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A Monitoring Framework for Global Financial Stability

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EXECUTIVE SUMMARY

Since the inception of the *Global Financial Stability Report* (GFSR), its framework for financial stability monitoring has continued to evolve and improve. This paper describes the conceptual framework that underpins the current approach in the GFSR for evaluating global financial stability risks. By doing so, this paper aims to contribute to financial stability by enhancing transparency about how it makes its assessments and improving communication. The GFSR is one of the IMF's flagships assessing financial stability, and it is released following a discussion by the Executive Board.

The conceptual framework is one in which cyclical financial stability risks arise as macro-financial imbalances increase because of greater risk-taking by lenders and borrowers. High imbalances can amplify negative shocks and create an adverse feedback loop as prices fall and financial firms are forced to deleverage, leading to a sharp decline in economic growth. This framework is based on a growing body of research from policymaking institutions and academia that explores macro-financial linkages, many of which were ignored before the financial crisis.

The first part of the approach involves monitoring a set of indicators in a matrix defined by types of macro-financial imbalances across types of lenders and borrowers in the financial system. It involves assessing asset valuations, leverage and funding mismatches of financial intermediaries, and credit of borrowers. This structured and consistent framework for monitoring across countries and time also facilitates investment in better data and models that will contribute to better risk assessments in the future.

The second part is a summary aggregate measure of financial stability risk, expressed as downside risks to forecast GDP growth conditional on financial conditions, or growth at risk. Financial conditions measure the cost of funding and reflect the underlying price of risk in the economy. The key innovation of this measure of financial stability risk is that it reflects that the entire distribution of forecast GDP growth is linked to financial conditions. That is, it is important to consider not only expected growth but risks to expected growth. In addition, there may be an intertemporal trade-off for risk, which suggests it is important to consider risks to growth over time. While loose financial conditions raise growth and reduce risks to growth in the near term, they may increase downside risks to growth in the medium term because vulnerabilities have built up in response.

The two parts of this approach are complementary, with the more granular analysis of various specific vulnerabilities providing necessary nuance and depth to the aggregate summary measure of downside risks to growth. The focus on vulnerabilities highlights potential targets for macroprudential policies. In addition, because growth at risk is a continuous measure and can be updated regularly along with forecasts for expected growth, it allows financial stability risks to be incorporated into decision-making frameworks for prudential or monetary policy, rather than only intermittently when financial risks are very high. By offering a concrete measure of financial stability risks in terms of a common metric—GDP growth—it provides a path to better communication and coordination among financial regulators and central banks, which is important for effective macroprudential policymaking.

INTRODUCTION

1. This paper describes the conceptual framework that guides assessments of financial stability risks for multilateral surveillance, as currently presented in the *Global Financial Stability Report* (GFSR). This conceptual framework emphasizes that cyclical risks can arise because financial firms and investors increase risk-taking in response to loose financial conditions, leading to a buildup of macro-financial imbalances. Imbalances include compressed risk premiums on asset prices and higher leverage and greater maturity transformation of financial firms. In addition, financial firms and investors often have incentives to increase risk-taking collectively because of increased competition or incomplete compensation contracts, which can increase correlations. This paper aims to further enhance transparency and improve communication with countries, many of which have adopted similar approaches for their own financial stability monitoring, by describing in detail the underpinnings and objectives of the framework for multilateral surveillance in the GFSR.

2. The framework emphasizes consistency in measuring financial vulnerabilities across countries and over time and offers a summary statistic to quantify aggregate financial stability risks. The framework supports a systematic empirical approach to multilateral surveillance with two parts: The first part involves regularly monitoring a broad set of indicators of macro-financial imbalances that have been identified in a rich body of research as generating negative externalities, such as those associated with fire sales and contagion. These imbalances can serve as intermediate targets for macroprudential policies. The second part involves estimating an aggregate summary measure of financial stability risks, expressed as GDP growth at a low percentile of its forecast distribution conditional on financial conditions. Both parts are done for countries, regions, or globally and aim to include analysis of spillovers across countries.

3. The two parts of the empirical approach—a matrix of specific vulnerabilities and a summary measure of financial stability risks—are distinct but highly complementary for monitoring and policymaking. More specifically, the first part, to monitor specific vulnerabilities, can be presented in the GFSR as a heatmap or spider chart and highlights recent changes and the degree to which vulnerabilities are elevated relative to their historical norms. In addition, analysts could describe their evaluation of how the vulnerabilities could transmit and amplify some possible shocks based on various risk scenarios. Importantly, this first part of the empirical approach is intended to be flexible and reflect the reality that vulnerabilities will emerge in new forms, and analysts will not always have sufficient information to capture them, especially given the wide range of countries and regions that are covered. However, the cost of this necessary flexibility is that it cannot provide a consistent definition or single quantitative assessment of the severity of financial stability risks. For example, an assessment that nonfinancial corporate debt is high and underwriting standards are weak, which implies a vulnerable financial system and economy, still does not provide a summary measure of risks to economic growth or of a banking crisis or whether policymakers should take policy actions.

4. The second part is presented as a time series of downside risks to GDP growth, or growth at risk (GaR), along with summary financial conditions indices and associated components. That is, GaR estimates for the near term or medium-term (two to three years ahead) can be compared directly with their historical estimated values to judge the severity of risks. However, the GaR forecasts on their own cannot capture the nuances of the more detailed assessment from a matrix designed to identify vulnerabilities, which is needed for determining possible policy actions. Hence, the two parts are complementary.

5. Each part is expected to improve over time because the desire for consistent measurement of risks will incentivize improvements in data and models. The matrix offers a structure to assess vulnerabilities and encourages the development of data over time to improve risk measurement across countries and regions to contribute to a global assessment. It could lead to more and better indicators of financial conditions and vulnerabilities that could be used to estimate GaR for countries or regions, or on a global basis. In addition, global GaR is estimated from a single global financial conditions summary index, which aggregates conditions in countries and areas, and work on an index of global financial vulnerabilities is advancing, which can be used in the future to improve models of GaR. However, GaR is not easily estimated for countries without deep financial markets or financial data, and so more work is needed to develop alternative measures of downside risks to output growth for those countries.

6. The two-part empirical monitoring framework facilitates incorporating financial stability risks into discussions of macroeconomic performance. Risks to financial stability often are expressed as the probability of a banking crisis, without a rigorous way to translate that risk into terms used by other macro policymakers. GaR provides a measure of the level of macro-financial systemic risks in terms of the level of risks to output growth, and thus would allow macrocritical financial stability risks to be incorporated into broad macroeconomic models. Expressing financial stability risks arising from the financial sector in the same terms as used in models for other macroeconomic policies will help when evaluating alternative policy options and foster greater coordination across policymakers. It can contribute to better macroeconomic management, which needs to be comprehensive, consistent, and coordinated (see Gaspar, Obstfeld, and Sahay 2016).

7. For monetary policy, the framework is also relevant because the policy rate is a basic underpinning of the price of risk. Of course, macroprudential policies may be the better policy instrument because they can be directed at specific vulnerabilities. In that case, monetary policymakers would be informed of actions needed. Even without coordination, there would be gains from avoiding working at cross-purposes (see Adrian , Duarte, and others 2018 for more discussion).

FINANCIAL STABILITY MONITORING FRAMEWORK

8. This section presents a stylized conceptual framework for identifying and monitoring cyclical risks to financial stability.[1] The framework is grounded in macro-financial linkages—those between the financial sector and the real economy—and in particular in how the financial sector can propagate and amplify shocks. It makes an important distinction between shocks and macro-financial imbalances, where shocks are external and hard to predict. On the other hand, macro-financial imbalances develop endogenously as lenders and borrowers respond to a low price of risk in the presence of financial frictions; these imbalances then act as amplifiers of shocks (Figure 1). They include high asset valuations and high leverage in the financial sector. Once imbalances are sufficiently high, they can amplify negative shocks that cause the price of risk to rise, which can lead to declines in asset prices and an unwinding of balance sheet leverage, which brings about a restriction in credit and higher downside risks to growth. In this framework, the degree of financial stability risks will depend on the severity both of negative shocks and of financial imbalances.

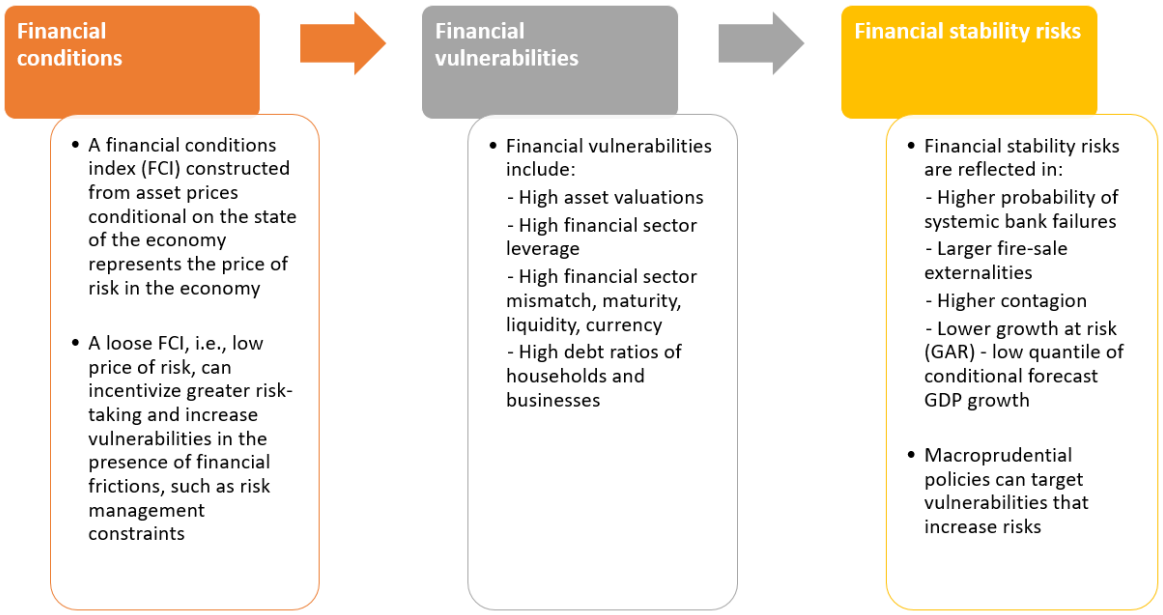
A. Financial Vulnerabilities and Externalities

9. A low price of risk given financial frictions can lead to macro-financial imbalances as lenders and borrowers respond. The price of risk, or financial market risk appetite, has long been considered an important factor for macroeconomic fluctuations (Minsky 1986). A negative shock can cause the price of risk to rise, leading investors to require a higher return for risky projects, leading to an economic downturn. Conversely, when the price of risk falls, the value of safe bonds falls and required returns on risky projects fall, and the economy expands. The price of risk is often represented in empirical studies by a financial conditions index (FCI) composed of asset prices conditional on the state of the economy. Financial conditions are often an important predictor of growth, but financial stability assessments should also capture the effects they have on the buildup of vulnerabilities and conditional downside risks to growth following periods of a low price of risk. [2]

[1] This section is drawn heavily from Adrian and Liang (2018). See also Brunnermeier, Eisenbach, and Sannikov (2013) and Claessens and Kose (2017) for an extensive survey. There are also important structural vulnerabilities in the financial system that are important to monitor, such as those related to market structure, but these issues are not necessarily as tightly tied to the business cycle and endogenous to financial conditions, and so are not discussed in this framework.

[2] Financial conditions have been found to help predict expected growth. Short-term yields and term spreads on risk-free securities capture the stance of monetary policy and therefore contain useful information about future economic activity (Bernanke and Blinder 1992; Ang, Piazzesi, and Wei 2006). Corporate bond spreads signal the default-adjusted marginal return on business fixed investment (Philippon 2009), and corporate bond risk premiums have been found to reflect the creditworthiness of financial institutions (Gilchrist and Zakrajšek 2012). There is some evidence that elevated volatility of stock returns can be a useful predictor of short-term contractions in output, but the predictive power of stock returns is weak (Campbell 1999; Stock and Watson 2003). Research is ongoing to develop alternative measures of the price of risk or risk appetite for the macroeconomy, but such indicators would not be available for a broad set of countries of interest for the GFSR. See, for example, Pflueger, Siriwardane, and Sunderam (2018), who measure risk appetite with the valuations of high-volatility stocks to low-volatility stocks.

Figure 1. Macro-Financial Linkages: Endogenous Risk-Taking, Financial Vulnerabilities, and Financial Stability Risks



Source. IMF staff.

10. Financial frictions have been foundational for macro models that include credit cycles. When lenders face asymmetric information so that there is an external finance premium for borrowers, loose monetary policy or financial conditions can improve the net worth of borrowers and through a financial accelerator effect increase credit for household and business spending (Bernanke and Gertler 1989; extended by Bernanke, Gertler, and Gilchrist 1999). Changes in the net worth of financial institutions subject to capital constraints also may affect the supply of credit in a procyclical way and have independent effects on the real economy (Gertler and Kiyotaki 2009, Gertler and Karadi 2010). Borrowers may not consider externalities when making their individual borrowing decisions, which can lead to excess credit (Korinek and Simsek 2016). While these mechanisms establish links between financial conditions and financial stability risks, they generally do not suggest nonlinear amplification effects that are as sharp as observed in financial crises.

11. The endogenous response of financial intermediaries can lead to higher leverage of financial intermediaries and greater loan supply and to greater maturity transformation. Higher asset prices boost capital adequacy and ease risk management constraints of financial intermediaries, who respond by increasing leverage, short-term funding, and maturity mismatches in the financial sector (Brunnermeier and Pedersen 2009; Adrian and Shin 2010, 2014; Adrian and Boyarchenko 2016). Looser capital constraints increase leverage of the marginal investor, reducing risk premiums on assets (He and Krishnamurthy 2013). Improvements in the prospects of businesses can increase lending but reduce underwriting standards when banks have private information about borrowers (Dell'Ariccia and Marquez 2006). Similarly, local currency appreciation is associated with

improved balance sheets of local borrowers and more highly leveraged banks, which links financial stability to shocks to exchange rates (Bruno and Shin 2014).

12. When more firms and managers are engaged in the same activities, payoffs for higher risk may increase. That is, investment mandates and agency costs can lead to higher correlation in increased risk-taking behavior. For example, there may be more competition to lend in boom periods, which leads to less screening of potential borrowers and more loans being made. Managers often are compensated based on relative performance and will do better if they have losses at the same time as their competitors (Morris and Shin 2014). More highly correlated behavior increases the risks of systemic banking crises and deeper fire sales.

13. The degree of international financial integration has increased dramatically in the past few decades, also increasing correlations across countries. There is ample evidence that more global financial integration and interconnectedness can lead to more transmission and amplification of shocks through international capital flows. Empirical studies of correlations of asset prices across countries find evidence of contagion (comovement of returns not related to fundamentals) in response to exogenous shifts in risk preferences, and spillover effects from distress in the US financial sector depend on the resilience of the domestic banking sector and credit market conditions (see Agenor and Pereira da Silva 2018 for a comprehensive review of studies of financial spillovers across countries).

14. In addition, increases in the complexity of the financial system that lead to loss of information can result in greater overall uncertainty and nonlinear outcomes. Flight to quality episodes are triggered by events and unexpected correlations. These make the risk management models investors rely on obsolete, and they disengage given Knightian uncertainty (Caballero and Krishnamurthy 2008). Beliefs based on extrapolating the past and neglecting downside risks can explain why the price of risk can be very low for prolonged periods (Gennaioli and Shleifer 2018). Neglected downside risks can rationalize how financial systems can become highly leveraged as agents leverage up when they share the belief that the price of risk is unlikely to increase sharply and that other agents are somehow protected from negative shocks.

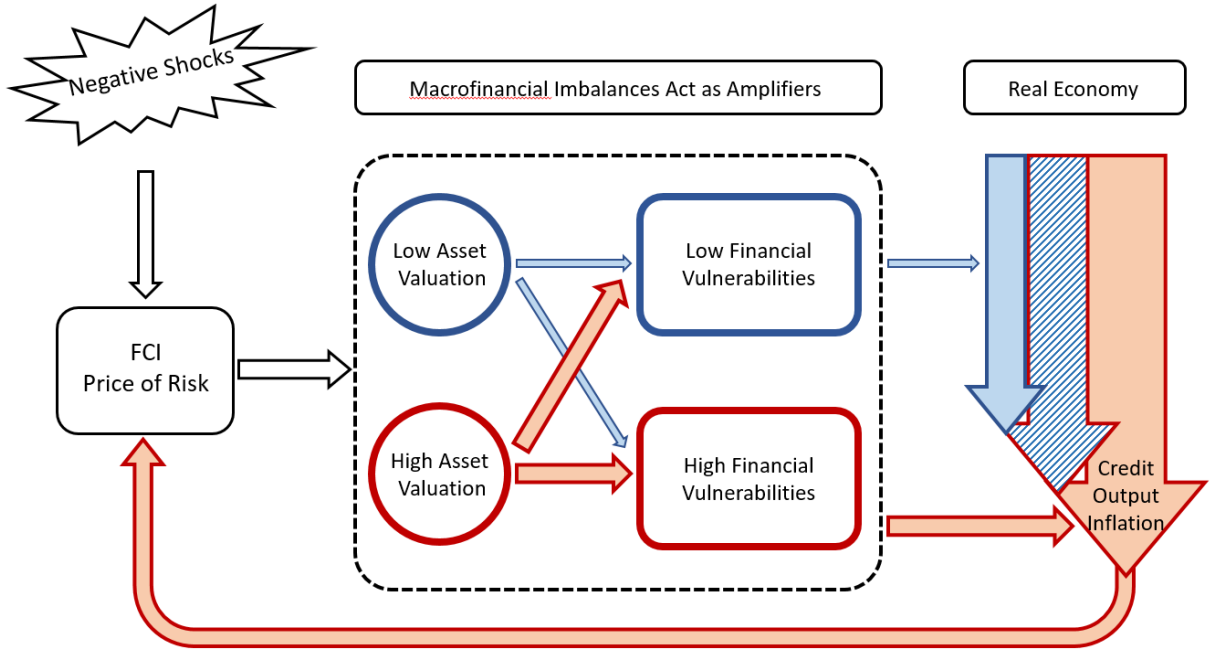
15. Compressed risk premiums can be expected to be followed by a reversal of valuations. For example, periods of narrow risk premiums for corporate bonds are a useful predictor of negative returns in subsequent years, which in turn is associated with a contraction of output likely owing to a pullback in credit supply (López-Salido, Stein, and Zakrajšek 2017). Leverage cycles can also arise as more optimistic investors that are leveraged need to sell assets, leaving them in the hands of more pessimistic buyers who value the assets less (Geanakoplos 2009).

16. These vulnerabilities increase financial stability risks and the likelihood of negative externalities of contagion and fire sales. Fire sales will lead to lower prices and losses for the seller, but also losses for other holders. If other holders are constrained, they too may be forced to sell. Through negative feedback loops, fire sales can trigger a sharp contraction in credit and decrease in real output.

B. Financial Vulnerabilities and Amplification of Shocks

17. Negative shocks cause the price of risk to increase, and the effect on the real economy will depend on the degree of vulnerability (Figure 2). A first amplification effect of a negative shock and an increase in the price of risk is a fall in asset prices. The size of the fall will depend on whether assets are undervalued or overvalued, with sharper price falls if assets are overvalued (high asset valuations). A second amplification effect of an increase in the price of risk is through financial vulnerabilities. A repricing of assets will be amplified if financial firms are highly leveraged and are forced to deleverage and sell assets in fire sales, which would lead then to a further repricing (Brunnermeier and Pedersen 2009; Greenwood, Landier, and Thesmar 2015). The net worth of borrowers falls and risk-management constraints of lenders become binding, leading to declines in credit, output, and inflation.

Figure 2. Transmission and Amplification of Shocks and Risks to the Macroeconomy



Source: IMF staff.

Note: FCI = financial conditions index.

18. Risks to financial stability, measured as downside risks to output growth, will be greatest when both asset price valuations and financial vulnerabilities are high (the red circle and red rectangle in Figure 2). Declines have the potential to lead to a negative feedback loop between output, price of risk, and thus fire sales and contagion as elevated asset prices and high vulnerabilities unwind, leading to sharp nonlinear declines in growth. When both asset price valuations and financial vulnerabilities are low (the blue circle and blue rectangle in Figure 2), an

increase in the price of risk from a negative shock will have a much more muted effect on asset prices and credit supply, and thus the economy. If instead financial vulnerabilities are low when asset valuations are high, the effect of an increase in the price of risk likely would be a large rise in financial market volatility but not a substantial magnification of consequences for output, especially if monetary policy can respond to increase aggregate demand. An oft-cited example is the deflating of the tech bubble in the United States in 2000, which resulted in a modest recession with little imprint on financial intermediaries.

19. This framework implies that the costs of preventing high financial vulnerabilities have the benefits of mitigating a steep rise in the price of risk and sharp downside risks to output growth in the event of a large adverse shock. Policies aimed at slowing the buildup or reducing financial vulnerabilities will likely impose costs at times when risks are not necessarily apparent. That is, policies focused on making the financial system more resilient, and thus less likely to amplify shocks, will result in a higher price of risk in periods with small negative shocks and low volatility.

MATRIX OF VULNERABILITIES TO MEASURE FINANCIAL STABILITY RISKS

20. The financial vulnerabilities considered in this financial stability framework are shown below in two matrices (Figures 3 and 4), with selected examples of indicators that would be monitored and tracked over time. The column headings are broad financial vulnerabilities, including asset price valuations and market liquidity, leverage, maturity and liquidity mismatch, external debt claims and currency mismatch, and interconnections and complexity. The row headings are different parts of the financial sector or markets. The matrix form highlights the commonality of vulnerabilities, such as leverage, across a wide variety of financial firms (banks, nonbanks, and market-based intermediaries) as well as different parts of the nonfinancial sector (households, businesses, and governments). Likewise, valuations and market liquidity and functioning can be monitored across many types of asset markets, such as sovereign, corporate, equity, foreign exchange, and real estate. Entries in the cells are shown only for illustration of concepts that analysts should try to capture.

21. Many of the variables are the same as those that track financial conditions and credit availability for regular macroeconomic forecasting. But the focus for financial stability is on the degree to which they would amplify a negative shock and create negative externalities. For example, lower borrowing costs and higher credit availability to households and businesses are considered a standard transmission channel for monetary policy, but when accompanied by compressed risk premiums and weak underwriting standards, the likelihood of externalities and nonlinear amplification effects would be higher.

Figure 3. Macro-Financial Imbalances: Asset Markets

Examples of indicators that can be monitored

	Asset Price Valuations and Market Liquidity
Short-term Funding	LIBOR-OIS spreads
Sovereign Debt	Term premiums Risk spreads Volatility Market depth Trading volumes
Corporate Debt	Risk premiums Underwriting standards Market depth Trading volumes
Equities	Equity risk premium Implied volatility Volatility risk premium Market depth Trading volumes
Foreign Exchange	Cross-currency swaps FX implied volatility Market depth Trading volumes
Real Estate—Residential	House price growth House-price-to-rent deviation Lending standards
Real Estate—Commercial	Commercial property price growth Commercial-price-to-income deviation Lending standards

Source: IMF staff.

Note: FX = foreign exchange; LIBOR = London interbank overnight rate; OIS = overnight indexed swap.

Figure 4. Macro-Financial Imbalances: Financial Vulnerabilities

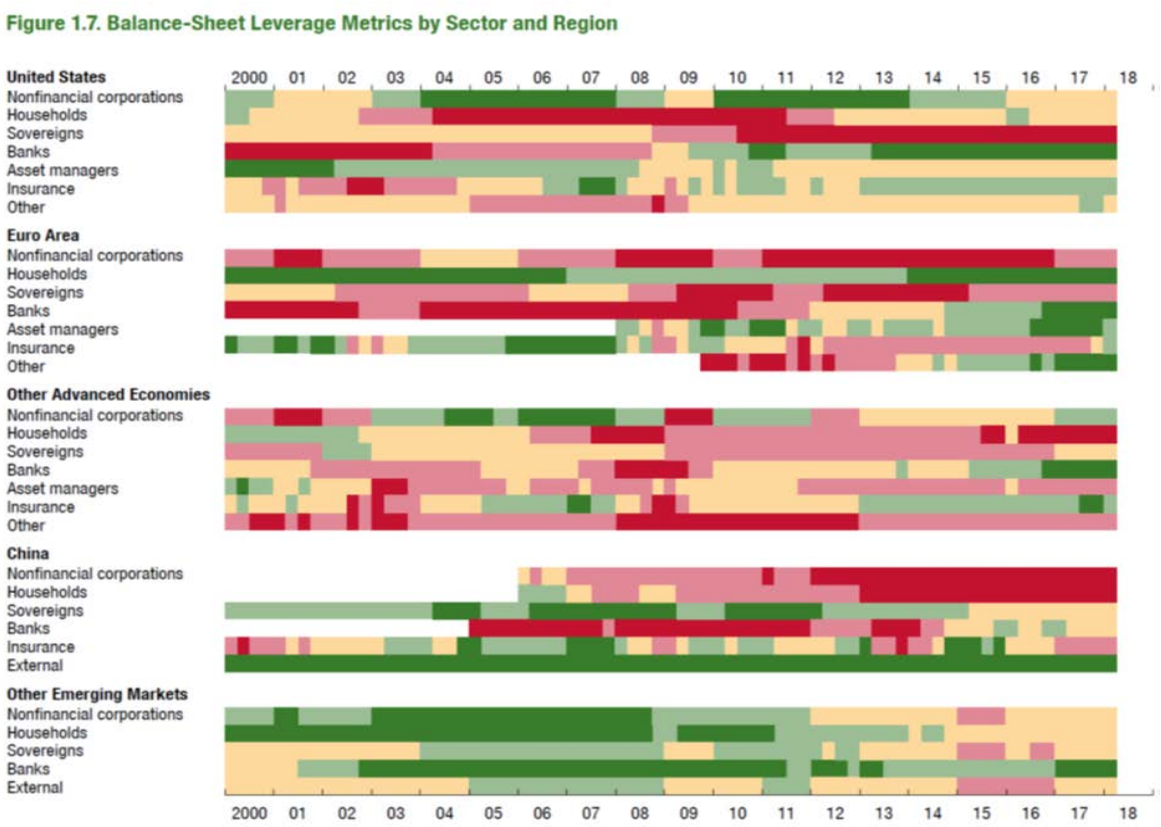
Examples of indicators that can be monitored

	Leverage	Maturity and Liquidity Mismatch	External Debt Claims and Currency Mismatch	Interconnections and Complexity
Banking Sector, Depository Institutions	- Regulatory capital - Stress test capital - Market-based capital measures - Off-balance-sheet assets and derivatives	- Short-term wholesale funds ratio - Liquid asset ratios - Regulatory liquidity - Asset-liability duration gap - Collateral eligible for the discount window	- US$ funding needs - Cross-border funding - Reliance on cross-currency FX swaps	- Interbank claims - Nonbank financial claims - Cross-border activities - Price-based systemic risk measures
Nonbank Financial Firms and Market-Based Finance	- Regulatory capital - Leverage ratios - Off-balance-sheet assets and derivatives - Securitizations (risk retention) - Margin credit - Collateralized borrowing and haircuts	- Short-term wholesale funds ratio - Carry trades - Open-end funds and exchange-traded funds (with less liquid assets)	- Open-end and other funds invested in foreign debt	- Claims on banks - Claims on other nonbank institutions - Financial innovations that introduce complexity - Common business models (e.g., index funds)
Central Counterparties (CCPs)	- Capital - Default fund - Margins - Credit lines	- Liquidity lines		- Members provide services to CCPs - Members are connected to multiple CCPs
Private Nonfinancial—Households	- Credit to GDP - Credit growth - Debt service - Lending standards	- Debt with adjustable rates		- Debt overhang - Home foreclosure externalities
Private Nonfinancial—Business	- Credit to GDP - Credit growth - Interest coverage - Lending standards	- Short-term debt - Adjustable-rate debt - Liquid assets - Liquidity and depth of securities market	- Debt issued in foreign currencies	
Government Sector	- Government debt to GDP - Debt growth - Off-balance-sheet liabilities	- Debt maturity profile - Short-term debt - Liquidity and depth of market	- External debt - US dollar versus local currency debt - Short-term debt to foreign exchange reserves - Capital flows	

Source: IMF staff.

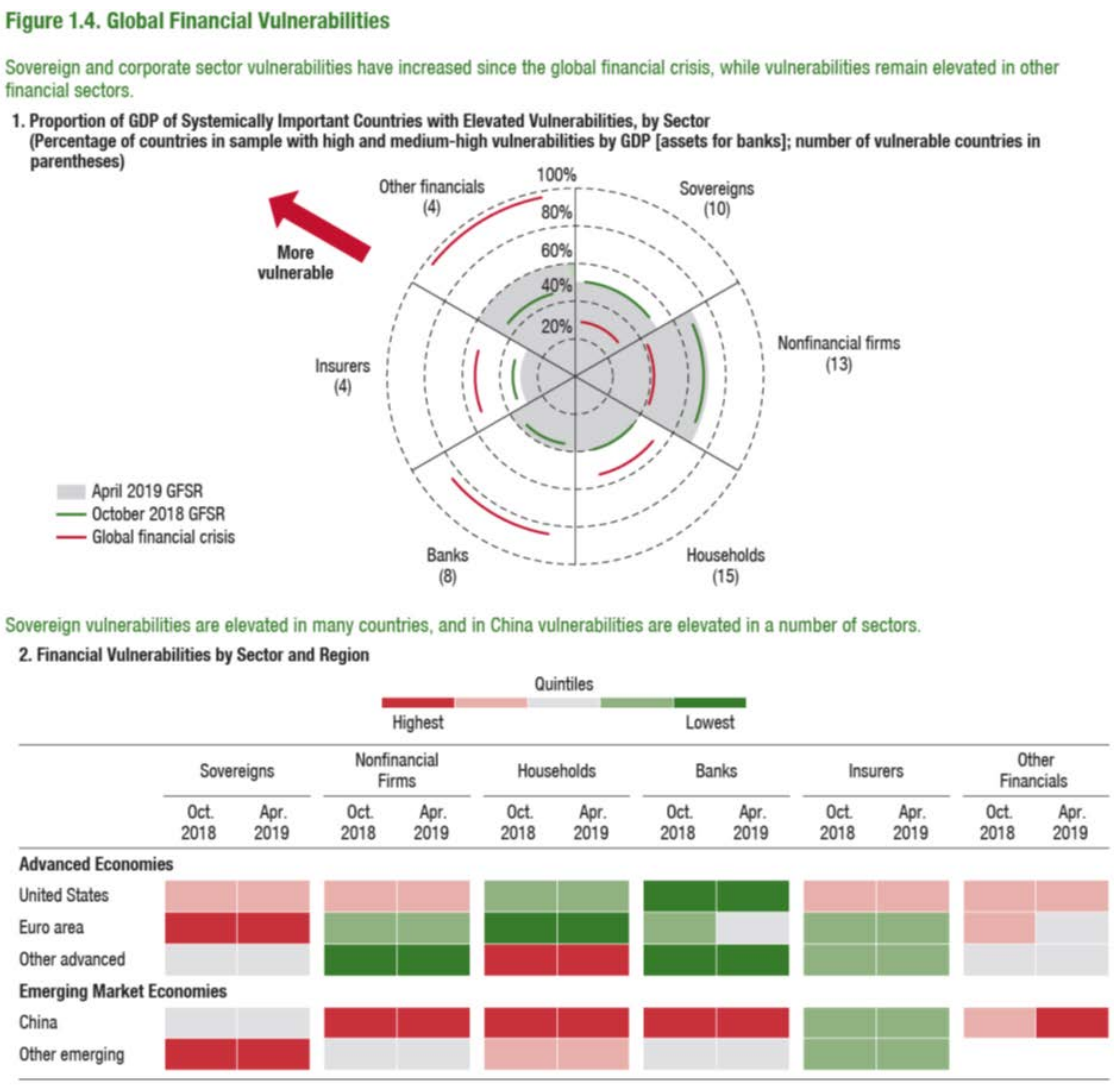
22. The first chapters of recent GFSR reports have highlighted various parts of these matrices. These measures are consistent with IMF guidance developed for bilateral advice (IMF 2014). For example, valuation metrics for equities, corporate bonds, and house prices for some major countries and regions were shown in the October 2017 and April 2018 GFSR reports. Measures of leverage based on balance sheets were discussed in the October 2018 GFSR for several countries and regions (Figure 5). In the most recent, April 2019, GFSR an index of financial vulnerability by sector for some countries and regions is illustrated by a spider chart (Figure 6).

Figure 5. Balance-Sheet Leverage by Sector and Region



Source: IMF, Chapter 1 of the October 2018 *Global Financial Stability Report*.

Figure 6. Financial Vulnerabilities by Sector and Region



Source: IMF, April 2019 *Global Financial Stability Report* (GFSR).

23. These types of presentations emphasize the value of greater consistency of measures across countries to improve multilateral surveillance over time. These figures would have flagged some key vulnerabilities ahead of the financial crisis, such as high household leverage in the United States (Figure 5) and high vulnerabilities in banks and nonbank financial institutions globally (Figure 6). Nonetheless, the framework needs to be flexible and able to incorporate other potential emerging vulnerabilities because the specific manifestation of vulnerabilities that will pose substantial risks to financial stability in the future may differ from those that led to high risks in the past.

24. Filling out the matrices in Figures 3 and 4 could be challenging for many countries or regions because of lack of data. However, while such data may not be available initially, establishing a regular monitoring matrix should foster investment in better, more consistent data that will allow for deeper analysis of the metrics and better empirical models once the data are filled in. Also, the matrices are designed to be flexible, so that they can adjust with changes in the financial system and incorporate financial innovations that affect risk-taking and correlated behavior.

AGGREGATE MEASURE OF FINANCIAL STABILITY RISKS: GROWTH-AT-RISK APPROACH

25. This section describes the GaR measure of financial stability risks for multilateral surveillance. GaR is a summary top-down measure of risks to financial stability arising from financial conditions.[3] It captures downside risks to GDP growth, which is especially useful when financial conditions affect different parts of the distribution in different ways. Specifically, GaR is defined as a low percentile of the conditional GDP growth distribution; the lower 5th percentile of the distribution is chosen here, though other percentiles are possible. That is, a GaR value indicates that there is a 5 percent probability that forecast growth will be lower than that value. GaR was introduced in the GFSR in April 2017, and the GaR estimates presented in the discussion that follows represent continued work to improve the methodology and broaden its applicability. The discussion then presents a term structure of GaR—that is, how it varies over a projection horizon of three years based on initial financial conditions. The term structure illustrates whether or not looser financial conditions that reduce downside risks in the near term can be sustained into the medium term.

26. GaR has important benefits for policymaking because it expresses risks directly in terms of output growth, which is ultimately the metric for welfare. Summary measures of financial stability risks could also include measures of the cost of fire-sale externalities in terms of loss of bank capital (Greenwood, Landier, and Thesmar 2015), the probability of multiple bank failures (Jin and De Simone 2014), or conditional value at risk (Adrian and Brunnermeier 2016), but those measures are not easily translated into risks in terms of economic activity. Work is ongoing to model how macroprudential and monetary policies would affect GaR. Thus, the current GaR framework does not offer policy prescriptions.

A. Estimating Growth at Risk

27. To illustrate the measure, the discussion first presents the results from empirical estimations based on two panels, one of 11 advanced economies and another of 11 emerging market economies. The GDP growth distribution is forecast as a function of a financial conditions index, GDP growth, inflation, and indicators of financial vulnerabilities, specifically credit growth and

[3] See Prasad and others (2019) for the use of GaR in bilateral surveillance and a description of some country case studies.

a dummy variable for a credit boom, a dummy variable for each country, and a constant. The analysis uses quantile regressions, which allow for more general modeling of the functional form of the GDP distribution.

28. FCIs are constructed for each country to capture funding and credit costs, which represent the underlying price of risk. The FCIs are estimated by controlling for current macroeconomic conditions, and thus are more than a measure of the unconditional cost of funds.[4] Up to 17 variables are used, including domestic and global financial price indicators, corporate credit risk spreads, equity prices, volatility, and foreign exchange for each country. [5] In addition, financial vulnerabilities are measured by growth in credit to GDP (Borio, Drehmann, and Tsatsaronis 2011 show the importance of credit) and a credit boom dummy variable, which is the interaction of high credit-to-GDP growth and a high FCI. These conditions represent the type of environment when risk-taking would be greatest.

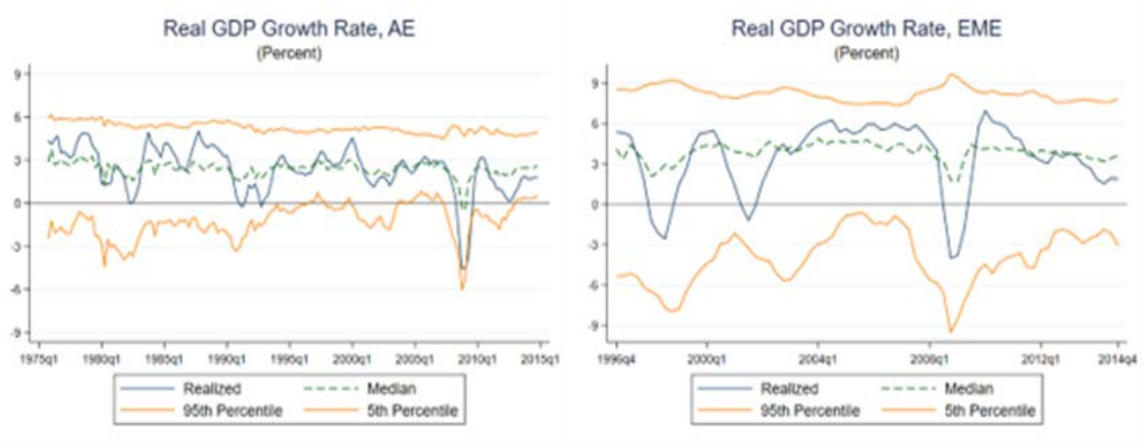
29. Figure 7 illustrates key features of the distribution of forecast GDP growth and indicates that volatility is not constant and risks to GDP growth are more skewed to the downside than upside. The one-year-ahead distribution of forecast GDP growth shows that when the median projected growth is lower, so is the 5th percentile. In contrast, there is little variability at the 95th percentile, suggesting greater variability for downside risk than upside risk. The differences in variability emphasize the importance of risks around a central tendency for growth and of measures of financial stability risks that can capture changing volatility.[6]

[4] The FCIs are estimated based on Koop and Korobilis (2014) and build on a time-varying parameter vector autoregression model (Primiceri 2005). See Adrian, Grinberg, Liang, and Malik (2018) for more details.

[5] The variables include interbank spread, corporate spread, sovereign spread, term spread, equity returns, equity return volatility, change in real long-term rate, MOVE, house price returns, percent change in the equity market capitalization of the financial sector to total market capitalization, equity trading volume, expected default frequencies for banks, market capitalization for equities, market capitalization for bonds, domestic commodity price inflation, foreign exchange moves, and VIX. These data are the same as those used to construct the FCIs that were used in the October 2017 GFSR. We use a more general flexible method to control for current macroeconomic conditions and to account for the lack of availability of some data for the full estimation period. We also exclude two credit variables because we are interested in the interaction of price terms and credit and thus do not want credit to also be in the FCI, although this change does not materially change the FCI when most other data series are available.

[6] Notably, the conditional distribution for inflation forecasts does not exhibit the same degree of asymmetry, suggesting constant variance is a more reasonable assumption.

Figure 7. One-Year-Ahead GDP Growth Forecasts Conditional on Financial Conditions



Source: Adrian, Grinberg, and others (2018).

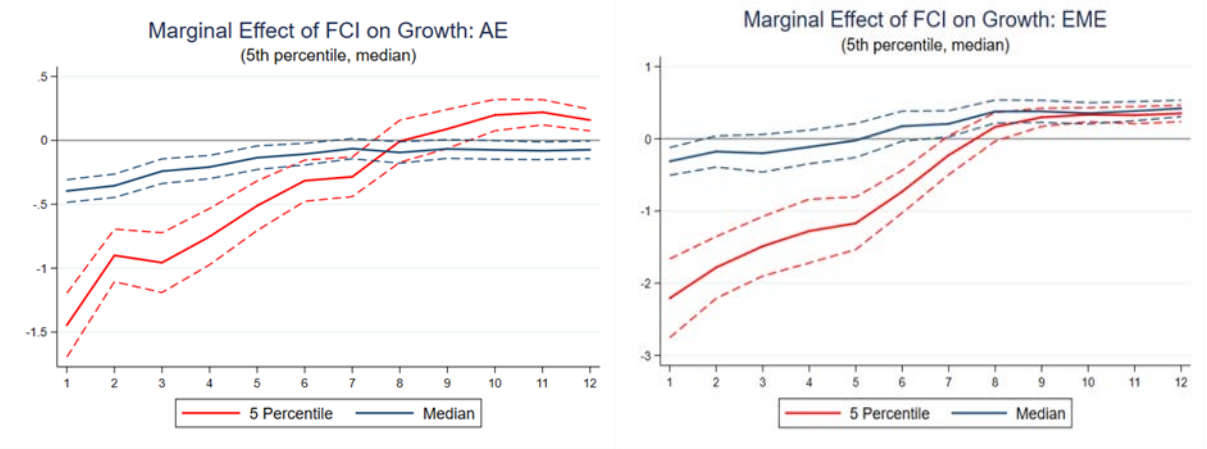
Note: AE = advanced economy; EME = emerging market economy.

B. Estimating the Term Structure of Downside Risks

30. Figure 8 illustrates that the effects of financial conditions on the median and 5th percentile of GDP growth vary over the projection horizon. Coefficient estimates of the FCI for the lower 5th percentile (red line) from panel quantile regressions differ significantly from coefficients for the median (blue line) over the near-term projection horizon for both advanced economies and emerging market economies.[7] The negative coefficients in near-term quarters for the 5th percentile are economically large and negative, indicating that the marginal effects of looser financial conditions (a decrease in the FCI) are a significant decrease in downside risk. The larger changes in the coefficients for the 5th percentile relative to the median over the projection horizon illustrate that the expected growth distribution shifts significantly over the projection horizon. Moreover, the reversal in the signs of the coefficients on FCI for the 5th percentile suggests that there is an important intertemporal trade-off for loose financial conditions—that reduced downside risks in the near term are not sustained and abate significantly in the medium term.

[7] GDP growth is defined as average quarterly growth for the cumulative period ending in quarters 1 through 12, at an annual rate.

Figure 8. Estimated Coefficients on FCI for GaR and Median Growth, Advanced Economies and Emerging Market Economies



Source: Adrian, Grinberg, and others (2018).
Note: The panels plot the estimated coefficients on the financial conditions index (FCI) from panel quantile regressions for the median and the 5th percentile (GaR) for one to twelve quarters into the future. Estimates are based on local projection estimation methods, and standard errors are from bootstrapping techniques; bands represent plus or minus one standard deviation. Advanced economies (AEs) comprise 11 countries, with data for most from 1973 to 2017. Emerging market economies (EMEs) comprise 11 countries, with data for most from 1996 to 2017.

31. The shift in the conditional distribution of GDP growth is consistent with buildups of macro-financial imbalances over the projection horizon in response to loose financial conditions, consistent with research on macro-financial linkages. When financial conditions initially are loose and risk management constraints are less binding, projected GDP growth is higher and its distribution is tighter. However, the loose financial conditions allow vulnerabilities to build through various mechanisms when there are financial frictions, which then leads to a sharper rise in downside volatility of GDP growth when the system is hit by a shock. The change in coefficients is consistent with a leverage cycle, as in Geanakoplos (2009) or Adrian and Shin (2010), which highlights an intertemporal trade-off where loose financial conditions raise growth and reduce volatility in the near term, but increase volatility in the medium term because of endogenous buildups of vulnerabilities.

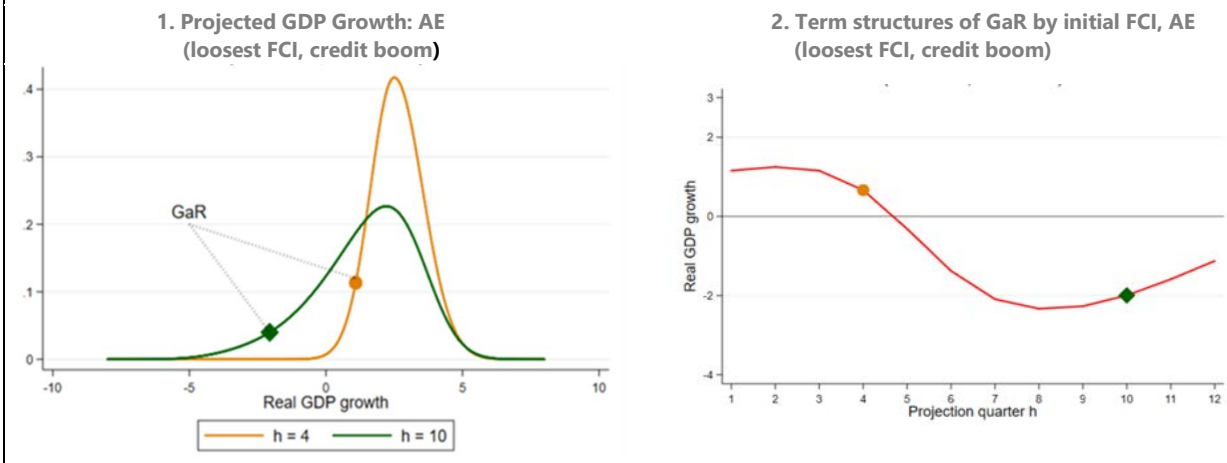
32. The probability distribution for projected GDP growth can be depicted for a representative country for selected forecast quarters to illustrate GaR and its term structure. In particular, the forecast growth distributions for an average country in the panel of 11 advanced economies for two projection periods h, at 4 and 10 quarters, conditional on an initial loosest FCI (top 1 percent) and a credit boom (interaction of high credit growth and loose FCI), shown in Figure 9, panel 1, illustrates two concepts: first, the distribution in the near term (at projection quarter h = 4, gold line) has a higher median and lower variance than the distribution in the medium term (at

projection quarter h = 10, green line). Second, the distribution in the near term has a much smaller left tail (less downside risk) than the distribution in the medium term.[8] That is, downside risk is much greater at ten quarters ahead than at four quarters ahead.

33. The probability distribution can be estimated for each forecast quarter h, and the 5th percentile for each h can be plotted to trace out the term structure of GaR, as shown in the right panel. The term structure of GaR conditional on high FCI and a credit boom, shown in Figure 9, panel 2, illustrates that downside risks are lower in near-term quarters than in quarters further ahead, indicating that the lower tail of the forecast growth distribution gets fatter over time.

34. Many studies have linked financial conditions to expected growth; indeed, monetary policy typically affects the economy through its impact on financial conditions. But the analysis shows that financial conditions disproportionately affect the lower tail of the distribution of forecast growth. Moreover, the effect of financial conditions switches signs over the projection horizon, with initial looser financial conditions reducing downside risks to growth in the near term but increasing downside growth risks in the medium term. These results are robust to other estimation techniques. However, lack of data or less significant effects of financial sector risk-taking and credit on expected growth are limitations of applying this model to every country.

Figure 9. Probability Distribution of Forecast GDP Growth and Growth at Risk for Loose Financial Conditions and a Credit Boom



Source: Adrian, Grinberg, and others (2018).

Note: AE = advanced economy; FCI = financial conditions index; GaR = growth at risk.

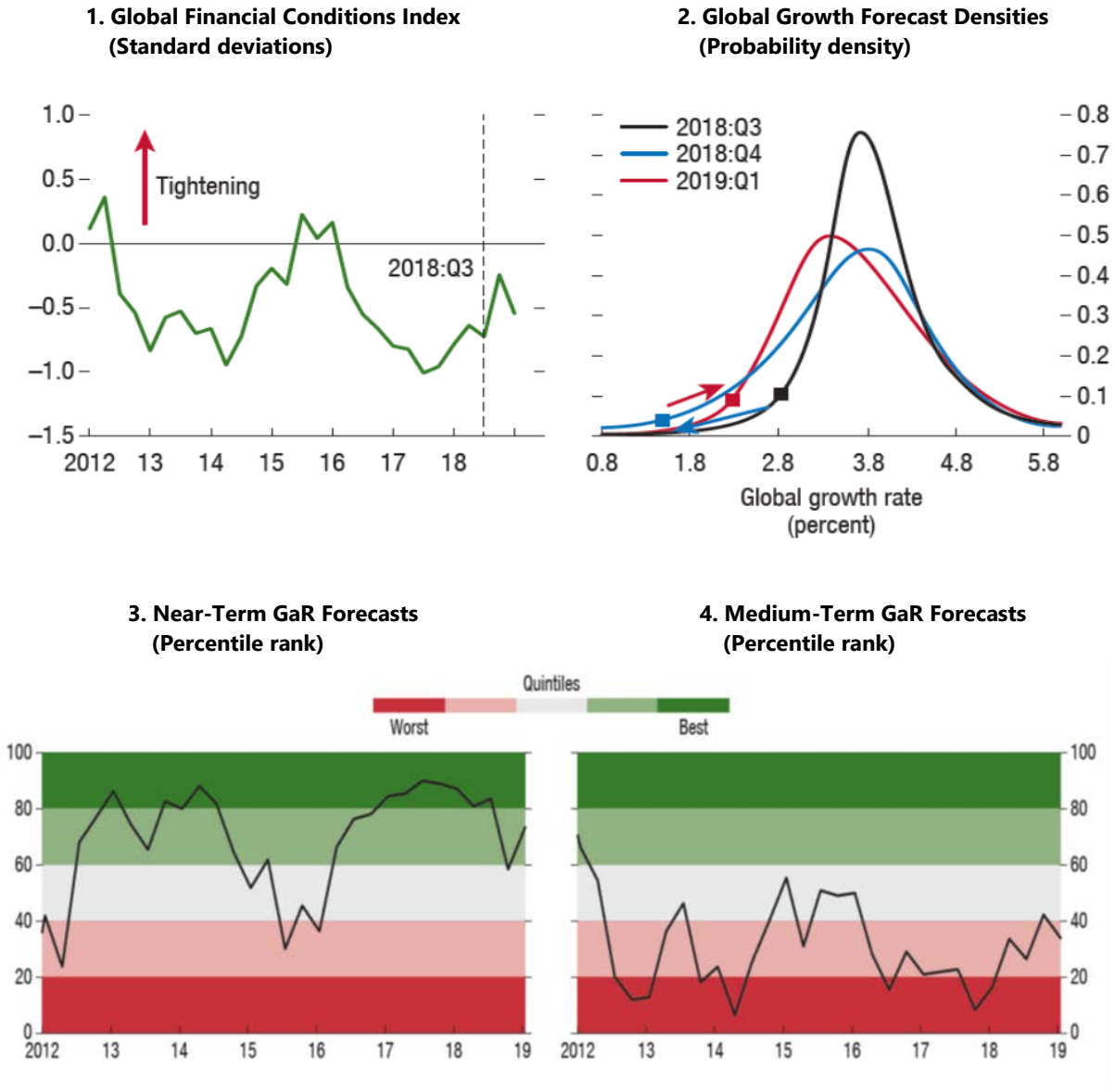
[8] The distribution shown is the average for the panel of advanced economies and is one possible presentation approach for multilateral surveillance. Another approach would be to show a weighted average, based on country GDP or financial sector importance to GDP aggregated up to advanced economies and emerging market economies separately or to advanced economies and emerging market economies combined.

C. Quantifying Downside Risks to Global GDP in the Near Term and Medium Term

35. Global GaR, estimated using global GDP and a global FCI, was first used to communicate an aggregate top-down view of financial stability risks in April 2018 (Chapter 1 of the GFSR). The methodology for GaR had been introduced earlier in Chapter 3 of the GFSR in October 2017. Global GDP is the aggregate GDP for 43 countries. The global FCI is based on financial conditions indices for these areas, including the 29 jurisdictions with systemically important financial sectors.

36. The April 2019 GFSR expanded on how this financial stability monitoring framework is being implemented. In particular, there was more consistent reporting of financial conditions, financial vulnerabilities by sectors, and GaR (country, region, or global). The global FCI is shown in Figure 10 (panel 1), and it loosened from the previous quarter, though was not as loose as at the time of the October 2018 GFSR (denoted by 2018:Q3). Conditional on global FCI, the densities of forecast global growth for one-year ahead (panel 2) suggested an improvement in the outlook for downside risks at the time of the April 2019 GFSR relative to the previous quarter. The one-year-ahead GaR forecast (panel 3) rose to near the upper range of its historical distribution. However, GaR forecasts for three years ahead (panel 4) are less favorable, though they suggest downside risks are less severe than forecast in late 2017, when very loose global financial conditions set the stage for a possible buildup of vulnerabilities.

Figure 10. Global Financial Conditions Index and Growth-at-Risk Estimates



Source: IMF, April 2019 *Global Financial Stability Report*.

Note: GaR = growth at risk.

37. While global GaR does not attribute the medium-term downside risks to any particular vulnerability, indicators in the monitoring matrices can help identify possible contributors. One likely contributor is greater indebtedness of borrowers, which had been rising in some countries or regions and in some sectors in recent years. The spider map and heat map of financial vulnerabilities (Figure 6) highlight elevated sovereign debt, household debt, and nonfinancial

business debt in a number of regions, in addition to high leverage at banks and other financial firms in China as sources of financial vulnerability.

38. A future measure of global GaR could try to capture financial vulnerabilities and cross-border interconnections. Work will continue to improve on GaR measures in two ways. First, indicators of financial vulnerability, as in Figure 6, can be included in estimates of global GaR in the future, similarly to the way they were included in the panel estimates discussed in the previous section. This will allow a richer assessment of which vulnerabilities present significant risks. Second, contributions by individual countries to global GaR may vary in ways that are not reflected solely by GDP weights. The difference in potential contributions can be seen by the high variability in vulnerabilities. Differences in contributions might also arise because of differences in the degree of interconnection to global activity or because a country is a more significant financial center than another country of similar size. The Adrian and Brunnermeier (2016) conditional value at risk method to estimate systemic risk contributions might be one way to develop this new global GaR measure. These authors define conditional variance of risk as a metric for systemic risk contribution, based on value at risk as a metric of risk.

VULNERABILITIES AND MACROPRUDENTIAL POLICY TOOLS

39. A systematic approach to monitoring cyclical risks to financial stability is the foundation for implementing better macroeconomic stabilization policies. An IMF guidance note (2014) for bilateral surveillance provides a link between types of financial vulnerabilities illustrated in the matrix in Figure 4 and the types of macroprudential tools that could be used to address them. The approach for multilateral surveillance discussed in this paper also can foster better policies globally, even when policies are implemented by domestic authorities. A global GaR could provide insight on cross-country financial spillovers that could feed into multilateral and bilateral advice. This is becoming more important as the degree of international financial integration has been increasing dramatically.

40. The IMF recently launched a new annual survey on the use of macroprudential policies (IMF 2018), and the policies can be mapped to the financial vulnerabilities in the matrices shown in Figures 3 and 4. The initial survey was sent in early 2017 and asked countries to self-report the use of macroprudential tools across categories of tools that relate to potential sources of vulnerabilities (identified in IMF 2014). Tools include those that would apply to credit exposures of banks, liquidity and foreign exchange mismatches of banks, liquidity and fire-sale risks of nonbanks, and risks from systemically important financial institutions. The survey also reports on institutional frameworks for setting macroprudential policies, including the role of the central bank, financial regulators, and financial stability committees. In this way, the survey links the work on monitoring financial stability risks to assessing targeted macroprudential policy tools that countries could use to reduce those risks.

41. The survey finds that many countries had the authority and used structural macroprudential tools to reduce balance sheet vulnerabilities at banks. Most countries report the availability of tools to manage leverage and liquidity in the banking sector and insurers (Figure 11). Many also report tools to manage banks' risks from exposures to households and businesses. For liquidity and FX mismatches, the liquidity coverage ratio, net stable funding ratio, and net foreign exchange positions were the three most used tools. However, fewer countries reported having the authority or using tools to address maturity and foreign exchange (FX) mismatch vulnerabilities of nonbank lenders or financial markets in which banks and nonbanks participate. Systematic reporting of matches by authorities and use of tools by countries with elevated financial vulnerabilities are an important element of multilateral surveillance for the GFSR.

Figure 11. Macroprudential Tools for Addressing Financial Vulnerabilities

Table 1.3. Availability/Use of Prudential Tools for Different Types of Vulnerabilities

	Balance Sheet Vulnerabilities							
Sectors	Leverage[1]	Liquidity[2]	Maturity[3]	FX Mismatch[4]	Leverage[1]	Liquidity[2]	Maturity[3]	FX Mismatch[4]
	Countries that Have Relevant Prudential Tools (as percent of all countries)				Countries with Elevated Vulnerabilities and Relevant Prudential Tools (as percent of all countries with elevated vulnerabilities)			
Banks	97	97	21	45	100	100	24	38
Nonbank financials								
Insurers	89	84	0	79	33	50	NA	NA
Other financials	55	62	3	0	50	71	0	NA
Nonfinancial sector (borrower-based tools applied through banks)								
Corporations	69	0	3	17	78	0	0	NA
Households	72	0	24	10	80	NA	NA	NA

Sources: Bank for International Settlements; Bank of Japan; Bloomberg Finance L.P.; China Insurance Regulatory Commission; European Central Bank; Haver Analytics; IMF, Financial Soundness Indicators database; IMF, Macroprudential Policy Survey; S&P Global Market Intelligence; S&P Leveraged Commentary and Data; WIND Information Co.; and IMF staff calculations.

Note: Based on the sample of 29 jurisdictions with systemically important financial sectors. The assessment of vulnerabilities is based on the analysis shown in Figure 1.4. Elevated vulnerabilities refer to countries/sectors with a percentile rank in the respective vulnerability exceeding 60 percent. Cells highlighted in blue have entries below 50 percent, which should be interpreted to mean that 50 percent or more of systemically important countries do not have any prudential tools to address specific vulnerabilities. Some of the reported tools can be classified as microprudential. Based on the available information, it is not always possible to clearly distinguish between availability and use. FX = foreign exchange; NA = not available; NBNI = nonbank noninsurers.

Source: IMF, April 2019 *Global Financial Stability Report*.

42. The survey, by providing more comprehensive data, also facilitates much-needed research to evaluate the effectiveness of alternative policies to improve the practice of setting macroprudential policies. Research findings to date suggest some success in reducing vulnerabilities with macroprudential tools, but experiences have been limited. For example, Cerutti, Claessens, and Laeven (2015) find borrower-based tools, such as loan to value and debt service to income, can significantly reduce household credit growth, but the effects are smaller in open economies, and there is some evidence of avoidance as the use of tools comes with greater cross-

border borrowing.[9] Akinci and Olmstead-Rumsey (2018) also find significant effects for tightening loan to value, debt service to income, and other housing measures on credit and house prices, though mostly in emerging market economies.

43. The survey also emphasizes the institutional structures for setting macroprudential policies and provides valuable data for more research on what structures are effective for taking actions to reduce financial stability risks. Based on responses from 111 countries that report having a macroprudential authority, 80 countries indicate a significant role for the central bank consistent with IMF principles on macroprudential policy based on research that suggests more timely action by central bank leadership to reduce credit growth (IMF 2014). More recent research documents the rapid growth of multiagency financial stability committees since the global financial crisis and the increased role of the Ministry of Finance in setting policies (Edge and Liang 2019). The increasingly wide range of practices and limited evidence on effectiveness indicate that it is important to better understand the motivations for these structures and the implications for macroprudential policymaking.

44. Further research will allow for counterfactual policy analysis for the joint setting of macroprudential and monetary policies to achieve growth and stability. Adrian and Duarte (2017) add financial vulnerability to a commonly used model of the macroeconomy, specifically a New Keynesian model, and show that optimal monetary policy would differ from a standard Taylor rule, even when monetary policy pursues an inflation target. Additional work to add macroprudential policy is ongoing (see Adrian 2018).

CONCLUSIONS

45. This paper describes the conceptual framework in the GFSR, which has been evolving for multilateral surveillance to enhance transparency and communication about the assessment of cyclical financial stability risks. It is grounded in macro-financial linkages—those that link the financial sector to macroeconomic growth and stability. Research has highlighted that many macro-financial linkages had been overlooked by policymakers and academia in the run-up to the global financial crisis. While some vulnerabilities, such as high borrower leverage or significant maturity mismatch in financial firms, have been found to be common to many financial crises, the conceptual framework emphasizes that monitoring also should look ahead for different manifestations of vulnerabilities, especially as financial integration across countries has been increasing.

46. In addition, the new GaR measure emphasizes the importance of paying attention to the entire distribution of forecast growth from financial conditions rather than any single point estimates when evaluating growth and stability. Moreover, GaR emphasizes the

[9] Cerutti and others (2016) document that many tools used by those countries have not varied frequently over time, suggesting that many were not used to offset cyclical vulnerabilities: loan to value was the most frequently adjusted, followed by changes in reserve requirements (not for monetary policy purposes).

importance of paying attention to how forecast risks to growth are expected to evolve over time as well, because actions to loosen financial conditions to boost growth and reduce volatility in the near term can incentivize greater risk-taking and lead to a buildup of vulnerabilities, which can increase downside risks to growth in the medium term.

47. The proposed monitoring framework of vulnerabilities will also contribute to more effective macroprudential policies. The framework emphasizes the value of consistent metrics to improve both bilateral and multilateral surveillance, which can improve communication and understanding of financial stability risks among macroprudential policymakers. Combined with better data on the use and effectiveness of macroprudential tools to target specific vulnerabilities, this work provides a foundation for systematic assessments and policy implementation to reduce financial stability risks.

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