some countries. We present suggestions for additional pertinent variables Appendix I (Appendix Table 2) and have made their inclusion possible through the flexibility of the Ms. Muffet template.

IV. ANALYTICAL FRAMEWORK

In this section, we provide an analytical framework for interpreting the CFSM. The outputs generated by Ms. Muffet may be assessed from several dimensions, namely through:

- cross-sectional points-in-time for a particular country;

- time series for a particular country;

- the multilateral-bilateral perspective; and

- cross-sectional points-in-time across countries.

A. Country Example

We select an IMF member country—an emerging market economy—to demonstrate the application of the CFSM. In order to avoid implicating any one country, we will refer to it as "Country X" for the purposes of this analysis. Given the anonymity of the country, our assessment is for illustrative purposes only and we flag areas where more granular and nuanced analyses may be desirable, where relevant. Ideally, the analysis should discuss what the CFSM outputs suggest, and then be juxtaposed against actual developments relating to the various risks and conditions to provide the necessary explanation (see Appendix IV for an example matrix template). In this example, however, latter discussion is not possible.

Cross-section analysis

The "default" CFSM is that of a cross-section of macro-financial risks and conditions (and their components) between two specified periods in time. In other words, the CFSM shows how the main risks and conditions for a particular country have changed *over* that period. These may be subsequently parsed by examining developments at more granular levels of the stability map, to determine the key drivers for those changes. We consider macro-financial developments in Country X between 2008Q3 (i.e., the nadir of the GFC) and 2013Q3:

- *Individual risks are mixed but conditions have become easier* (Figure 5(i)). Specifically, macroeconomic risks are at the levels seen during the nadir of the GFC, although inward spillover risks and credit risks have declined. In contrast, market and liquidity risks have risen. At the same time, risk appetite for the country's assets is greater relative to the GFC period while monetary and financial conditions have become slightly looser over the defined period.

- *Focusing on risk appetite, we pare the aggregated indicator into two elements: investment decisions and risk pricing* (Figure 5(ii)). Investors appear to have been more risk-seeking in terms of their investment decisions. However, they appear to have become slightly more cautious in pricing those risks:

- *The elements are further decomposed into sub-indicators, with investment decisions covering portfolio and FDI allocations, while risk pricing is reflected in the risk premium and volatilities of market returns* (Figure 5(iii)). FDI inflows have moderated slightly, while portfolio flows have expanded sharply, consistent with lower market volatility. However, the risk premium demanded by investors for taking on risk has risen, possibly pointing to more appropriate risk-return trade-offs.

- *The volatility sub-indicator is broken down into three market variables—equities, bonds and currency* (Figure 5(iv)). The data shows that the volatility in stock market returns has declined, as has the volatility in the exchange rate. In contrast, the volatility in government bond yields has remained relatively stable.

Figure 5. CFSM and Components: Country X, October 2008 and April 2013

(i) Aggregated Indicators
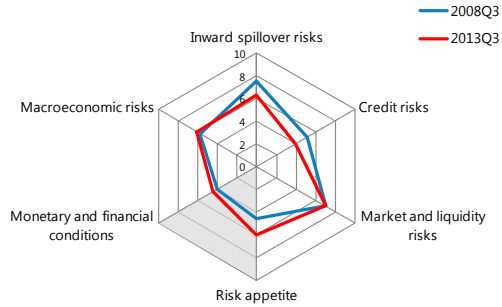
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

(ii) Elements
(Focusing on the risk appetite aggregated indicator)
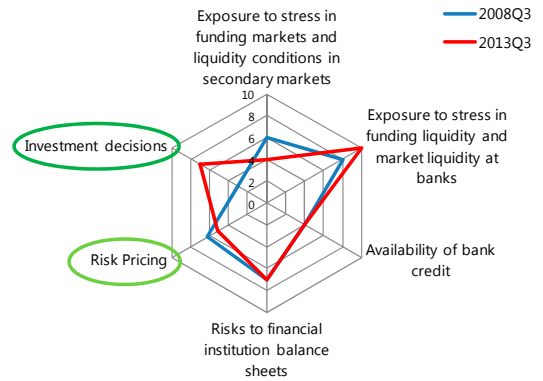
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

(iii) Sub-indicators
(Focusing on risk appetite elements)
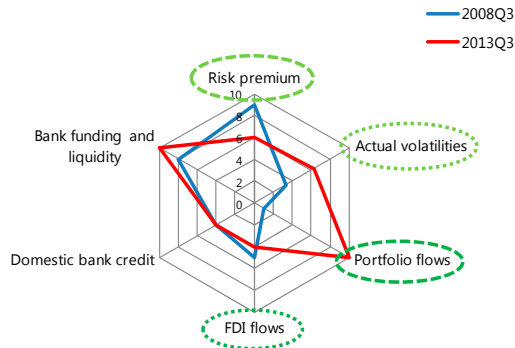
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

(iv) Variables
(Focusing on risk appetite sub-indicators)
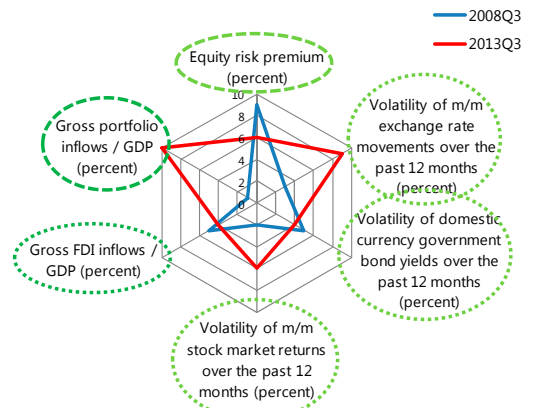
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

Source: Ms. Muffet.

Time series analysis

Time series analyses of the six aggregated indicators suggest that they are robust in representing macro-financial conditions and in presaging the realization of risks. An examination of their performance for Country X over the 2003Q3–2013Q2 period—anchored on 2008Q3—yields the following observations (Figure 6):

- *Macroeconomic risks had remained relatively "range-bound" around the 5-year average leading to the GFC.* They fluctuated between 4–6 before peaking in early-2009, in the months following the Lehman failure, and have returned to average levels since.
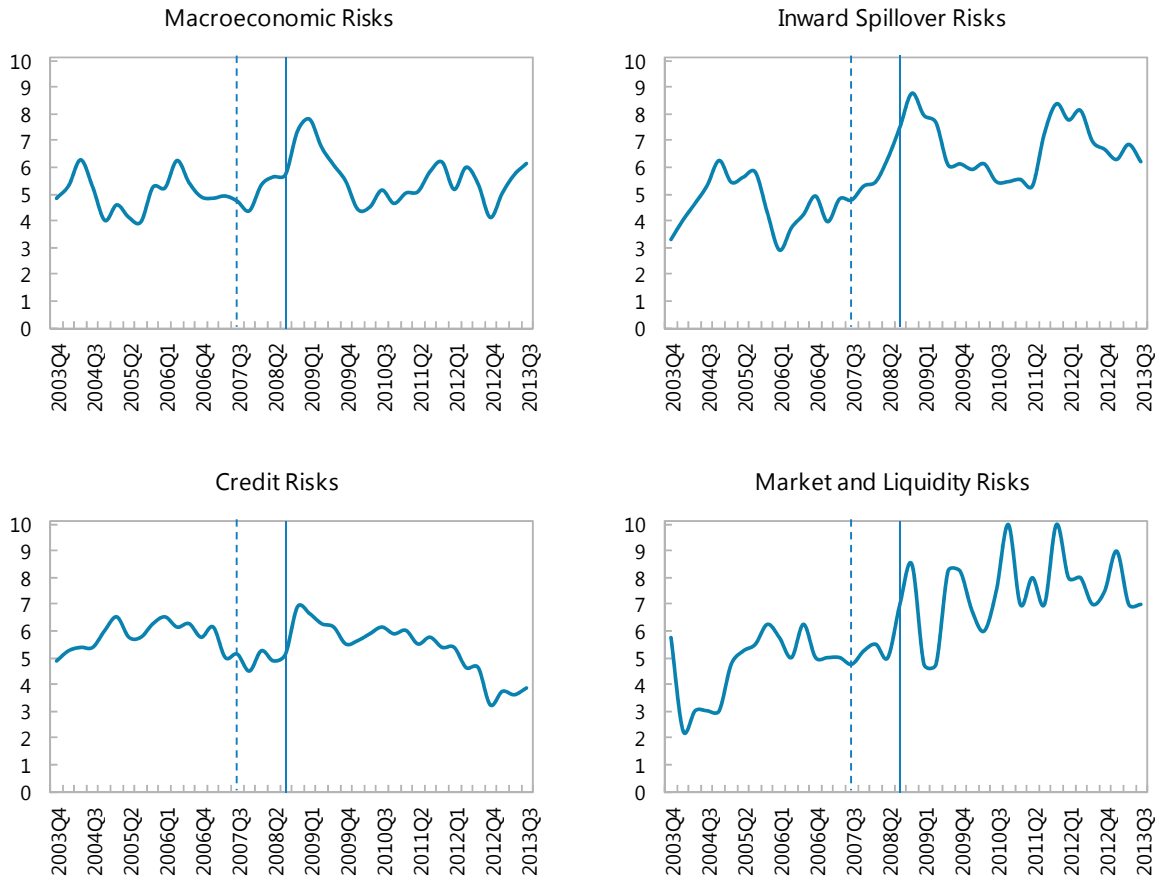
- *Inward spillover risks started climbing sharply in 2007 at the onset of the GFC.* They peaked in 2008 before falling off in 2009 and 2010. The risks again heightened when European sovereigns came under stress in 2011 and 2012.

- *Credit risks have been largely contained throughout the GFC.* They have receded markedly since 2011 and have remained below the pre-defined average.

- *Market and liquidity risks increased sharply during the GFC.* They have remained elevated, with the volatile conditions likely influenced by the tension between ongoing market concerns towards emerging markets and easy global conditions following the wide-scale liquidity operations by central banks.

- *Investor risk appetite increased in the years leading up to the GFC and but then reversed sharply in 2007.* Investor interest in the country's assets rekindled in 2009 and has continued to grow.

- *Monetary and financial conditions were very loose in the lead-up to the GFC but tightened markedly* at the onset of the crisis. Since then, conditions have tightened on two distinct occasions—in the wake of the Lehman crisis; and during the European sovereign debt crisis—offset by the unconventional monetary policies adopted in major jurisdictions.

Figure 6. CFSM: Time Series of Risks and Conditions for Country X

(i) Risks

Macroeconomic Risks

Inward Spillover Risks

Credit Risks

Market and Liquidity Risks

(ii) Conditions

Risk Appetite

Monetary and Financial Conditions
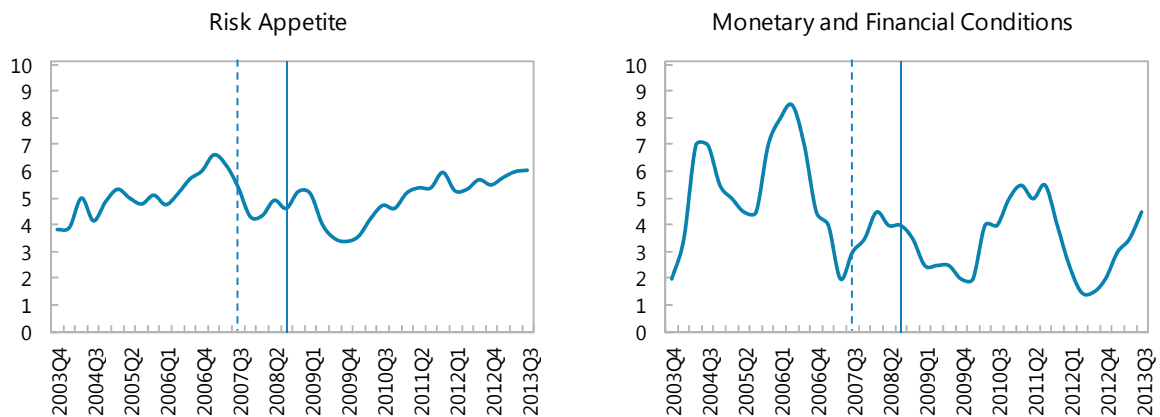
Source: Ms. Muffet.
Note: The broken vertical lines mark the beginning of the GFC in 2007Q3, when BNP Paribas blocked withdrawals from hedge funds and Northern Rock sought liquidity support from the Bank of England. The unbroken lines indicate the worst quarter of the GFC, when Iceland and Hungary were forced to seek international support.

B. The Multilateral-Bilateral Link

Macro-financial surveillance could be enhanced by improving the ability to link developments at the multilateral level with those at the bilateral level. In this context, our framework allows the analysis of empirically-derived *directional* changes in the risks and conditions at the country level relative to those at the global level. Although the mapping between the two is not one for one, given the differences in methodologies (see Dattels, 2010), the "5" ranking represents the long term average for both. More importantly, our internal comparisons between the CFSMs of countries that are included in the derivation of the GFSM show consistency between the two methodologies.

We juxtapose the CFSM for Country X against the GFSM, both over the 2008Q3–2013Q3 period (see Appendix II for a discussion on the timing of the mapping between the two). The risks and conditions for Country X appear to have broadly moved in the same direction as those at the global level (Figure 7):

- *Macroeconomic risks in Country X remain unchanged, broadly in line with global developments.* The former has remained around the same level as that during 2008Q3, while the latter has moderated slightly but remains at elevated levels.

- *Inward spillover risks have declined somewhat for Country X, in tandem with improvements in advanced economies.* Inward spillover risks have moderated slightly on the back of the turnaround seen in Europe and the United States, compared to largely unchanged risk levels in emerging markets.

- *Credit risks for Country X have decreased, which is consistent with global developments.* They have fallen below the levels during the worst of the GFC, while global risks in this area remain above their long-term average.

- *Market and liquidity risks for Country X remain stubbornly high, compared to the global environment, which raises a red flag.* Global risks in these areas have declined significantly, to below the long-term average, pointing to country-specific concerns for Country X.

- *Nonetheless, risk appetite for Country X assets appears to have improved in line with the rest of the world.* Risk appetite for Country X has increased to above its comparator average, likely buoyed by the general (and significant) increase in risk-seeking behavior elsewhere.

- *Monetary and financial conditions in Country X have eased only very slightly despite the significant loosening globally.* Conditions in Country X are at about the average of the 5-year period to 2008Q3, in contrast to the vast easing seen overall, and the underlying reasons could possibly be analyzed further.

Figure 7. The GFSM and CFSM, October 2008 and April 2013
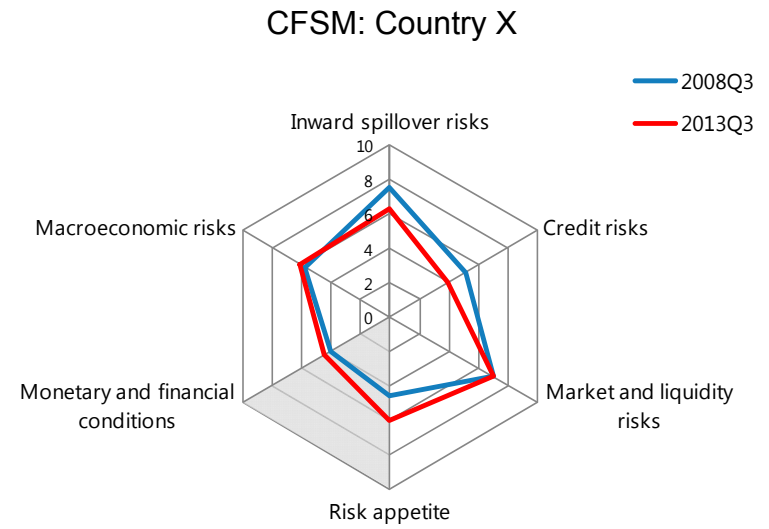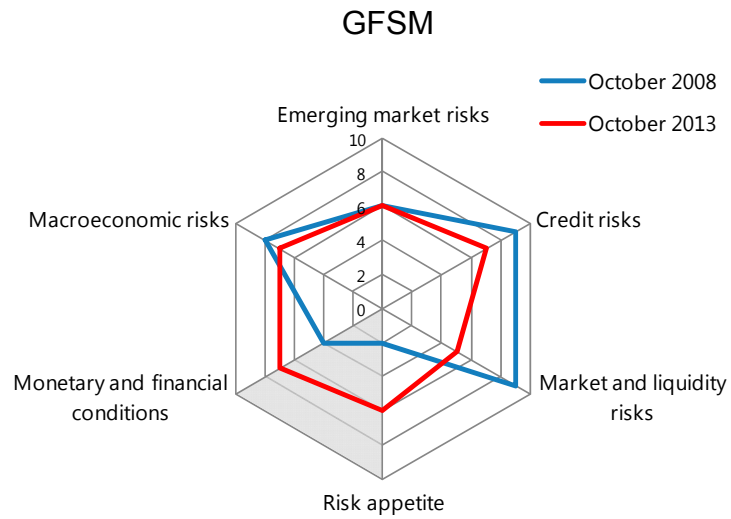
GFSM

Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

Sources: GFSR (2013); and Ms. Muffet.

CFSM: Country X

Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

C. Cross-Country Comparisons

Cross-country comparisons of individual risks and conditions could also yield useful insights into developments in a particular country. We highlight some important considerations in this aspect of CFSM analysis:

- *The level of development (and nature) of the sample countries should be similar.* This would facilitate meaningful comparisons across a group of peers.

- *Common variables, sub-indicators and elements should be used to construct the aggregated indicators.* Given that data availability are different across countries, only components that are available across all countries in a particular sample should be used to facilitate meaningful comparisons.

- *The interpretation is relative across countries and over time.* Given that G20 means and standard deviations are used to calculate the variable z-scores for all countries in the selected sample, the levels of and changes in risks and conditions for each country can be compared vis-à-vis other countries in the sample, as well as relative to the anchor period of 2008Q3.

On this basis, we choose five other (anonymized) EMEs in addition to Country X (Figure 8). As in other examples in this paper, we focus on the 2008Q3–2013Q3 period:

- *A worrying trend is that risks in several of the selected EMEs have generally remained similar to the levels seen during the worst of the GFC.* Only inward spillover risks have decreased for all but Country U, with EMDEs appearing to have benefitted from the incipient recovery in AEs. Compared across countries, macroeconomic, inward spillover and credit risks are lowest in Country V. However, market and liquidity risks in Country V are among the highest, along with Countries X and Y, suggesting that closer scrutiny of these risks may be warranted especially for Country V.

- *Macro-financial conditions have been mixed.* Risk appetite has largely remained around the GFC average for all countries in the sample, while monetary and financial conditions have eased significantly in all countries except Countries X and Z.

Figure 8. CFSM: EMDE Cross-Country Comparisons of Risks and Conditions

(i) Risks

Macroeconomic Risks
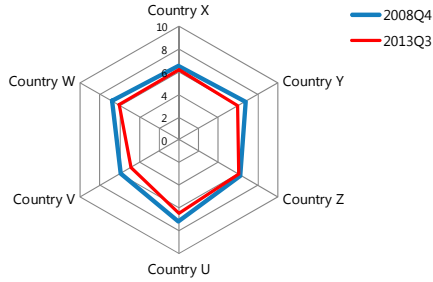
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

Inward Spillover Risks
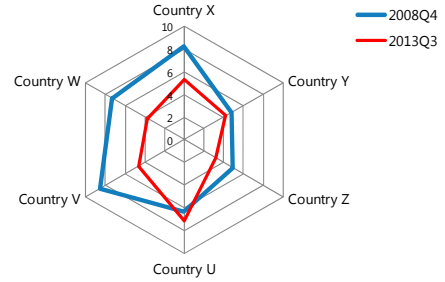
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

(iii) Credit Risks

Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

(iv) Market and Liquidity Risks

Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

(ii) Conditions

Risk Appetite

Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

Monetary and Financial Conditions

Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.
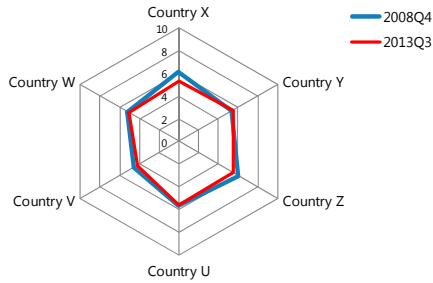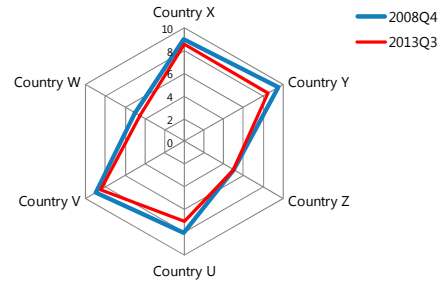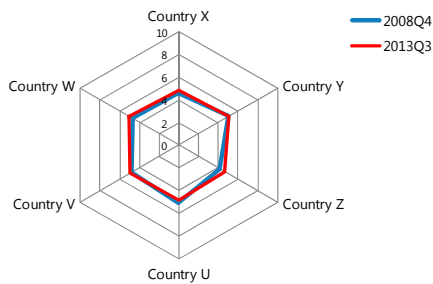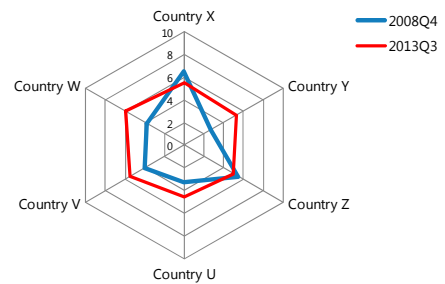
Source: Ms. Muffet.

V. CONCLUSION

The IMF is continuing to expand its analyses of macro-financial risks and to improve the link between bilateral and multilateral surveillance. The 2012 ISD established a comprehensive framework for the latter. And as an important contribution to the former, the GFSR had introduced the GFSM in April 2007 to assess changing macro-financial risks and conditions from a multilateral perspective.

As a next step, we have developed the compendium bilateral CFSM. The CFSM provides an empirical framework for explicitly linking these various aspects of the IMF's surveillance—macroeconomic with financial, and multilateral with bilateral analyses. It maps the various categories of macro-financial risks and conditions for individual countries along the lines of the GFSM and provides a means for identifying potential sources of macro-financial risks particular to a country, to highlight areas where more detailed analyses may be required. The bilateral with the multilateral findings are then be empirically linked through comparisons between the CFSM and GFSM to identify incipient risks in a particular country relative to global developments.

To facilitate analyses, we have developed the **M**CM **S**pidergram: a **M**acro-**F**inancial **E**nvironment **T**ool or "Ms. Muffet." It generates the CFSM for all IMF member countries, encompassing AEs and EMDEs, which may then be juxtaposed against the corresponding GFSM. Spidergrams of the CFSM components allow a drill-down into key areas of concern while related time series charts for each aggregated indicator, element, sub-indicator and variable show changes in macro-financial risks and conditions over time. Outputs also include cross-country spidergrams of individual risks and conditions which enable peer comparisons. The tool may be replicated by external users with access to the necessary databases using the Excel template provided with this paper.

The empirical evidence suggests that the CFSM is robust in capturing changing macro-financial risks and conditions. The time series rankings of each CFSM aggregated indicator allow us to assess their performance in the period leading up to and then following the onset of the GFC. We find the methodology to be broadly satisfactory, both as an indicator of rising risks to financial stability prior to the GFC and as a measure of stress during the crisis. Our internal comparisons between the CFSMs of countries that are key in the derivation of the GFSM also show consistency between the two methodologies.

That said, improvements to the CFSM will always be possible. Given that our main aim is to capture all the IMF's member countries, we have necessarily drawn from key economic and market databases to ensure the broadest possible coverage. Our database could be supplemented by more bespoke country data which may not be publicly available. As countries continue to improve the coverage and quality of their reported data, the calculation of their CFSM will likely become more robust and comparisons across countries will become more consistent. Additional enhancements to our methodology could also include the

incorporation of risk mitigants, such as macroeconomic and financial buffers, the quality of regulation and supervision, and the strength of the crisis management and resolution framework, and the imposition of thresholds to determine which risks and conditions require policy action.

APPENDIX I. THE CONSTRUCTION OF CFSM INDICATORS

Appendix Table 1. CFSM: Core Variables and Associated Data Series

Source: Authors (magnified attachment provided in the accompanying Excel templates folder).

Appendix Table 2. CFSM: Possible Additional Variables and Associated Data Series

Category (Represented by aggregated indicator)	Element	Sub-indicator	Indicators	Unit	Series	Source	Published as Stock/Flow	Frequency	Published Unit	Interpretation of Variable	Calculation of Variable z-score and Rank
Risk											
Macroeconomic	Macroeconomic stability	Credit to the economy	Cross-border credit to non-banks (percentage deviation from time trend)	Percent	Cross-border credit to non-banks	BIS	Stock	Quarterly	U.S. dollars	Either too positive or too negative is undesirable.	Deviation from time trend converted to 2-way z-score; 5-year SD based on initial period selected, linear time trend is estimated over 5 years on a rolling basis. The z-score is converted to a 0-10 ranking, with 0 being the lowest and 10 being the highest risk, and 5 approximately the long-term average.
			Change in the ratio of total credit to GDP (y/y)	Percentage points	Credit from other depository institutions	IFS	Stock	Annual, quarterly	Domestic currency	Either too positive or too negative away from mean/norm is undesirable.	Standardized to a 2-way z-score; 5-year mean and SD based on initial period selected. The z-score is converted to a 0-10 ranking, with 0 being the lowest and 10 being the highest risk, and 5 approximately the long-term average.
					Credit from other financial corporations	IFS	Stock	Annual, quarterly	Domestic currency		
					Cross-border credit to non-banks	IFS	Stock	Annual, quarterly	Domestic currency		
					Nominal GDP	WEO, IFS	Flow	Annual, quarterly	Domestic currency		
			Total credit (percentage deviation from time trend)	Percent	Credit from other depository institutions	IFS	Stock	Annual, quarterly	Domestic currency	Either too positive or too negative is undesirable.	Deviation from time trend converted to 2-way z-score; 5-year SD based on initial period selected, linear time trend is estimated over 5 years on a rolling basis. The z-score is converted to a 0-10 ranking, with 0 being the lowest and 10 being the highest risk, and 5 approximately the long-term average.
					Credit from other financial corporations	IFS	Stock	Annual, quarterly	Domestic currency		
					Cross-border credit to non-banks	BIS	Stock	Quarterly	U.S. dollars		
	Macroeconomic outlook	Production	Economic confidence	Index level	Consumer confidence index	Haver	Stock	Annual, quarterly	Index level	The more positive the more desirable.	Standardized to a z-score; 5-year mean and SD based on initial period selected. The z-score is converted to a 0-10 ranking, with 0 being the lowest and being the highest risk, and 5 approximately the long-term average.
					Business sentiment index	Haver	Stock	Monthly	Index level	The more positive the more desirable.	
					Purchasing managers' index (PMI)	Haver	Stock	Monthly	Index level	The more positive the more desirable.	
Credit	Stress on banking sector from corporates	Corporate financial obligations	Corporate debt / GDP	Percent	Banking system credit to nonfinancial corporations	BIS, FSI	Stock	Quarterly	U.S. dollars	The smaller the more desirable (bounded at zero).	Standardized to a z-score; 5-year mean and SD based on initial period selected. The z-score is converted to a 0-10 ranking, with 0 being the lowest and 10 being the highest risk, and 5 approximately the long-term average.
					Outstanding domestic debt securities issued by corporates	BIS	Stock	Quarterly	U.S. dollars		
					Corporate external debt	Authorities	n.a.	n.a.	n.a.		
					Nominal GDP	WEO, IFS	Flow	Annual, quarterly	Domestic currency		
	Stress on banking sector from households	Household financial obligations	Household debt / GDP	Percent	Banking system credit to households	BIS, FSI	Stock	Quarterly	Domestic currency	The smaller the more desirable (bounded at zero).	Standardized to a z-score; 5-year mean and SD based on initial period selected. The z-score is converted to a 0-10 ranking, with 0 being the lowest and 10 being the highest risk, and 5 approximately the long-term average.
					Nominal GDP	WEO, IFS	Flow	Annual, quarterly	Domestic currency		
Condition											
Monetary and financial	Availability of other credit	Nonbank credit	Growth in credit intermediated by bond markets (y/y)	Percent	Outstanding domestic debt securities issued by corporates	BIS	Stock	Quarterly	U.S. dollars	The more positive the looser the condition.	Standardized to a z-score; 5-year mean and SD based on initial period. The z-score is converted to a 0-10 ranking, with 0 being the tightest condition and 10 being the loosest condition, and 5 approximately the long-term average.

Source: Authors (magnified attachment provided in the accompanying Excel templates folder).

APPENDIX II. THE FREQUENCY AND TIMING OF DATA USED TO DERIVE AN AGGREGATED INDICATOR

The latest available data are always used as input at any particular point in time. We adhere to the following criteria in constructing our dataset:

- As much as possible, quarterly frequencies are used, but if not, the latest available annual values are applied.

- Where necessary and possible, quarterly and annual data series are merged.

- If necessary, annual GDP is interpolated and a constant quarterly growth rate is assumed in deriving a proxy for quarterly GDP; the WEO annual forecast is used for interpolation purposes in the current year.

As an example, the user may be interested in constructing the latest CFSM in October 2013. Drawing on the representation in Figure 4, let us assume that the data for series s_1, …, s_9 for aggregated indicator, X_1, are separately available up until the end of various different quarters as follows (Figure 9):

- December 2012 for s_1, s_2, s_5 and s_7;

- March 2013 for s_3, s_4, s_8 and s_9;

- June 2013 for s_6, s_{10} and s_{11};

where s_2, is the annual GDP series.

The estimation of aggregated indicator, X_1, estimated as at end-October 2013, would thus apply:

- the latest available data points for: s_1 and s_2 (variable v_1^1); s_3 (variable v_2^1); s_6 (variable v_4^3); s_7 (variable v_5^3); s_8 (variable v_6^3); s_9 (variable v_7^1); s_{10} (variable v_8^1) .

- the end-December 2012 data point for s_4 and the latest (also end-December 2012) data point s_5, for variable v_3^2.

- the end-June 2013 data point for s_{11} and the interpolated end-June 2013 forecast data point for s_2, for variable v_9^1.

If there is no subsequent data release by the end of November 2013, then any CFSM generated on that date would be identical to the one previously produced at the end of October. If, however, additional data are published between the two dates, these would be incorporated into the November CFSM.

Comparisons of the CFSM with the GFSM are necessarily based on quarterly to semi-annual mappings. The GFSM is published twice a year, in the April and October GFSRs, while the CFSM may be generated for each quarter, both using the latest available data. Thus, the appropriate mappings are as shown in Appendix Table 3:

Appendix Table 3. Time Mapping of the CFSM to the GFSM

CFSM		GFSM 1/
Q4, Year *t*-1	→	April GFSR, Year *t*
Q1, Year *t*	→	April GFSR, Year *t*
Q2, Year *t*	→	October GFSR, Year *t*
Q3, Year *t*	→	October GFSR, Year *t*

Source: Authors.
1/ The April GFSM typically uses data published in Q4 of the previous year and in Q1 of the current year; the October GFSR typically uses data published in Q2 and Q3.

Figure 9. CFSM: How the Latest Available Data are Applied

Source: Authors.

APPENDIX III. THE CALCULATION OF Z-SCORES AND CONVERSION TO NUMERICAL RANKINGS
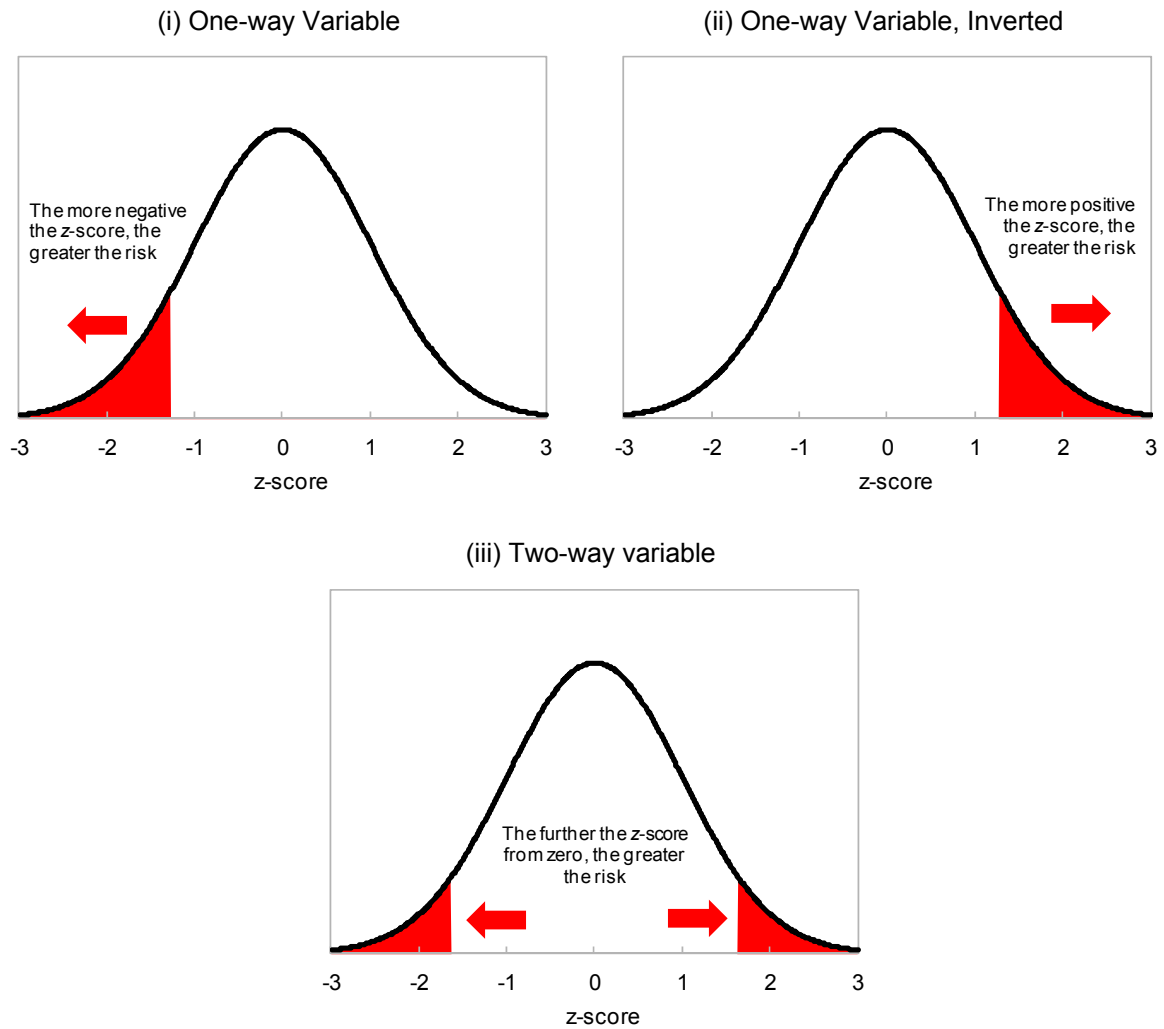
A "larger" z-score should reflect a higher level of risk, looser monetary and financial conditions or higher risk appetite. However, there are several concepts that need to be taken into account in their calculation and their conversion to numerical rankings:

1.   Variables are typically "one-way" or "two-way." For example:

•   The *fiscal balance* is a one-way variable—the more positive the balance (relative to GDP) vis-à-vis the medium-term average, the more desirable it is for macro-financial stability. The fiscal balance may be either positive or negative. Other examples include *stock market returns* and *banking system liquid assets*.

•   Conversely, *government debt* is also a one-way, but "inverted," variable—the smaller the balance (relative to GDP) vis-à-vis the medium-term average (i.e., the more negative away from the mean), the more desirable it is for macro-financial stability. Government debt is bounded at a zero minimum. Other examples include *government, corporate* and *household debt*.

•   In contrast, *inflation* is a two-way variable—the greater the change in prices from the mean or pre-defined norm in either direction, reflecting either greater inflationary or disinflationary/deflationary pressures, the less desirable it is. Inflation may be either positive or negative. Other examples include the *output gap*.

2.   The interpretation of a z-score depends on the nature of the variable (Figure 10). Using the examples in (1) above:

•   In the case of the *fiscal balance*, the more **positive** the z-score, the **lower** the risk (Figure 10(i)).

•   In the case of *government debt*, the more **negative** the z-score, the **lower** the risk (Figure 10(ii)).

•   In the case of *inflation*, the **smaller** the z-score, either positive or negative, the **lower** the risk (Figure 10(iii)).

3.   Thus, the mapping of the z-score to a numerical ranking varies depending on the interpretation of the former. As with the variables, it may be "one-way" or, where the absolute value of the z-score is calculated, "two-way:"

•   For consistency in the conversion, we map the lowest risk situation to the lowest numerical ranking of zero and the highest risk to the highest numerical ranking of 10

(Appendix Table 4). Using the examples in (2) above, the numerical rankings are assigned as follows (Figure 11):

- For the *fiscal balance*, the numerical ranking moves in opposite direction to the z-score—the more positive the *z*-score, the lower the risk and hence the lower the numerical ranking assigned (Figure 11(i)).

- For *government debt*, the numerical ranking increases with the z-score—the more positive the *z*-score, the greater the risk and hence the higher the numerical ranking assigned (Figure 11(ii)).

- For *inflation*, the larger the z-score (either positive or negative), the greater the risk. Consequently, the *absolute* value of the *z*-score is calculated such that the larger the score, the greater the risk and thus the higher the numerical ranking assigned (Figure 11(iii)).

- Macro-financial *conditions* are interpreted differently from their risk counterparts. In the two instances, risk appetite and monetary conditions, the more risk averse the environment or the tighter the condition, the closer the respective numerical rankings are to zero. The changing directions are not necessarily positive or negative developments in themselves; rather, it would depend on the existing environment.

4. Finally, it should be noted that some variables could be both one-way and two-way depending on the risk or condition they reflect. *Bank credit* is a case in point:

- It is a two-way variable under *Macroeconomic Risks* as overly strong growth could lead to overheating, while a sharp slowdown or contraction could significantly affect economic activity.

- In contrast, it is a one-way variable under *Monetary and Financial Conditions*, as stronger growth in credit (i.e., the more positive the z-score) and hence better credit availability is desirable.

- Conversely, it is a one-way (inverted) variable under *Credit Risks*, as the stronger the growth (i.e., the more positive the *z*-score), the greater the risk to banks.

Figure 10. CFSM: Probability Density of Normal Distribution and Interpretation of *z*-scores

(i) One-way Variable

The more negative the *z*-score, the greater the risk

z-score

(ii) One-way Variable, Inverted

The more positive the *z*-score, the greater the risk

z-score

(iii) Two-way variable

The further the *z*-score from zero, the greater the risk

z-score

Source: Authors.

Appendix Table 4. CFSM: Assignment of Numerical Rankings to *z*-scores

Ranking	Percentile		Risk Assessment
	One-way	Two-way	
0	Up to 1	49.5–50.5	Lowest
1	1–5	47.5–49.5 and 50.5–52.5	:
2	5–10	45.0–47.5 and 52.5-55.0	:
3	10–20	40.0–45.0 and 55.0–60.0	:
4	20–40	30.0–40.0 and 60.0–70.0	:
5	40–60	20.0–30.0 and 70.0–80.0	Norm/historical average or trend
6	60–80	10.0–20.0 and 80.0–90.0	:
7	80–90	5.0–10.0 and 90.0–95.0	:
8	90–95	2.5–5.0 and 95.0–97.5	:
9	95–99	0.5–2.5 and 97.5–99.5	:
10	Above 99	Up to 0.5 and above 99.5	Highest

Source: Authors.

Figure 11. CFSM: Mapping *z*-scores onto Numerical Rankings

(i) One-way Variable

(ii) One way Variable, Inverted

(iii) Two-way Variable
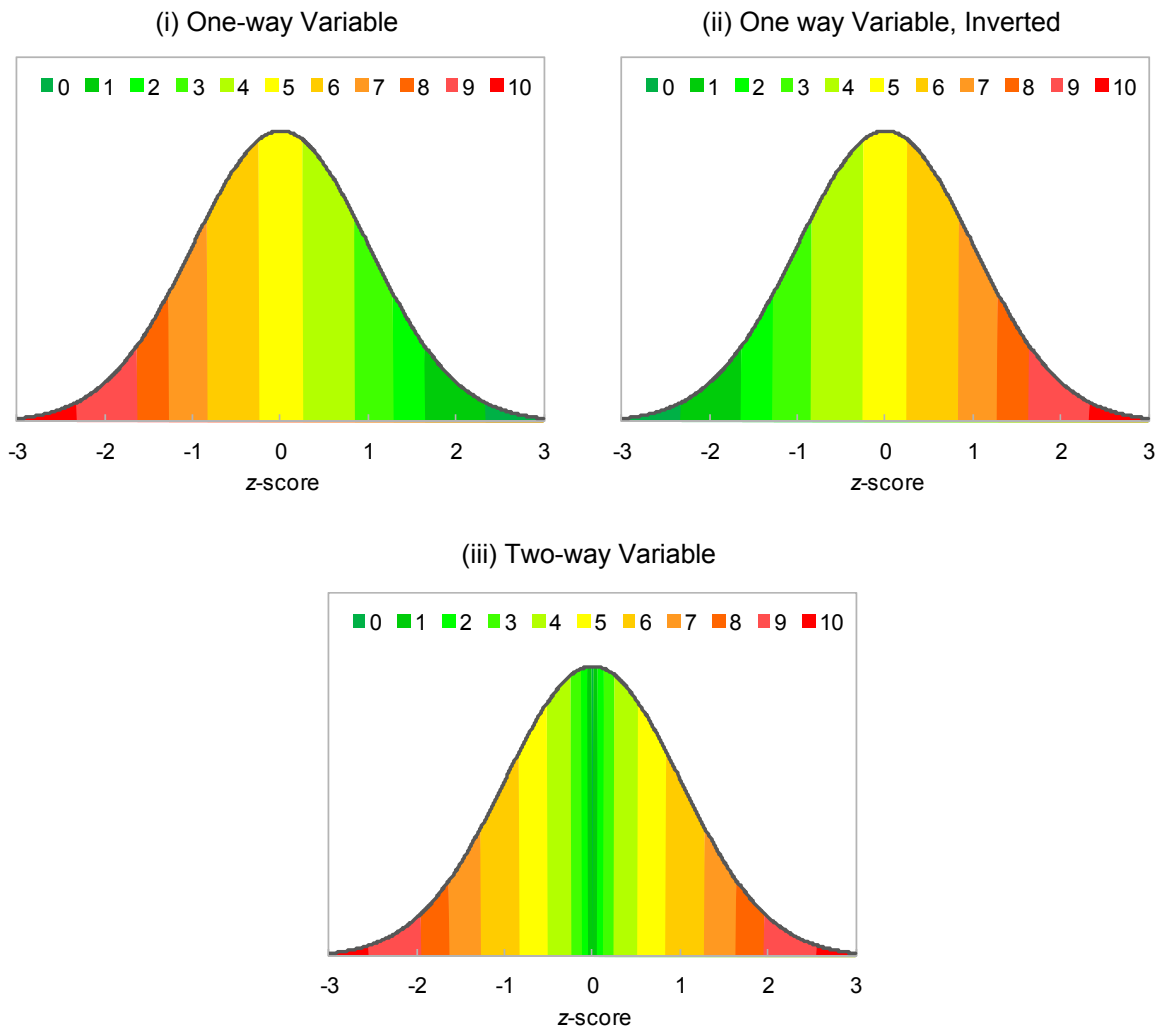
Source: Authors.

Appendix Table 5. Country X: CFSM Analytical Matrix

Alternative Presentation 1: Thematic Analysis of CFSM [Describe what the CFSM shows]	Alternative Presentation 2: Output Analysis of CFSM [Describe what the CFSM shows]	Country Situation [Describe actual developments in the country]
Macroeconomic risks	Cross-section analysis	…
Cross-section analysis	Macroeconomic risks	…
Time series analysis	Inward spillover risks	…
Bilateral-multilateral analysis	Credit risks	…
Cross-country analysis	Market and liquidity risks	…
Inward spillover risks	Risk appetite	…
Cross-section analysis	Monetary and liquidity conditions	…
Time series analysis	Time series analysis	…
Bilateral-multilateral analysis	Macroeconomic risks	…
Cross-country analysis	Inward spillover risks	…
Credit risks	Credit risks	…
Cross-section analysis	Market and liquidity risks	…
Time series analysis	Risk appetite	…
Bilateral-multilateral analysis	Monetary and liquidity conditions	…
Cross-country analysis	Bilateral-multilateral analysis	…
Market and liquidity risks	Macroeconomic risks	…
Cross-section analysis	Inward spillover risks	…
Time series analysis	Credit risks	…
Bilateral-multilateral analysis	Market and liquidity risks	…
Cross-country analysis	Risk appetite	…
Risk appetite	Monetary and liquidity conditions	…
Cross-section analysis	Cross-country analysis	…
Time series analysis	Macroeconomic risks	…
Bilateral-multilateral analysis	Inward spillover risks	…
Cross-country analysis	Credit risks	…
Monetary and liquidity conditions	Market and liquidity risks	…
Cross-section analysis	Risk appetite	…
Time series analysis	Monetary and liquidity conditions	…
Bilateral-multilateral analysis		…
Cross-country analysis		…

Source: Authors.

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