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ANALYZING AND MANAGING FISCAL RISKS—BEST PRACTICES

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Informal Session to Brief: Analyzing and Managing Fiscal Risks—Best Practices

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**International Monetary Fund
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ANALYZING AND MANAGING FISCAL RISKS: BEST PRACTICES

May 4, 2016

EXECUTIVE SUMMARY

Comprehensive analysis and management of fiscal risks can help ensure sound fiscal public finances and macroeconomic stability. This has been underscored by the global financial crisis and the more recent collapse in commodity prices, which starkly illustrate the vulnerability of public finances to risk. Indeed, over the past quarter century, governments experienced on average an adverse fiscal shock of 6 percent of GDP once every 12 years, with some of the largest stemming from financial crises.

Countries need a more complete understanding of these potential threats to their fiscal position. Existing fiscal risk disclosure and analysis practices tend to be incomplete, fragmented, and qualitative in nature. A more comprehensive and integrated assessment of the potential shocks to government finances, in the form of a fiscal stress test, can help policymakers simulate the effects of shocks to their central forecasts and their implications for government solvency, liquidity, and financing needs. Comprehensive, reliable, and timely fiscal data covering all public entities, stocks, and flows are a necessary foundation for such analysis.

Countries should also enhance their capacity to mitigate and manage fiscal risks. Fiscal risk management practices are often blunt, ad hoc, and too focused on imposing limits on the creation of exposures. Countries need to expand their toolkits for fiscal risk management and adopt the use of instruments to transfer, share, or provision for risks. In doing so, countries need to weigh the possible benefits from reducing their exposure to shocks against the financial and other costs of the policies that may be needed.

Finally, countries should make greater use of probabilistic forecasting methods when setting long-run objectives and medium-term targets for fiscal policy. The paper illustrates how simple probabilistic tools can be used to map the uncertainty around medium-term trajectories for public debt. In combination with fiscal stress tests, these tools can provide valuable information regarding the probabilities that a country will stay within the debt ceilings embedded in their fiscal rules.

The Fund is playing an important role in supporting improvements in fiscal risk analysis and management among its members. This includes technical assistance in constructing public sector balance sheets; developing institutions and capacity to identify specific fiscal risks and to quantify their potential impact; undertaking fiscal stress tests; and integrating risks into the design of medium-term fiscal targets.

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INTRODUCTION

1. Sound public finances are critical to allow fiscal policy to assist in stabilizing economic activity in the short-run and to promote economic growth over the longer term.

This means that public sector balance sheets must have sufficient room to enable policymakers to provide short-term support to aggregate demand, to scale up public infrastructure where necessary, or to respond to the broad range of other fiscal priorities that may emerge.

2. However, the past decade has served to underscore how shocks to public sector balance sheets can impair governments' ability to exercise good fiscal policy.

The financial sector bailouts after the global financial crisis, the fiscal impact of the great recession that ensued, and more recent collapse in commodity prices, have left public debt ratios at historic highs. These have left many governments less able to respond to macroeconomic shocks or enact policies that could boost long-term growth (IMF, 2015c, 2015e, and 2015f).

3. Better fiscal risk management can help make the public finances more robust. The experience of recent years has underscored the need to better understand the size and nature of these risks and their implications. Being better aware of fiscal risks can allow governments to put in place policies to budget for these more carefully and to take steps, where appropriate, to limit their exposure to shocks. Better understanding of fiscal risks, greater transparency, and effective risk management practices can also help underpin credibility and market confidence (IMF, 2012).

4. Policymakers should also take fiscal risks into account when formulating fiscal targets. Many countries have included public debt ceilings as a part of their medium-term fiscal frameworks. To assess whether policies are consistent with keeping public debt below these ceilings, it is essential to understand the size of fiscal risks and their potential effect on public debt ratios in case they materialize.

5. This paper provides a set of analytical tools and best practices to help policy makers understand and manage fiscal risks. Rather than seeking to provide an alternative to standard debt sustainability analysis, the paper's focus is on how countries can assess and manage fiscal risks more broadly—including tail risks—and to better incorporate uncertainty into fiscal policy analysis. The paper is structured as follows. The next section provides an overview of the scale and nature of fiscal risks, based on a comprehensive survey of 80 countries. This is followed by an assessment of the state of fiscal risk analysis and management, as well as proposed enhancements to both in the form of a new fiscal stress test and an expanded fiscal risk management toolkit. After this, an analytical approach that allows policymakers to assess the implications of fiscal risks for the formulation of fiscal policy is presented. Finally, the paper concludes with a discussion of the priorities in advanced economies (AEs), emerging market economies (EMEs), and low-income countries (LICs) seeking to improve their analysis and management of fiscal risks.

THE SCALE AND NATURE OF FISCAL RISKS

6. Fiscal risks are factors that may cause fiscal outcomes to deviate from expectations or forecasts. Fiscal risks can arise from macroeconomic shocks or the realization of contingent liabilities—that is obligations triggered by an uncertain event (IMF, 2012). These can be either explicit liabilities that are legally grounded (e.g., government loan guarantees) or implicit liabilities, where there is a public expectation of government responsibility not established in law (e.g., to bail out troubled subnational governments).

7. Conventional fiscal risk analysis and forecasting tends to underplay the magnitude, distribution, and impact of potential shocks to the public finances. This reflects, either explicitly or implicitly, a view that fiscal risks are relatively modest in size; independent (i.e., the realization of one risk does not make the realization of any other risk more or less likely); symmetric in nature (i.e., positive shocks are as likely as negative ones); and linear in their impact on the public finances (i.e., the costs/benefits of a shock increase proportionately with its size).¹ In fact, as described below, fiscal shocks tend to be large, adverse, and nonlinear, with potentially material implications for fiscal risk management.

A. Sources of Fiscal Risk

8. Empirical analysis of the sources and nature of fiscal risks calls conventional assumptions into question. In preparing this paper, staff conducted the most comprehensive survey of fiscal risks to date, looking at sources of shocks to government debt in 80 countries between the period 1990 and 2014. Of the various fiscal risks that materialized over this period, whose fiscal impact and likelihood are summarized in Figure 1 and Table 1:²

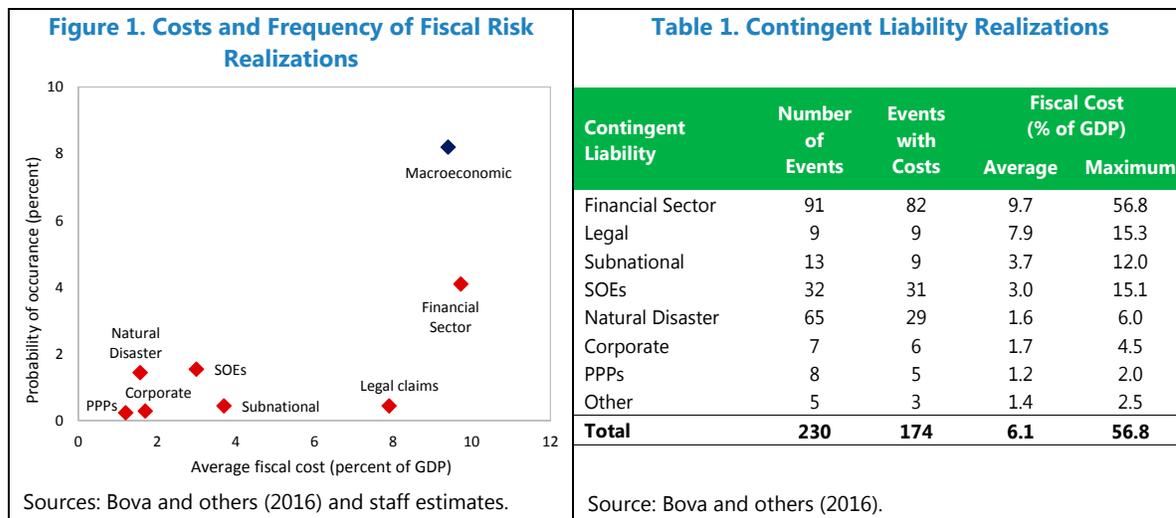
- **Macroeconomic shocks** in the form of sharp declines in nominal GDP growth are relatively frequent and have large implications for public debt. Public finances are typically hit by a macroeconomic shock once every 12 years, with an average fiscal cost equivalent to around 9 percent of GDP.³
- The **financial sector** is an even larger source of shocks to public finances, though less frequent than macroeconomic shocks. Government rescues of troubled financial institutions happen once every 24 years on average, have an average cost of about 10 percent of GDP (and in one case causing a fiscal cost of 57 percent of GDP).

¹ Parliament of Australia (2014) and Irish Fiscal Advisory Council (2015).

² Other than for macroeconomic shocks, all fiscal costs are based on the survey of specific events where contingent liabilities were realized undertaken by Bova and others (2016).

³ Macroeconomic shocks were calculated separately from the survey. Episodes were identified as those where nominal GDP growth falls by one standard deviation relative to its average. The fiscal cost is the loss in revenue resulting from lost output (compared to the case in which nominal GDP had continued to grow at the five year average rate preceding the crisis).

- **Legal cases** are a surprisingly large, but relatively infrequent source of fiscal risk, with demands for government compensation costing around 8 percent of GDP on average and 15 percent of GDP in the most extreme cases.⁴
- **Subnational governments** are also a significant but less frequent source of fiscal risk, with rescues of troubled regional and local governments costing 4 percent of GDP on average, and 12 percent of GDP in extremis.
- **State-owned enterprises (SOEs)** are a potentially significant and common source of fiscal risks, with government bailouts of troubled SOEs costing 3 percent of GDP on average and 15 percent of GDP in the most extreme cases.
- **Private non-financial companies** are a modest and infrequent source of fiscal risk with corporate bailouts or the assumption of debt obligations costing around 1½ percent of GDP on average and 4½ percent of GDP in extreme cases.
- **Natural disasters** are a modest and relatively frequent source of fiscal risks, costing 1½ percent of GDP on average and 6 percent of GDP in extremis. Of course, these averages mask the fact that the frequency and impact of disasters will be much higher for disaster-prone countries, such as Caribbean countries.
- **Public private partnerships (PPPs)** are a relatively modest and infrequent source of fiscal risk, with government rescues of PPP projects costing 1 percent of GDP on average and 2 percent of GDP in extremis.⁵



⁴ The scale of legal costs during the period was heavily affected by court decisions mandating compensation payments for domestic and foreign currency deposits frozen in many Central and Eastern European countries following the collapse of the Soviet Union and the former Yugoslavia.

⁵ While the number and costs of PPP risk realization episodes are low, the use of PPPs has only begun to increase significantly in recent years, and so also has the potential to generate larger fiscal costs in the future.

9. These types of fiscal risks are likely to continue to be a source of stress for countries in all income groups. Economic growth has returned but remains sluggish, spending pressures in many countries are significant, and there are considerable uncertainties regarding prospects for raising revenues. Moreover, vulnerabilities to shocks are also elevated, with public debt levels at historic highs in many countries and interest rates at historic lows. Notwithstanding the fact that significant contingent liabilities have already materialized, particularly those in the financial sector, vulnerabilities on this front remain significant. In AEs, stocks of explicit contingent liabilities remain large—averaging around 50 per cent of GDP in EU countries,⁶ while in EMEs there are significant risks related to state-controlled resource companies, infrastructure projects, and high levels of corporate debt.⁷

B. The Nature of Fiscal Risks

10. The nature of fiscal risks makes them a particular threat to fiscal solvency.

Specifically:

- **Fiscal shocks can be very large:** While year-on-year macro-fiscal volatility tends to fall within a fairly narrow band, countries can occasionally be subject to sudden macroeconomic deteriorations resulting in sharp increases in government deficits and debts. For example, as shown in Figure 3a, during the 2009 financial crisis, macroeconomic shocks averaged 2.4 standard deviations of their pre-2008 distribution across advanced economies (for the 2008–2009 period). Similarly, the distribution of contingent liability shocks has a long tail, with a fairly large number of episodes costing over 10 percent of GDP, and a few exceeding 20 percent of GDP. On average, countries have experienced a significant fiscal shock (around 6 percent of GDP) once every 12 years, with a large event (costing over 9 percent of GDP or more) occurring every 18 years on average.
- **Fiscal risks tend to be biased toward the downside.** While positive fiscal shocks also occur, governments are more prone to anticipate these and incorporate them into their forecasts than negative ones, leaving the balance of risks skewed toward the downside. This is exacerbated by the fact that public finances have historically been prone to large and infrequent negative macroeconomic shocks, calls on contingent liabilities, and wars which give the distribution of shocks to government debt a fat right-hand tail.⁸ This optimistic bias in official forecasts can be seen in Figure 2b which shows the average three-year ahead error for official forecasts of general government debt as a percent of GDP among the EU Member States (excluding Latvia and the Czech Republic) was between 1 percent and 8 percent.

⁶ See Eurostat (2016).

⁷ For example, the IMF's Fiscal Transparency Evaluations identify contingent liabilities (implicit and explicit) of around 30 percent of GDP for Peru, 90 percent of GDP for the Philippines, and 50 percent of GDP for Russia.

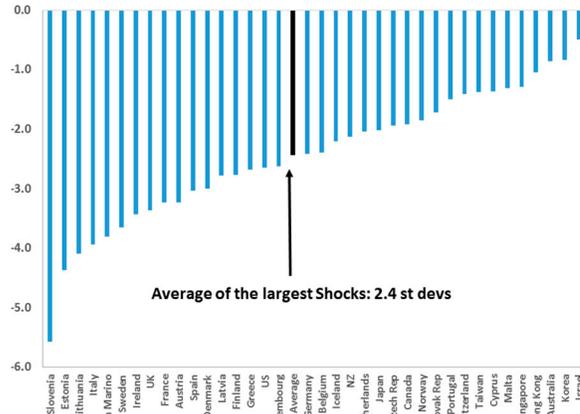
⁸ This has been shown by Escolano and Gaspar (2016) for the U.S. and U.K., and by Frankel and Schreger (2013) and Strauch, Hallerberg, and von Hagen (2004) for a broader range of advanced and emerging market economies.

Figure 2. Nature of Fiscal Risks

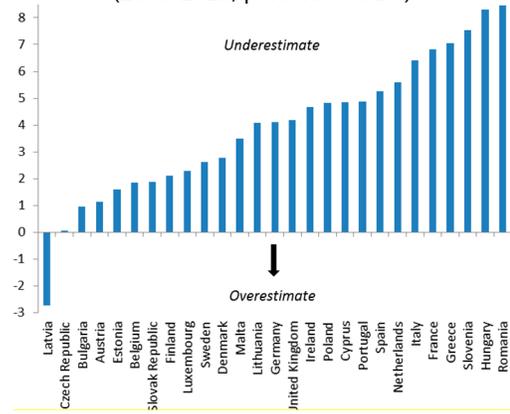
The average fiscal shock is typically larger than assumed in conventional analysis

Risks are also frequently underestimated

a. Size of Largest Real GDP Shocks
(Pre-2008 Standard Deviations)



b. Forecast Errors for Government Debt in Y+3
(2000-2013, percent of GDP)

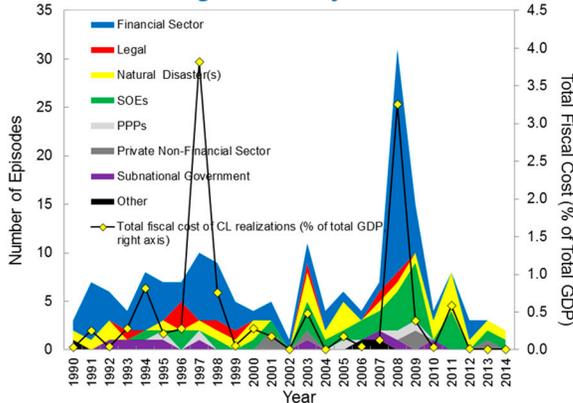


Source: Staff estimates.

Contingent liability realizations tend to be highly correlated during crises...

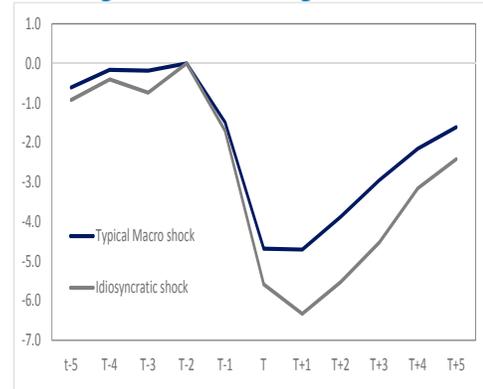
...and the impact of large and idiosyncratic shocks are disproportionately large.

c. Contingent Liability Realizations



Source: Bova and others (2016).

d. Budget Balance During Macro Shocks



Source: Staff estimates.

- Fiscal shocks are highly correlated.** As shown in Figure 2c, when something goes wrong, it is rarely a singular event. While the average direct cost of a specific contingent liability realization is 6 percent of GDP, the average increase in the debt-to-GDP ratio over the typical event is a much larger 15 percent of GDP. This reflects the fact that macroeconomic downturns tend to trigger the realization of other shocks, such as financial sector crises, the collapse of SOEs and subnational governments, and other contingent liabilities. These shocks are also highly correlated with each other, with a distinct bunching of contingent liability realizations during crisis periods. Previous analysis (IMF, 2012) found that only one third of the deterioration of debt ratios among the hardest hit countries during the global financial crisis was due to standard macro-fiscal dynamics, with the balance arising from the crystallization of an array of other fiscal risks.

- **The impact of fiscal shocks can be highly nonlinear.** While most macro-fiscal scenario analysis tends to assume that the fiscal consequences of a macroeconomic shock are a linear function of the size of the shock, larger macroeconomic shocks tend to be much more damaging than smaller shocks (Figure 2d). On the expenditure side, budget rigidities mean that expenditures are often difficult to reduce significantly in nominal terms, leading to greater increases in spending as a share of GDP during more extreme shocks.⁹ On the revenue side, economic downturns caused by specific shocks (such as the collapse of housing prices) can have disproportionately large effects as profits decline and losses are carried forward, leading to a decline in revenue to GDP ratios.¹⁰

C. Implications for Fiscal Policy-making

11. The size, timing, and nature of fiscal risks have important and fundamental implications for fiscal policy-making. In particular, they imply that fiscal policymakers require:

- **A comprehensive understanding of potential risks to their public finances and their interrelationships**—The foregoing analysis illustrates that fiscal risks are frequent and significant, so that effective fiscal management requires a solid understanding of the source, size, and probability of risks materializing;
- **A wider range of instruments for mitigating and managing those risks**—The diverse array of potential threats to the public finances suggests there is no “magic bullet” to safeguard the public finances and a range of tools are needed to reduce the probability and size of risk realization;
- **Explicitly taking fiscal risks into account when setting fiscal rules or targets**—The choice of fiscal anchor needs to be robust to the realization of major shocks that could otherwise steer the public finances and macroeconomy into a position of stress; and
- **Analysis of both the costs and benefits of mitigating fiscal risks.** This analysis should be informed by data on the probability of these risks occurring, their macroeconomic consequences, and the financial and other costs of risk mitigation strategies.

The next section discusses the adequacy of existing fiscal risk analysis and management arrangements relative to these requirements and best practices in fiscal risk management. This section also indicates the relevant considerations for policymakers when judging the costs and benefits of mitigating fiscal risks. This is followed by a discussion of how better risk analysis and probabilistic forecasting methods can help policymakers assess the probabilities of complying with the debt ceilings established in their fiscal rules.

⁹ While these rigidities can help stabilize economic activity in the short term during normal times, they can limit the ability of governments to undertake fiscal adjustments when these are needed.

¹⁰ See Box 1.1 of IMF (2015b).

FISCAL RISK ANALYSIS AND MANAGEMENT

A. State of Fiscal Risk Analysis

Fiscal Risk Disclosure and Analysis Practices

12. The Fund's 2014 revisions to its Fiscal Transparency Code places particular emphasis on fiscal risk disclosure and analysis, but current practice often falls short. In particular, the coverage and quality of countries' current fiscal risk reporting arrangements varies significantly based on their level of development and the nature of the risks involved.¹¹ This is confirmed by a new comprehensive review of fiscal risk analysis and disclosure practices that has been conducted by staff.¹² The key findings are summarized below.

- **Quantitative macro-fiscal sensitivity and scenario analyses:** Only about 30 percent of countries surveyed publish these (Figure 3a).¹³ And while most of these examine the sensitivity of the main fiscal aggregates to indicative changes in individual macroeconomic parameters (such as commodity prices, exchange rates, and GDP growth), only a small number of countries provide more sophisticated, model-based scenario analyses that explore the impacts of shocks to a number of macroeconomic parameters simultaneously. Another 4 percent of countries have begun publishing stochastic projections of key fiscal aggregates in the form of fan charts, to highlight the degree of uncertainty around the central estimates.
- **Balance sheets:** Only 28 percent of the surveyed countries publish these, and half of these only cover financial assets and liabilities excluding non-financial items such as land, mineral reserves, and pension liabilities. As macro-fiscal scenarios tend to focus only on the flow impact of economic shocks, balance sheets provide a wider sense of the public finances' exposure to variations in asset and liability values. However, only a handful of countries, including Australia and New Zealand, examine the impact of macroeconomic trends and government policies on the future evolution of government assets, liabilities, and net worth.
- **Specific fiscal risks:** Two-thirds of countries surveyed include some discussion of these in their budget documentation (Figure 3c). However, only 16 percent surveyed publish a quantified fiscal risk statement listing the specific or "discrete" risks to which the public finances are exposed. These fiscal risk statements typically disclose the size of the potential liability, but not its likelihood of materializing.

¹¹ The shortcomings may in part reflect differences in capacity across countries, but also a reticence on behalf of governments to discuss deviations around central forecasts due to concerns that it may undermine credibility, and to publish details on contingent exposures.

¹² Based on a survey IMF's budget institutions database for 58 countries (15 AEs, 31 EMEs, emerging market and middle income economies, and 12 LICs), the International Budget Partnership Open Budget Survey and the IMF's coverage of fiscal accounts database (COFA) of 158 countries.

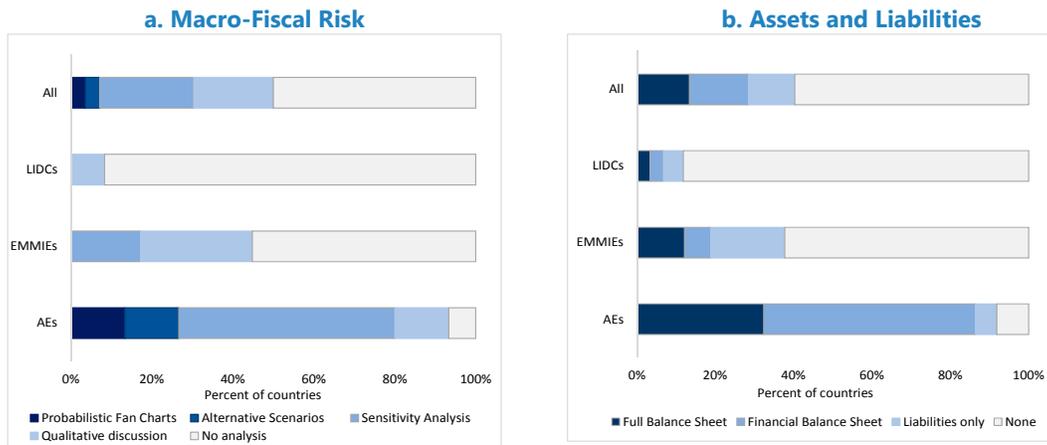
¹³ The IMF has been at the forefront in promoting the compilation of government balance sheets to support fiscal policy and macroeconomic analysis (IMF, 2013b, 2015d).

- Long-term fiscal sustainability analyses:** 40 percent of countries surveyed publish some form of these (Figure 3d). In this group, just over one half regularly publish single long-term projections for age-related programs, while some advanced countries (such as Australia, the United States, and United Kingdom) go further and explore multiple long-term scenarios for government revenue and expenditure based on a range of demographic and other assumptions (such as different profiles for healthcare costs).

Figure 3. Review of Current Practices in Fiscal Risk Disclosure and Analysis

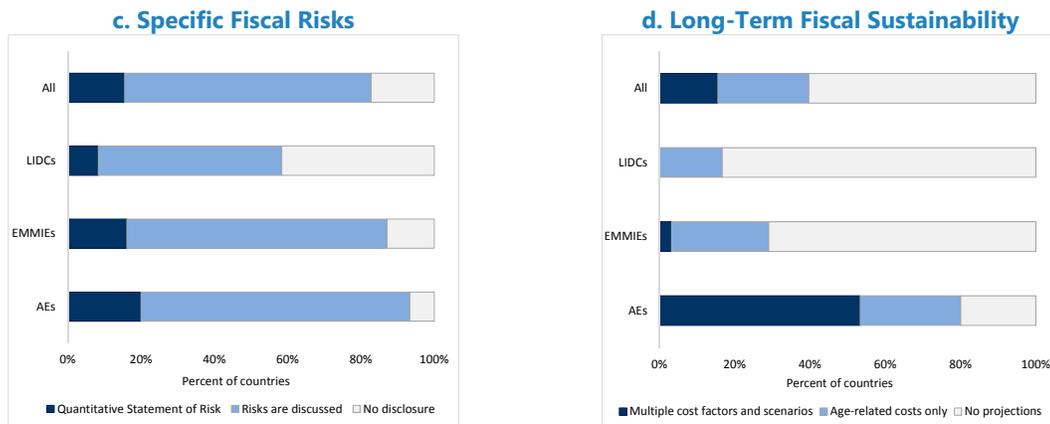
Few countries conduct sophisticated analysis of macro-fiscal risks...

...while even fewer examine the impact of macro trends and policy on government balance sheets



Many countries discuss specific risks but not many quantify their size or probability...

...while relatively few non-advanced countries publish long-term projections



Sources: Staff estimates based on IMF Budget Institutions Database and IMF COFA database.

13. While current approaches to fiscal risk disclosure and analysis have strengthened the understanding of fiscal risks, further improvements are needed. Most scenario and sensitivity analysis for macroeconomic risks tends to explore only modest-sized shocks, and assumes risks are independent, symmetric, and linear. Balance sheet data tends to be backward

looking, with few countries forecasting developments in their asset and liabilities. Specific risk assessments tend to focus on explicit contingent liabilities and underplay or ignore implicit liabilities, such as those to the domestic banking sector.¹⁴ Although some countries publish estimates of the size of explicit contingent liabilities in fiscal risk statements, relatively few discuss the likelihood of their realization or estimates of expected costs. Reporting and analysis of specific risks also tend to be spread over a range of government institutions and publications, meaning that interrelationships between risks are rarely explored.

B. State of Fiscal Risk Management

Nature of Fiscal Risk

14. The most effective approach to mitigating and managing a given fiscal risk depends on its underlying nature. As shown in Table 2, fiscal risks can be categorized according to whether they are:

- **Endogenous or exogenous.** Endogenous risks are those that are generated from government activities or where the probability of the event can be influenced by government actions. Correspondingly, these can be most easily mitigated through controls on public sector activity. For example, the risk from credit guarantees can be reduced or eliminated by prohibiting public entities from issuing them (as in the case of local governments in Serbia), though the benefits of this risk mitigation technique would need to be weighed against foregoing their original policy rationale, such as ensuring an adequate supply of credit to the economy. Exogenous risks are those that arise from actions or events outside of government control. For example, there is little that government policy can do to reduce the probability of natural disasters, so the use of mitigating instruments such as insurance is a more appropriate strategy.
- **Continuous or discrete risks.** Continuous risks are regular events that cause outturns to differ from forecasts. These can be readily incorporated into overall fiscal settings (for example, by adopting conservative assumptions for fiscal forecasts in the case of Chile for commodity prices) or by setting state contingent fiscal rules (as was the case in Australia during recovery from the global financial crisis). Discrete fiscal risks are those that occur irregularly, and may even have yet to occur (such as flooding caused by climate change). The most effective management strategy for these discrete risks will depend on whether they are:
 - **Probable**, that is those likely to materialize in the near term. In this case, the expected cost of the risk should be provisioned for in the budget or medium-term forecast.
 - **Possible**, that is likely to occur at some point but unlikely to materialize in the near-term. Such risks may be better managed through insurance mechanisms (such as earthquake

¹⁴ While discussing implicit contingent liabilities can give rise to concerns about moral hazard (see Irwin, 2015), some countries are beginning to recognize the size and nature of potential government support to the banking sector in times of crisis—see, for example, Finland Ministry of Finance (2015).

reinsurance in Turkey), risk pooling (such as the World Bank's Caribbean Risk Insurance Facility), or the accumulation of buffer funds (such as deposit insurance funds for retail banks).

- **Remote**, that is potentially significant but difficult to predict over a given timeframe. Such risks can include systemic financial crises or wars and are often difficult or impossible to insure against. Such risks, if they are to be accommodated, would require sufficient fiscal headroom to deal with the shock if it arises.

Table 2. Typology and Examples of Fiscal Risks

SOURCE	INCIDENCE			
	Continuous	Discrete		
		Probable	Possible	Remote
Exogenous	Commodity Price Volatility	Student Loan Defaults	Earthquake	Systemic Financial Crisis
Endogenous	Budget Overruns	PPP Project Completion Bonus	Government Guarantee	Subnational Government Default

Fiscal Risk Management Practices

15. Countries utilize a range of instruments for managing fiscal exposures. These include:

- **Direct controls, ceilings, or caps (Figure 4a).** These are commonly used to limit governments' total exposure to a particular risk and are most effective where the risks are endogenous to the public sector. About 60 percent of countries place limits on guarantees and control their issuance. Three-quarters limit the liabilities of subnational governments or require them to comply with certain fiscal rules, although only half of these countries back up these rules with sanctions or enforcement mechanisms in the event of non-compliance. About 40 percent of countries control bank lending by imposing minimum lending standards.¹⁵ Around one-third of countries limit explicit liabilities to SOEs, while only around 10 percent of countries limit contingent liabilities from PPPs.
- **Regulations, incentives, and other indirect measures (Figure 4b).** These instruments vary depending on the type of risk faced and are utilized more where the risks are influenced by the behavior of private partners. About three-quarters of countries regulate financial sector exposures (for example, by imposing leverage ratios and higher capital-adequacy requirements for systemically important banks). Two-thirds of countries impose performance targets on SOE boards and the same proportion require value for money assessments for PPPs. 60 percent of commodity exporting countries have been able to diversify their tax base. However, only around 15 percent of countries charge risk-related fees to beneficiaries of government credit guarantees.

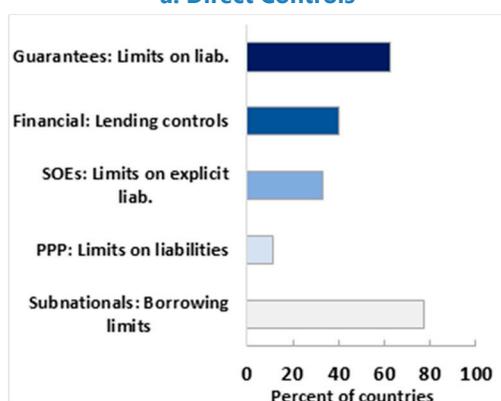
¹⁵ Minimum lending standards can reduce the risk of bank failures and therefore fiscal exposure (either directly where there are explicit guarantees in place, or implicitly where there are expectations of government bailouts).

- Risk transfer, sharing, or insurance mechanisms (Figure 4c).** These are utilized less frequently than other risk mitigation tools, potentially due to market depth, institutional capacity and political economy reasons. For example, only about one quarter of countries reinsure or securitize their credit guarantee portfolio, although almost 60 percent require beneficiaries to post collateral. About 5 percent of commodity exporting countries hedge commodity price risk. About 20 percent impose a levy on their financial institutions (effectively charging for explicit or implicit guarantees), while about two-thirds of countries insure public assets against the impacts of natural disasters.

Figure 4. Review of Current Practices in Fiscal Risk Management

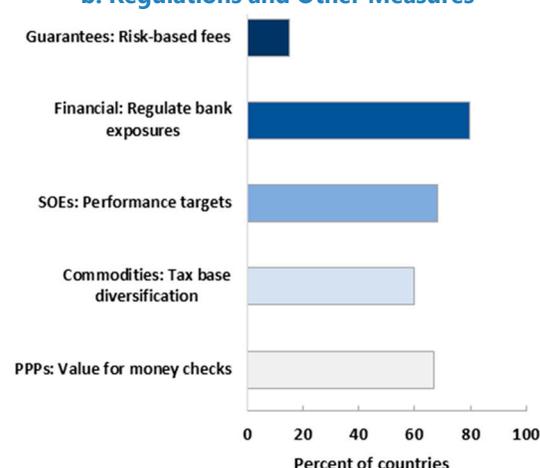
Direct controls are the most common form of risk mitigation measures

a. Direct Controls



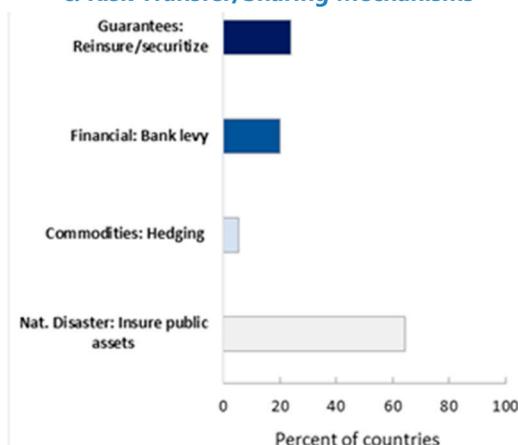
Regulations and incentives are also commonly used but usage is dependent on the type of risk

b. Regulations and Other Measures



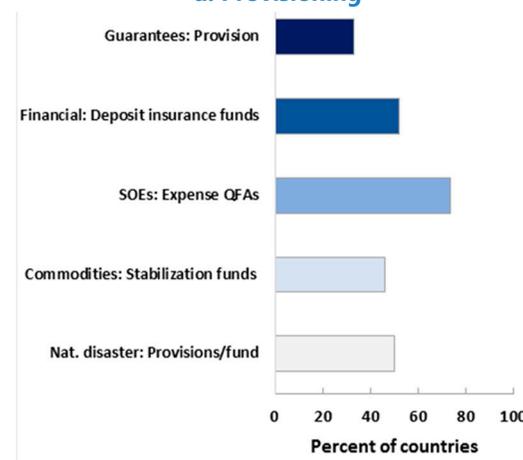
Risk transfer and sharing are the least common form of risk mitigation...

c. Risk Transfer/Sharing Mechanisms



...while provisioning is relatively common dependent on the type of risk

d. Provisioning



Sources: PEFA database; Beck and others (2008); Demirgüç-Kunt and others (2014); Cerutti and others (2015); OECD (2014); IMF Fiscal Transparency Evaluations; and staff estimates.

- **Provisioning (Figure 4d).** Many countries provision for fiscal risks by either directly expensing expected costs, establishing contingencies for specific risks or setting aside financial assets. For example, more than half of all countries have established explicit deposit insurance funds to guard against financial crisis risks.¹⁶ About half of countries examined expense quasi-fiscal activities of SOEs in the budget and half have set aside provisions of funds for natural disasters. About one-third of countries examined either provision for the expected costs of guarantee calls in their budget or have set aside an actual or notional guarantee fund to meet these costs. In addition, just under half of commodity exporters have established a stabilization fund as a buffer against lower commodity prices.

16. These results suggest that there is considerable scope for countries to both widen and better integrate their fiscal risk management practices. Current practices tend to be heavily concentrated on the use of direct controls over endogenous risks, while instruments that discourage, share, or insure against more exogenous risks are underutilized. Furthermore, risk management tends to be fragmented, ad hoc, and focused on individual risk categories, with little consideration of the relationship between the sources of risk and existence or effectiveness of mitigation measures. Finally, there is little evidence that policymakers systematically weigh the costs and benefits of different forms of intervention to identify the most cost-effective means of reducing their risk exposure.

C. Integrating Fiscal Risk Analysis: The Fiscal Stress Test

17. To provide a more comprehensive overview of potential shocks to the public finances and capture the interdependence between fiscal risks, this section proposes a new fiscal stress test (FST). The FST integrates analysis of macroeconomic shocks and the realization of contingent liabilities using historical data. The FST examines the impact of such shocks on not only fiscal flow variables (such as government revenue, expenditure, and financing), but also stock variables (such as government liabilities, assets, and overall net worth), to which most existing methods pay limited attention. Finally, it models the impact of a more extreme set of scenarios compared with existing fiscal risk analysis techniques.

18. This approach has several features that can usefully complement existing fiscal risk analysis techniques. It can provide fiscal policymakers with a more complete picture of the overall scale, sources, and likelihood of potential shocks to public finances. It offers a deeper understanding of how fiscal risks interact and useful guidance on where to focus fiscal risk mitigation efforts. It can also help to fine tune estimates of the fiscal headroom that would be needed to safeguard fiscal flexibility and sustainability in the event of a crisis, particularly when complemented by a full assessment of the distribution of risks (see section on fiscal risks and public debt ceilings).

¹⁶ Demirgüç-Kunt and others (2014).

Fiscal Stress Test Methodology

19. The FST mirrors the approach taken by the Fund in assessing financial stability in the context of the Financial Sector Assessment Program. There are two key elements (see Appendix 2 for a more detailed description):

- **Macroeconomic risks:** The FST models how public finances react to a large, correlated shock to key fiscally relevant macroeconomic variables typically including, GDP, inflation, commodity prices, exchange and interest rates, and housing and equity prices. Recognizing that a given country's past is not necessarily a good guide to the future, the analysis here bases the size and nature of shocks on realized tail-events from a range of comparator countries. The impact on public finances is assessed using a detailed fiscal model in order to account for the nonlinearities that occur during large macro-shocks on the revenue side, and the budget rigidities that tend to retard fiscal adjustments on the expenditure side.
- **Contingent liabilities:** The FST takes into account the range and likelihood of both explicit and implicit contingent liabilities, and their interaction with large macroeconomic shocks. First, the range of contingent liabilities is identified and quantified, and the key risk factors underlying them explored, including assessing their sensitivity to the macroeconomic variables. The likely cost to the public finances under the stress scenario is then estimated, as well as the potential for asset recovery in later years. These assessments can be drawn from a range of sources, such as Fiscal Transparency Evaluations, FSAP evaluations for the financial sector, and contingent claims analysis (CCA) (See Box 1).

Fiscal Stress Test Outputs

20. The FST looks at the combined impact of these shocks on the government's operating statement and an extended "comprehensive" balance sheet. The flow impact is captured through the impact of the combined shocks on government revenue and expenditure, which can persist for a number of years. The balance sheet impact is captured using a comprehensive balance sheet, which captures both changes in the volume and value of conventional financial assets and liabilities as well as in the present value of future revenue and expenditures.

21. Using these two instruments, the FST provides three summary indicators to assess the degree of fiscal pressure in an extreme scenario:

- **Fiscal solvency** is assessed by the change to comprehensive net worth, which reflects the impact of the macro shock and contingent liabilities on both financial assets and liabilities and the present value of future revenues and expenditures.
- **Government liquidity** is assessed by examining the government's gross financing needs from existing and additional new public debt issuance needed in response to the shock.
- **Government financing burden** is assessed by examining the share of interest expenditure in total government revenue.

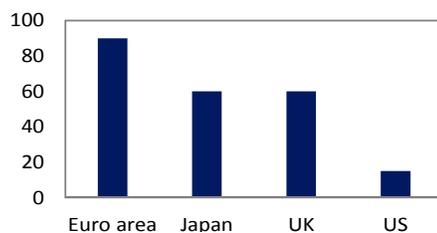
Box 1. Measuring Implicit Financial Sector Contingent Liabilities

Actions taken during periods of financial stress, and particularly those during the global financial crisis, demonstrate that governments often need to stand behind their domestic financial sector to prevent major bank defaults and further contagion (Irwin 2015). While some elements of this liability are explicit, in the form of direct guarantees and government backed deposit insurance, much is implicit, and only recognized in the event of a crisis. Although this implicit guarantee is not included on government balance sheets, it is important to understand its size and likelihood of being realized.

There are various approaches to assessing and valuing this implicit guarantee (see IMF 2014), one of which is the contingent claims analysis (CCA) (Gray and Jobst, 2013). This involves observing the different market pricing on debt and equities, exploiting the fact that in the event of default equity holders will be wiped out, but debt holders still carry some expectation of receiving government support. Equity prices and balance sheet data can be used in a CCA framework to estimate expected losses and associated credit spreads (fair-value CDS). This fair-value credit spread is frequently higher than observed bank CDS spreads since equity holders do not benefit from implicit guarantees but debt holders do. The difference in the observed and fair value CDS spreads indicates the size of the implicit subsidy (i.e., the market's view of the implicit government guarantee).

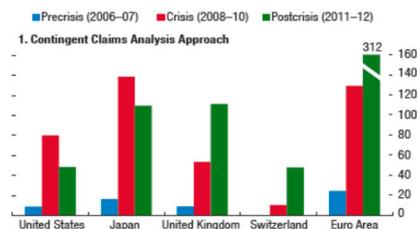
The estimate of the implicit subsidy can be applied to the stock of outstanding debt liabilities, or more specifically the expected value of the loss upon default, to determine a market based estimate of the expected value of the contingent liability at any given time. Estimates of the size of the implicit subsidy for systemically important banks range from 15 basis points in the United States to 90 basis points in the euro area in 2013, and the value of the corresponding implicit subsidy (i.e. expected value of government support) from around \$50 billion to \$300 billion in 2011–12.

Implicit Subsidy for Globally Systemic Banks
(basis points)



Source: IMF 2014.

Expected Value of Implicit Subsidy
(USD billions)



Source: IMF 2014.

The information from CCA is useful in a number of ways in assessing fiscal risks:

- It can provide an estimate of the market's valuation of government implicit support to the private sector (e.g., banks and corporate entities), which can be included within a comprehensive risk-adjusted balance sheet (see Gray, Merton, Bodie, 2008);
- The market-implied size of government support could be used in fiscal stress testing to inform the potential cost of government support and realized costs of intervention in the event of default;
- Regardless of whether government support is explicit or implicit, the CCA can provide a guide as to the market's expectation of support for particular banks; and
- The impact of various risk management reforms—such as increased capital ratios to reduce the likelihood of distress, deposit insurance schemes, or regulatory changes such as the Volcker rule—have reduced the likelihood and potential cost of government intervention.

While useful, CCA carries a number of caveats. CDS markets can be thin or non-existent for many banks especially in smaller markets. During financial crises, CDS spreads become highly volatile and unreliable, and the calculations assume that equity holders are wiped out in full, whereas in the financial crisis they were bailed out to some extent. Recent regulatory changes are designed to ensure a bail-in of creditors to a greater extent than was the case in the global financial crisis.

22. Application of the FST in two specific country examples illustrates the value of this type of analysis. The two countries were selected to illustrate the application of the FST to countries in different income groups and with different risk exposures.

- An illustrative FST carried out for Iceland (Box 2) assumed a large and persistent macroeconomic shock as well as realization of significant contingent liabilities in the housing sector. Under the stress scenario, public debt increases by 55 percent of GDP, and comprehensive net worth falls by 90 percent of GDP, while the fiscal burden reaches elevated levels. Liquidity needs increase sharply, to over 25 percent of GDP, despite the long average maturity of existing debt, due to the high financing needs of recapitalizing the Housing Financing Fund. The increase in Iceland’s public debt relative to baseline identified under the stress scenario is broadly in line with the increase experienced during the financial crisis.
- An illustrative FST for Peru (Box 3) showed a relatively smaller fiscal impact than in Iceland, with debt increasing by around 50 percent of GDP and comprehensive net worth declining by 40 percent of GDP, despite a larger macroeconomic shock and a fall in commodity prices. This reflects Peru’s smaller risk exposure, both in terms of its revenue base as well as its limited balance sheet and contingent liabilities. While interest expenses to revenues increase significantly, the overall revenue burden is relatively low and liquidity remains manageable due to the low initial deficit and debt levels.

Integrating Fiscal Risk Analysis and Management

23. FSTs could be undertaken by country authorities periodically to enhance their understanding of the impact of fiscal risks on public finances and better inform policymaking. This would enable stress tests to be tailored to individual country characteristics and risk exposures and would complement existing tools for fiscal risk analysis. Ideally, this analysis requires information on conventional public assets and liabilities, contingent liabilities and other exposures, and a detailed macroeconomic and fiscal model. However, even in countries where information is incomplete, stress tests can still be undertaken utilizing reasonable simplifying assumptions.

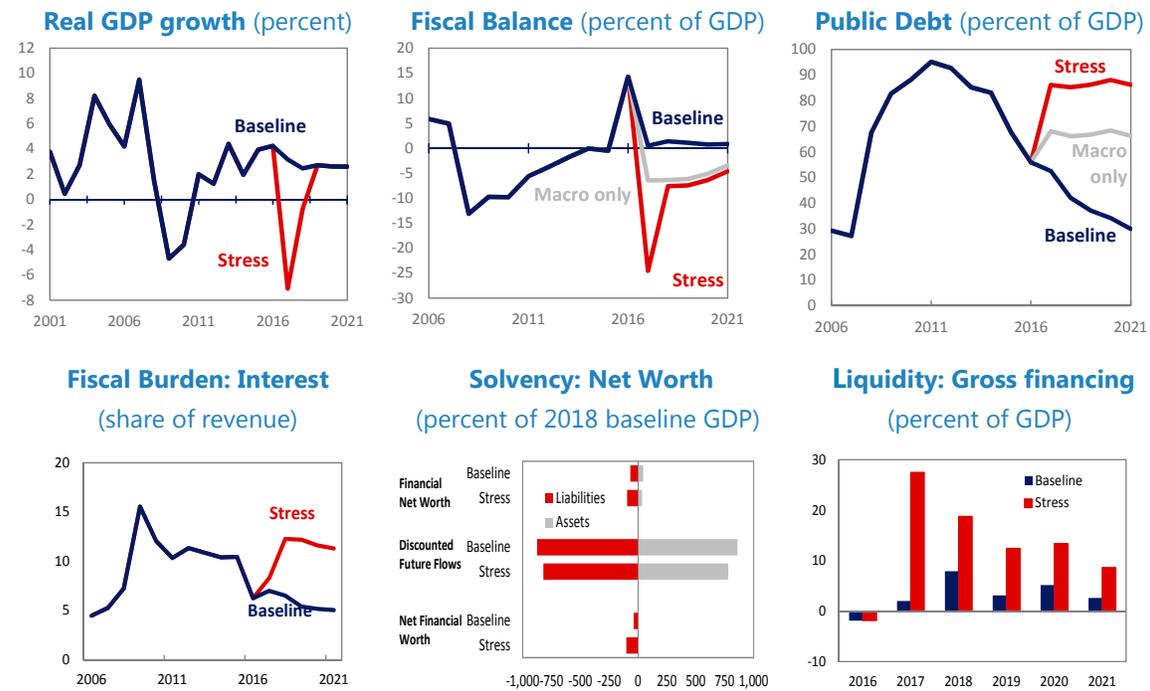
24. FSTs can provide the basis for better-targeted and more effective management of fiscal exposures. By providing comprehensive risk-based scenarios for the public finances, the results can provide a basis for better-targeted and coordinated fiscal risk management interventions. In particular, they can encourage policies to mitigate risks—i.e., steps to reduce the vulnerability of the public accounts to macroeconomic shocks, to discourage the taking on of contingent liabilities, and to help define the level of fiscal headroom needed to insure against bad times. The range of measures that countries can use to mitigate the risks identified are discussed in the next section.

Box 2. Iceland: Illustrative Fiscal Stress Test Results

Under this illustrative FST, Iceland’s public finances were examined following the realization of a number of correlated fiscal risks. These included a three standard deviation real GDP shock, combined with a one-third fall in housing prices, a fifty percent fall in equity prices, and increases in the international interest margins. These exogenous shocks flowed through to increases in unemployment, decreases in inflation and domestic interest rates (as the central bank responded). Finally, a large realization of contingent liabilities occurred as the Housing Financing Fund, which is heavily exposed to domestic housing assets, required recapitalization.

The impact of the macroeconomic shock is large and persistent in Iceland, with the fiscal balance moving back into deficit (following the large asset recovery-caused surplus in 2016), and continuing into the medium-term. On top of the standard declines in revenue from slower growth, revenue drops as a share of GDP due to housing-related revenue falling in line with house prices, and large corporate losses having a persistent impact on corporate tax revenues. On the expenditure side, rigidities in salaries and pensions lift the expenditure ratio. The contingent liability shock temporarily increases the fiscal deficit, and increases public debt by 18 percent of GDP.

Public debt increases by 55 percent of GDP by 2021 relative to baseline, broadly in line with the increase experienced during the crisis. The decline in comprehensive net worth—including the impact of future revenues and expenditures—is larger still, falling by around 70 percent of GDP. This is due to lower asset prices and the long-term consequences of the shock on both revenues and expenditures, with the budget not projected to return to surplus until 2025, before the deficit opens up again as demographic pressures take hold. Financing needs increase to very high levels, despite the relatively long maturity of existing debt, while the increase in the fiscal burden remains elevated but manageable.



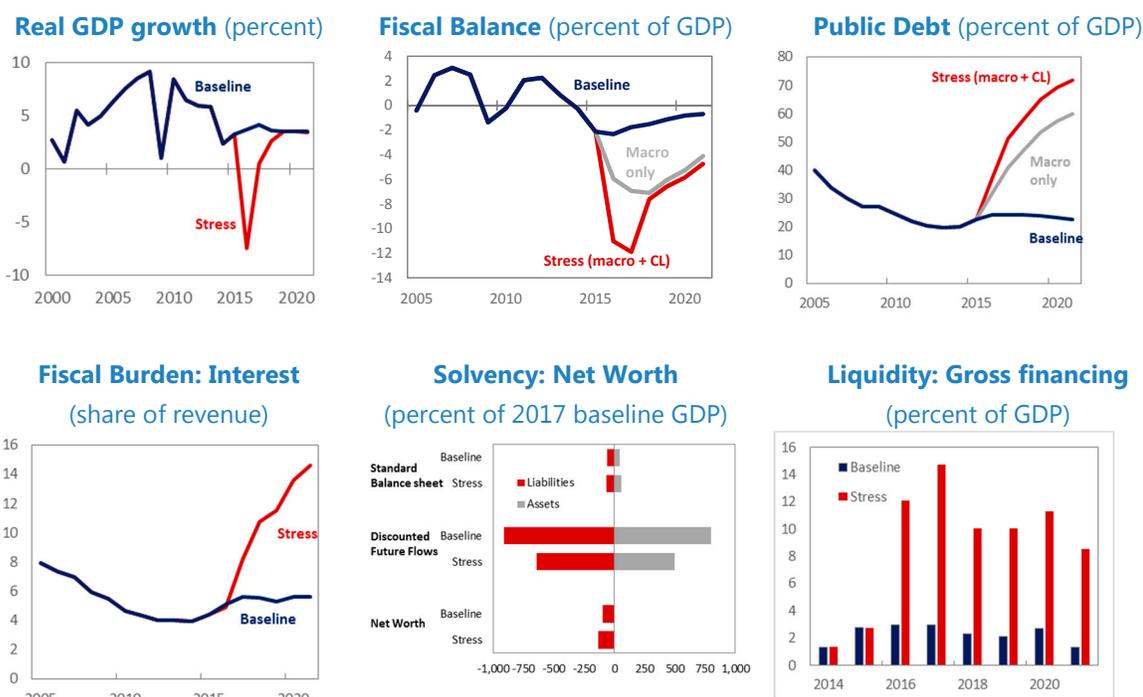
Source: Staff estimates.

Box 3. Peru: Illustrative Fiscal Stress Test Results

Under this illustrative FST, Peru’s public finances were subjected to a combined, large macroeconomic shock to assess the impact on solvency, liquidity, and fiscal burden. The Peru scenario is calibrated against the largest shocks that have occurred in comparator countries in the region. It involves a shock to GDP, asset prices, corporate interest spreads and commodity prices, as Peru’s commodity exports account for around 55 percent of total exports. This shock is larger than any experienced in Peru previously, with GDP falling 11.5 percent in real terms relative to trend growth in the first year.

The shock scenario is designed and run through the Western Hemisphere module of the IMF’s Flexible System of Global Models (FSGM) to provide the key economic parameters for the fiscal forecasting exercise, leading to a decline in inflation, increase in unemployment, reductions in the central bank’s policy rates and lower domestic consumption and investment. A double-headed contingent liability shock is applied, based on the findings of the 2015 Peru Fiscal Transparency Evaluation, requiring the recapitalization of some domestic banks and the payout of a large international investor dispute.

The fiscal impact in Peru is large, though not as big as in Iceland, despite the former experiencing a larger macroeconomic downturn. The reasons behind this are as follows: (i) Peru’s fiscal exposure to such a shock is somewhat smaller, with revenue collections not affected to the same degree, and less rigid budget expenditures; (ii) a smaller and less risky balance sheet; and (iii) lower contingent liabilities. Under this stress scenario, Peru’s gross debt increases by around 50 percent of GDP by 2021, comprehensive net worth—including the impact of future revenues and expenditures—declines by 38 percent of GDP, while liquidity needs peak at a manageable 15 percent of GDP in 2017, reflecting the relatively low existing debt burden. The fiscal burden increases quite sharply to 15 percent of revenues, as interest spending rises against a relatively low revenue base.

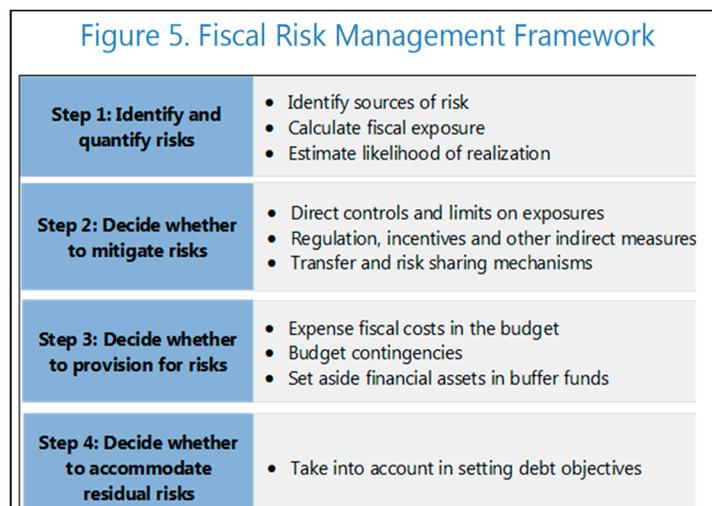


Source: Staff estimates, prepared in collaboration with the IMF’s Western Hemisphere and Research Departments.

D. A Wider Range of Risk Management Options: The Fiscal Risk Toolkit

25. The management of fiscal risks can be divided into four stages (Figure 5):

(i) identifying the sources of fiscal risks and assessing their magnitude and likelihood of realization; (ii) assessing whether mitigating steps should be taken to reduce fiscal exposure; (iii) determining whether to budget for risks that are not mitigated; and (iv) determining whether additional fiscal headroom is needed to accommodate some or all remaining fiscal risks. This four-stage approach is discussed in more detail below.



26. Governments must first have a sound understanding of the risks to public finances before they can be properly managed. This involves identifying the sources of fiscal risks, quantifying their magnitude and estimating the probability of occurrence. While countries are increasingly disclosing specific fiscal risks, and, in some cases quantifying maximum exposures, less attention is given to estimating the likelihood of realization. Quantitative estimates could include assessments of the maximum possible loss (for example, the face value of a guarantee), or, where feasible, the expected fiscal impact or maximum loss at a specific confidence interval (Box 4). In addition, in cases where quantification is too difficult, risks may be classified into categories (e.g., probable, possible, and remote) based on judgments about their likelihood. The Australian Government’s Statement of Risks, for example, details both quantifiable and unquantifiable contingent liabilities and specifies whether these are considered to be “remote.”

Box 4. Country Approaches to Quantifying Expected Costs from Fiscal Risks

Countries rely on a range of techniques to quantify contingent liabilities involving different levels of sophistication. Assessments can rely on the use of historical data where this is available (for example, default rates on guarantees to groups of individuals such as student loans, farmers, export finance); on market information; or by applying analytical techniques such as stochastic simulations or option pricing models such as used in the CCA as discussed in Box 1. Examples include:

- the U.S. Federal Deposit Insurance Corporation, which uses expected loss estimates derived from historical and institution-specific loss data;
- the Republic of Korea, previously used rating agencies to assess the likelihood of payments on certain types of explicit contingent debts;
- Chile, Colombia, and Peru which use simulations to estimate contingent liabilities associated with minimum revenue guarantees under PPP arrangements; and
- Sweden, which uses market and options pricing data, and simulations to price guarantees.

27. Having identified their exposure to various risks, governments then need to consider whether instruments should be used to mitigate them. There are a broad range of tools available to governments and some good practices in the management of specific fiscal risks are described in Table 3 (see also Appendix 1). The different approaches are not mutually exclusive; policymakers may elect to adopt a combination of mitigating measures to manage specific risks. The choice of instrument should be tailored to each country's individual circumstances and will depend on the nature of risks, the cost-tradeoff between mitigating and accommodating risks, and institutional capacities. Mitigating instruments can be grouped into three broad categories:

- *Direct controls* to limit fiscal exposure. For example, policymakers can avoid risk by deciding not to engage in certain commercial activities, limiting the extent of state ownership of commercial activities, or imposing caps on the liabilities public entities can accumulate. Examples of such direct controls include limits on sub-national borrowing or annual or multi-annual ceilings on the issuance of government guarantees. Policymakers can also re-orientate policies to limit exposure, for example by capping payments associated with government insurance schemes.
- *Indirect measures (regulations or charges)* to reduce risky activities. Policymakers can regulate individuals or entities that are sources of risk, for example by requiring banks to hold certain amounts of capital, mandating building requirements in areas prone to natural disasters, or mandating certain environmental standards. Policymakers can also discourage excessive risk taking through incentives, for example by eliminating the debt bias in the tax system, or by charging risk related guarantee fees or insurance premiums to those that benefit from government underwriting.
- *Transferring/sharing risks.* Policymakers can transfer risks to international capital markets by purchasing insurance (as in the case of Turkey for natural disasters), hedging instruments (as in the case of Mexico for oil price shocks), or securitizing and selling financial assets (e.g., for student loans in the U.K.) or through the use of state-contingent financial instruments (as in the case of Mexico for catastrophe bonds, and Malawi for weather-related derivatives). Policymakers can also ensure that the beneficiaries from government risk bearing share some of the risk, for example by only providing partial guarantees (as in the case of Canada), requiring the posting of collateral, or requiring deductibles for government insurance schemes. These measures can also reduce risk by discouraging risk-taking behavior.

28. Third, governments should consider whether to provision for those risks that are not mitigated. This can take the form of expensing the costs up-front in the budget (as in the case of the United States for credit guarantees or Australia for student loan defaults), creating a budget contingency for moderate risks that are likely to materialize (as in the case of the Philippines for natural calamities or Colombia for expected calls on guarantees), or negotiating contingent budget support (as in the case of some LICs), or setting aside financial assets to meet the costs of larger risks should they materialize (for example, Chile's stabilization fund or Canada's deposit insurance fund for financial crisis).

Table 3. Fiscal Risk Management Toolkit

Risk	1. Identify & Quantify	2. Mitigate			3. Provision			4. Accommodate
		Direct Controls	Indirect tools (regulation and charges)	Risk Transfer Instruments	Expense	Contingencies	Buffer funds	
Financial sector	Quantify contingent exposures Monitor financial soundness and risk indicators Incorporate financial sector stress tests into debt sustainability analysis	Reduce state participation in banks	Increase bank loss absorbing capacity (capital adequacy standards) Macroprudential tools to reduce procyclicality Reduce debt bias in tax system	Require banks to fund deposit insurance schemes Resolution mechanisms (e.g. Living wills)	Appropriate expected payments	Maintain cash buffers	Pre-fund deposit guarantee schemes	Fiscal headroom for residual risks
Natural disasters and environmental risks	Early warning systems	Planning to reduce footprint in risky areas	Tax premia in high risk areas Environmental standards Building codes Disaster preparedness strategies	Reinsurance Catastrophe bonds Cap payouts and require deductibles for govt. schemes Mandate insurance in high risk areas	Appropriate expended payments	Disaster contingency	Natural disaster funds	
Macro shock: e.g. Commodity Prices	Sensitivity analysis, alternative scenarios, probabilistic fan charts	Privatization of commodity producers	Commodity market regulation Tax base diversification	Hedging instruments (options, commodity futures)	Resource-based fiscal rules	Prudent price assumptions	Stabilization funds	
Guarantees	Maintain a central registry of guarantees and assess risks of at time of issue and over their life	Central authorizing entity Ceilings on liabilities Standard criteria for issuing Conditions on access	Charge risk-related fees	Partial guarantees Require collateral Reinsure if feasible	Appropriate expected cash flows	Provision for expected calls	Guarantee funds	
Public Private Partnership	Maintain central registry of PPP commitments Subject projects to sensitivity analysis	Central authorizing entity Ministry of Finance gatekeeper role Ceilings on PPP commitments	CBA and value for money checks Charge guarantee fees	Risk sharing allocation framework Cap payments linked to demand Insure retained contract risks where feasible	Appropriate expected cash flows	Provision for expected calls on guarantees	Guarantee funds	
State Owned Enterprises	Quantify explicit exposures Monitor financial performance Scenario analysis or stress testing	Reduce size of the SOE sector	Hold boards accountable for performance Reporting requirements	Explicit no-bail-out clauses	Appropriate expected subsidies and QFAs	Provision for cost in case of restructuring	-	
Subnational government	Monitor financial performance against benchmarks	Fiscal rules and limits on borrowing	Link degree of financial autonomy to performance Reporting requirements	Establish credible no-bail out clauses Retain authority to liquidate assets / appoint administrator	Appropriate expected support		Rainy day funds	

29. Finally, governments should then assess whether sufficient fiscal headroom exists to accommodate those risks that cannot be insured or mitigated. Some risks may be too large to provision for, too costly to mitigate, or simply not known with a sufficient degree of precision. Governments should take account of these risks in the setting long-run targets for government debt or net worth (as in the case of New Zealand) or at least ensure they have a sufficient safety margin relative to their debt ceilings defined in their fiscal rules. Ultimately, this policy decision should depend not only on the size of the risk exposure to the public finances but also the government's degree of risk aversion, and thus the appetite to self-insure through lower debt levels.

E. Costs and Benefits of Risk Mitigation

30. There are many reasons why it may not be optimal for governments to adopt policies that eliminate all fiscal risks or to maintain fiscal buffers large enough to cover all fiscal stress scenarios. For example:

- In the presence of market failures, governments can typically bear risk at a lower cost than other parties can. This is generally the case where risks are ill defined and difficult to quantify, where there are information failures that lead to incomplete markets (such as student loans), and when risks are catastrophic and cannot be diversified (such as earthquakes in large-scale high-risk areas or terrorism insurance).
- Eliminating all risks to the financial system could demand a level of deposit insurance, capital requirements, etc., that would unduly stifle credit creation and growth.
- Governments may also elect to bear risks for macroeconomic stability considerations (e.g., allowing automatic stabilizers to buffer the economic cycle or providing deposit guarantees to discourage bank runs during crisis).
- Fiscal risk management policies also need to take into account the degree of societal risk aversion and rate of time preference. For example, societies that are highly wealthy may be less concerned about low probability, high impact events, while societies with relatively elderly populations may tend to discount the future more highly than otherwise.

31. As a general principle, when markets are well functioning, risk should be borne by the entity that has the best ability and incentive to manage them. This should be the entity that is best able to influence the probability of a risk materializing or its impact, and that has the best capacity to absorb their costs (IMF, 2008). As an example, in PPPs, project risks related to construction and design should be borne by the private sector, while risks related to regulatory changes and political risks that impact specific projects may be borne by the government.

32. The decision whether to bear risks outright, or mitigate or provision for them, should be made based on an assessment of the likely costs and benefits. For governments with policy flexibility and access to international credit markets, it may be less costly to raise taxes or borrow to meet the costs of risks as they arise than to insure against them ex-ante. However, volatility in tax rates imposes costs and raising taxes may not be the desirable policy during times of stress. In this regard, pre-funding through insurance vehicles or budget funds may provide some tax smoothing

benefits. It may also provide certainty in funding for countries that cannot guarantee their access to international capital markets during times of stress. For those countries, mitigation or setting aside financial assets in buffer funds may be more appropriate. The choice as to whether to mitigate should be informed by the probability of occurrence. While purchasing insurance may be more worthwhile for countries that face high impact, but low probability events, since the cost of insurance tends to fall with the probability of loss (Cebotari, 2008), self-insurance may be more cost-effective for moderate risks.

33. Where risks are borne by the government, it should look to minimize moral hazard.

These arise because those benefiting from government risk are no longer financially responsible for their actions and so face reduced incentives to prevent losses and/or may engage in riskier behavior as a result. To manage moral hazard, the government should ensure that those able to influence the likelihood of an event occurring, or its impact, bear some of the risk. Governments can ensure that individuals retain some “skin in the game,” for example, by issuing partial guarantees or requiring insurance deductibles.

F. Institutional Arrangements for Fiscal Risk Management

34. Sound institutional arrangements are needed to support an effective and integrated approach to risk management. The appropriate organizational setup depends on country specific factors, and Box 5 provides examples of institutional arrangements in selected countries. Good practices include:

- **Establishing a risk management policy.** Governments should outline the pre-conditions under which they are prepared to take on specific fiscal risks (such as loans, guarantees, PPPs, etc.). For example, Canada’s guarantee and loan framework requires the sponsoring public entity to demonstrate that the project being proposed could not be financed on reasonable terms and conditions without a government loan or guarantee.
- **Defining clear accountabilities.** Individual departments and line ministries should be responsible and accountable for identifying, estimating, analyzing, and monitoring specific fiscal risks that fall within their functions. This is consistent with the principle that specialists are more likely to have the required capacity to monitor and manage specific risks within their area. However, there may be some areas, such as oversight of SOEs or PPPs, where centralizing the oversight function in the MoF can yield economies of scale.
- **Establish a central risk oversight body.** Even where risks are recorded and managed at ministry level, there is a strong case for centralizing monitoring and management of overall fiscal risk in a single body (Cebotari, 2008). It allows for an assessment of aggregate risk exposures across government and for the identification of any systematic relationships and interactions between risks. It also facilitates examination as to whether risks emanating from various sources are offsetting (and therefore may not require mitigation). This role can be assigned to a specific unit or high-level oversight committee, with a mandate to monitor how risks are evolving; establish risk-warning indicators; and undertake ‘war-gaming’ exercises to respond to risks. The unit could be tasked with assessing whether risk mitigation practices are adequate and recommend actions to strengthen them where required.

- **Establishing central controls over major risks.** The authority to approval contracts that expose the government to fiscal risks should be vested in a central authorizing entity, such as the Minister of Finance or cabinet committee. This is particularly important where policymakers have taken decisions to cap exposure to particular risks. The decision to take on risk should also be assessed as part of the budget process. Specific risk instruments (such as guarantees) should be benchmarked against traditional policy instruments and accounted for in agency budgets (as in the case of Sweden for guarantees and Australia for insurance premiums).

Box 5. Examples of Institutional Arrangements for Fiscal Risk Analysis and Management

The **New Zealand** Treasury has ultimate authority and control over borrowing, contracting obligations and assessing fiscal risk. However, individual agencies are primarily responsible for monitoring and provisioning for contingent liabilities and various risks within their functions. The Treasury publishes a regular statement on managing fiscal risks. All explicit fiscal risks are subject to parliamentary approval.

Australia operates a decentralized model, with agencies responsible for managing and reporting on risks through their annual report and contribution to a Fiscal Risk Statement that is published as part of the budget.

The **United Kingdom** has established a fiscal risk group within HM Treasury to identify and monitor fiscal risks. The group is chaired by the Treasury Chief Economist and comprised of senior treasury officials (including the tax department, spending areas, international, and financial stability department). It produces a dashboard of fiscal risks, with estimates of total exposure and rankings using the traffic light system. The U.K. Office of Budget Responsibility is also preparing to publish an in-depth fiscal risk report every two years, in addition to its regular semi-annual reporting on risks around the medium-term forecast.

South Africa has also established a fiscal risk committee with a mandate to identify the major sources of fiscal risk and quantify them as far as is possible, monitor risks and propose mitigating measures, and report on risks both for internal purposes and to the public. The committee meets quarterly and incorporates a wide range of actors from within the National Treasury that are required to report on their area of expertise. It is supported by a secretariat in the Fiscal Policy Department of the Treasury.

The **United States** has recently created an enterprise risk management office, headed by a chief risk officer within the Treasury Department, and is considering establishing similar risk management efforts in other agencies.

FISCAL RISKS AND PUBLIC DEBT CEILINGS

35. Explicit public debt ceilings have become an increasingly important consideration in the conduct of fiscal policy based on formal fiscal policy rules. Legislative constraints on government borrowing have been longstanding and, as will be described below, a growing number of countries have begun to enshrine debt ceilings into their fiscal rules. The ceilings usually serve as a medium-term reference for binding constraints on the annual fiscal balance, and in a growing number of cases, on the rate of public expenditure growth.

36. Risk has important implications for assessing whether countries are likely to stay under the ceilings deemed desirable under their rules-based fiscal frameworks. As documented above, countries are prone to significant fiscal shocks, which means that the day-to-day conduct of

fiscal policies should aim at keeping debt far enough below the ceiling. Allowance for frequent breaches of the ceiling could send wrong signals about the government's resolve to stick to its own commitments, which could ultimately undermine the credibility of a rules-based framework.¹⁷ To help illustrate these points, this section first provides a description of the cross-country experience with explicit debt ceilings. Second, it shows how probabilistic tools can help policymakers understand the impact of fiscal risk on the likelihood of remaining below official debt ceilings and could also help promote policies to avoid breaches. This approach complements the FST in that it allows one to identify the probability distribution of shocks and thus make a better-informed decision on the appropriate level of buffers, depending on the degree of risk aversion. And, even if initial debt levels are above the ceiling, this type of analysis can provide information on the likelihood that policies will allow debt to return to a level that is consistent with the debt rule.

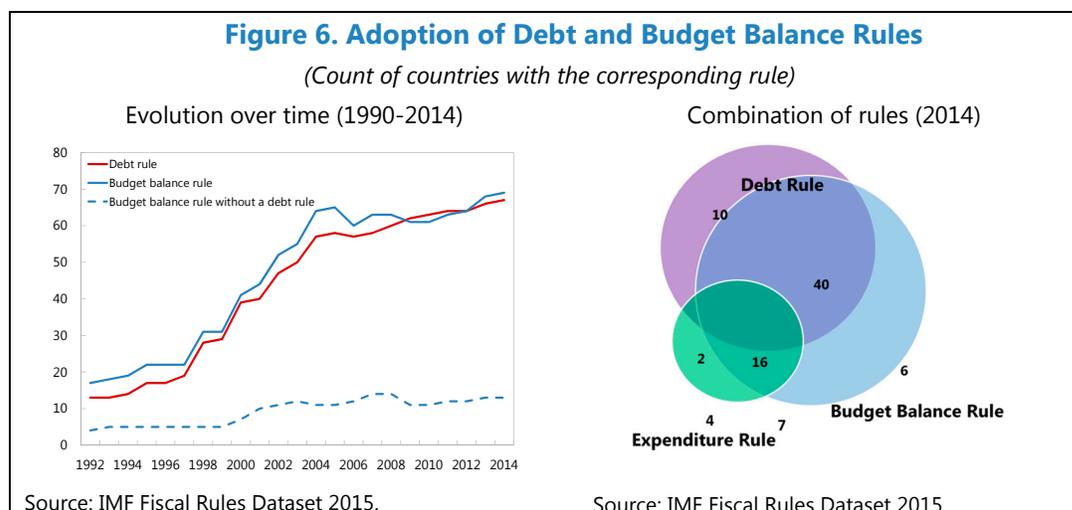
A. Public Debt Ceilings: Current National Practice

37. A key motivation to keep gross public debt below certain levels is that confidence in government solvency and liquidity tends to weaken as debt rises. There is ample empirical evidence that market confidence tends to erode, and borrowing costs to increase, as public debt levels rise (Appendix 3). At a certain point, the debt service burden rises faster than the government's ability to generate larger primary surpluses, putting the public debt to-GDP-ratio on an explosive (unsustainable) trajectory. And in recognition of the risk of falling into a debt spiral, many countries have included public debt ceilings as the reference point for their medium-term fiscal frameworks.

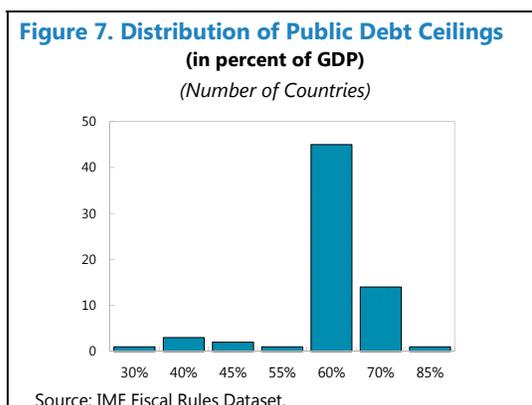
38. Explicit ceilings on public debt are a common feature of rules-based fiscal frameworks. About 70 countries worldwide currently have a rules-based fiscal framework that includes an explicit cap on gross public debt (Figure 6, left panel).¹⁸ As debt is often not directly controlled by policymakers, in practice most fiscal frameworks rely on binding budget deficit ceilings to make the debt cap operational. As of 2014, more than 80 percent of countries with a debt ceiling also had binding constraints on the budget balance, and among those, almost a third used expenditure ceilings as operational targets (Figure 6, right panel).

¹⁷ Well-defined escape clauses can mitigate the issue of too frequent breaches, although such clauses come with their own costs in terms of a loss of credibility, as well as potential complexities in implementing them.

¹⁸ Formal fiscal constraints established at the supranational level in the context of currency unions are included.



39. Debt ceilings are particularly widespread in the context of rules established at the supranational level. This is mostly in currency unions, where they serve as a goalpost for regional fiscal policy coordination. Specific ceilings vary greatly across countries, most of them falling between 40 percent and 70 percent of GDP (Figure 7). The clustering around 60-70 percent reflects in large part the strong representation of European Union (EU) and West African Economic and Monetary Union (WAEMU) member states in the sample of countries with fiscal rules.

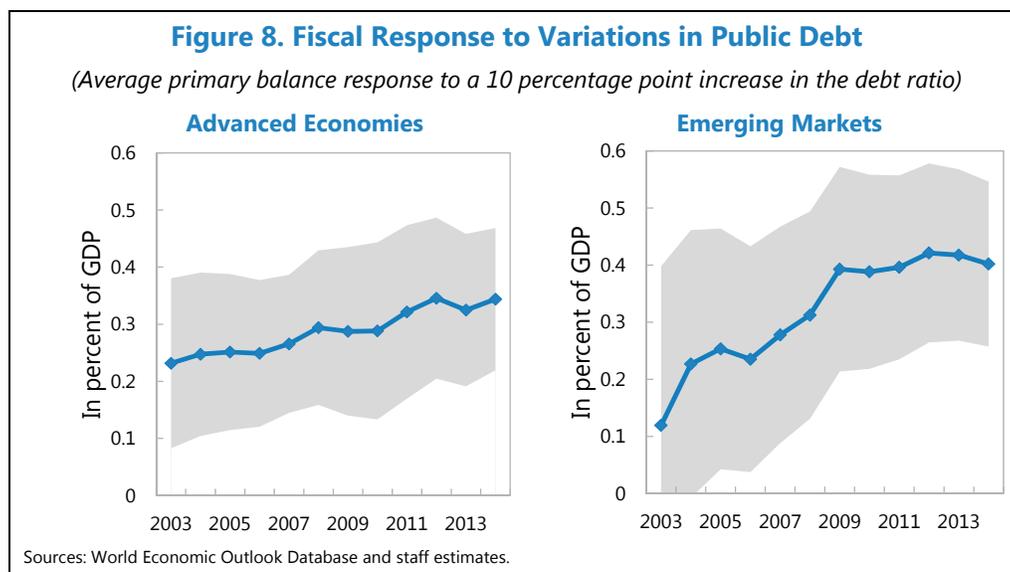


40. Such rules are mostly defined in terms of gross, rather than net public debt. In principle, to the extent that certain government assets can be easily liquidated to cover financial obligations, net public debt should be a more relevant ceiling than gross debt.¹⁹ A net debt ceiling also offers a more comprehensive coverage of balance sheet items directly connected to solvency and liquidity concerns. However, net debt can be complicated to establish and communicate, less transparent, and harder to compare across countries, since it is difficult to define which government assets are truly liquid, especially under stress.

41. Fiscal policy in AEs and EMEs has, on average, become increasingly responsive to public debt over the last decade. The “response” of fiscal policy to public debt can be measured by the degree to which fiscal policy is tightened—i.e., the primary balance rises—in reaction to an increase in the debt-to-GDP ratio. Staff econometric estimates point to an increasingly strong

¹⁹ The link between debt levels and borrowing costs tends to be mitigated by the government’s financial assets (see Appendix 3 for detailed estimation results). Net debt (gross debt net of financial assets) therefore seems to matter for creditors’ perceptions of solvency and liquidity.

reaction to public debt. For instance, while emerging economies, on average, showed a relatively insignificant response to debt developments through 2003, by 2012 the primary balance tended to improve by about 0.4 percentage point for every 10 percentage points of GDP increase in the public debt ratio (Figure 8).²⁰ The increase in the responsiveness to debt among AEs was less striking, rising from around 0.2 to over 0.3 over the same period. In contrast, there is no strong evidence that fiscal policy in LICs has responded to changes in public debt, which generally reflects the low debt environment and the focus of fiscal policy on developmental priorities in these countries.



42. The role of public debt as a key reference in rules-based fiscal frameworks puts a premium on a good understanding of the impact of risk on debt dynamics. As discussed above, the public finances are subject to significant shocks that can have substantial implications for the level of public debt. Hence, if public debt is allowed to remain too close to these ceilings, this implies a risk of breaches, which in turn can weaken confidence in the degree of commitment to the fiscal rule.

B. Debt Ceilings: Probabilistic Assessments

43. In the discussion below, the implications of incorporating risk into the analysis of public debt dynamics is presented. As mentioned above, fiscal authorities that are subject to debt ceilings will benefit from a better understanding of the risk that their policies could lead to a breach.

²⁰ Based on an empirical model measuring the response of the primary surplus to changes in debt levels, in a panel of countries as follows: $p_{it} = \lambda p_{it-1} + \rho d_{it-1} + \beta^+ ygap_{it} \mathbb{I}_{ygap_{it} > 0} + \beta^- ygap_{it} \mathbb{I}_{ygap_{it} < 0} + \kappa_i + \varepsilon_{it}$, where p is the primary surplus, d the debt-to-GDP ratio, and $ygap$ the output gap. The estimation is performed on a rolling window (to allow the coefficients to vary over time), and separately for AEs and EMEs. The biased corrected Least Square Dummy Variable (LSDV) estimation method is used. The overall estimation sample starts in 1985 and ends in 2014, with each rolling-window covering 20 years.

And armed with this information, policymakers may then decide to implement policy adjustments to increase the chances of keeping debt below the ceiling. Alternatively, if the required policy adjustments are viewed as being unwarranted, they may instead explore adjustments to the fiscal rule.²¹

44. The suggested approach estimates the probability of staying below the debt ceiling, taking into account the range of shocks affecting debt dynamics and the average response of fiscal policy to these shocks. Estimating that probability thus requires:

- An understanding of the drivers of debt dynamics over the medium-term, including the government's capacity to generate and sustain primary balances and the uncertainty surrounding interest rates, growth, the budget itself, and other relevant variables. To model the response of fiscal policy to these shocks, an estimated "reaction function" captures the average empirical policy response to output shocks and to debt developments themselves;
- Defining the relevant timeframe. Too short a horizon could lead to an understatement of the risk of breaching the debt ceiling or of the probability of getting back below it. Too long a horizon would undermine the confidence in projections for the outer years and produce probabilities with little immediate relevance for policymakers.

45. The probability of exceeding—or remaining below—the debt ceiling can be calculated using simulated distributions of future debt outcomes over a relevant time horizon. This is done by estimating the distribution of macroeconomic and fiscal shocks facing a given country, and then performing stochastic simulations of the future debt trajectory over the desired time horizon. The outcome of these simulations is a series of distributions of debt realizations for each year into the forecasting horizon. Those distributions allow calculating probabilities that public debt exceeds a given threshold at any point in time over the projection period, considering plausible constellations of shocks.

46. This approach can be adapted to data availability and the type of economy. The simulations can also either rely on explicit dynamic models of the key drivers of debt dynamics (as in Celasun, Debrun, and Ostry, 2007) or calibrated distributions of shocks (as in Budina and van Wijnbergen, 2007, or Baum and others, 2016). The first approach is appropriate for advanced economies and mature emerging markets for which data availability is less constrained and stable empirical relationships among variables are more likely (see, Debrun and others, 2016). The relevance of any forecasting model is indeed premised on its ability to identify reasonably stable relationships among relevant variables. The second approach would be better adapted to frontier and low-income economies undergoing rapid and profound structural transformation (Box 6).

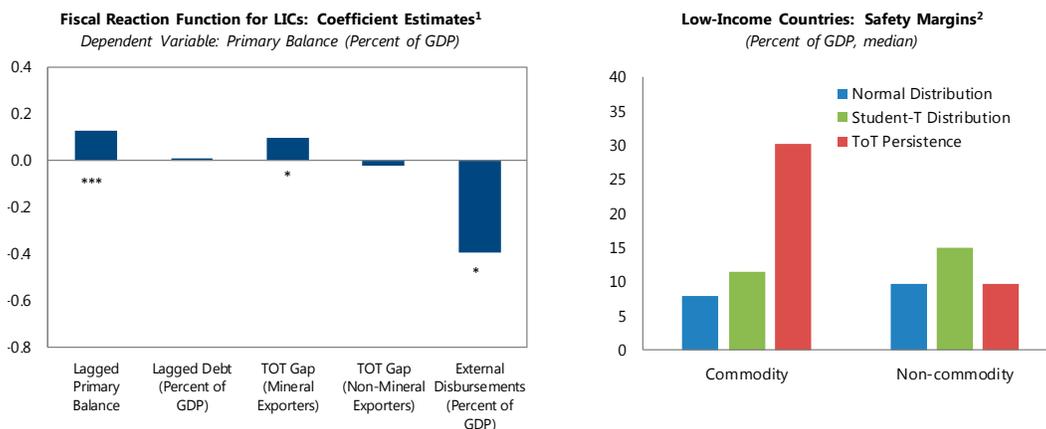
²¹ That would be the case if public debt is so far above the ceiling that the policy path required to lower debt below the ceiling within a short timeframe would be either politically or socially unfeasible, or economically too costly.

Box 6. Applying the Probabilistic Approach to Low-Income Countries

The paucity of data and higher macroeconomic volatility of LICs call for developing a tailored approach to measure the simulated distribution of debt outcomes in these countries. One of the novelties of the methodology developed for this group is that it accounts not only for standard shocks but also for tail risks. The main distinguishing features relative to AEs and EMEs are:

- **Volatility.** Country-specific volatility was simulated by drawing from a multivariate joint normal distribution—data constraints prevent the estimation of a VAR. While this approach controls for the correlation of risks, it does not fully capture tail events. Thus, as an extension, a multivariate student-T distribution (which has fatter tails) was also used to generate shocks.
- **Nature of shocks.** In addition to standard macroeconomic variables (growth, interest rates, exchange rates), simulations also included uncertainty regarding the terms of trade (ToT) and access to external financing. To proxy for the potential realization of contingent liabilities (which can be large in LICs) and other factors affecting debt dynamics, the distribution of stock flow adjustments (median) was accounted for at the individual country level.
- **Financing mix.** A distinction is made between different sources of financing (foreign versus domestic, and concessional versus non-concessional).
- **Fiscal behavior.** A fiscal reaction function was estimated specifically for LICs showing that fiscal policy is not necessarily guided by debt sustainability and stabilization objectives in these countries. In particular, the coefficient estimates for the fiscal reaction function (shown in the left panel below) reveal that the main drivers of fiscal behavior are financing constraints—in the absence of external financing countries reduce deficits—and terms of trade—commodity exporters tend to record larger primary balances when export prices are favorable. On the other hand, the primary balance does not react to lagged debt, although this does not necessarily imply explosive debt paths because of favorable interest rate–growth differentials.

This approach is useful to analyze the distribution of debt in the face of various shocks, a feature that is currently absent in the DSA framework for LICs. It can also be used to assess the size of the “safety margin” countries would need to absorb potential shocks and still stay beneath their debt thresholds indicated in the DSA. To illustrate this approach, the lower right panel shows the range of safety margins for a sample of 26 LICs. Overall, the safety margin tends to be larger in commodity importers even when considering tail risks (as proxied by the student-T distribution). However, in the face of persistent ToT shocks, the required safety margin for commodity exporters can increase exponentially, underlying the need to account for country-specific risk factors.

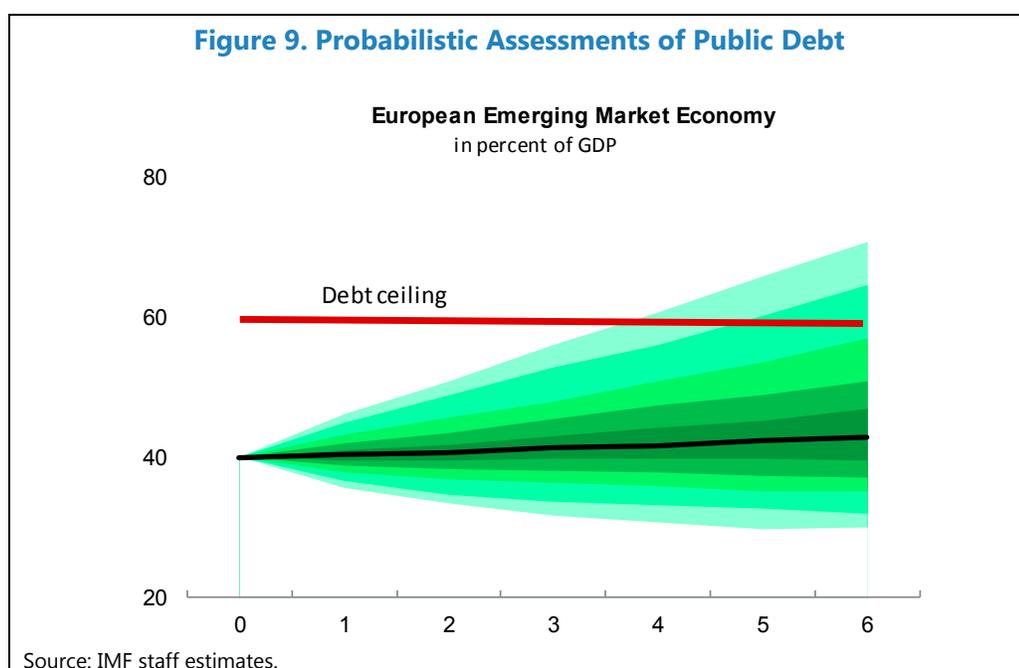


Sources: IMF, World Economic Outlook Database, and staff estimates.

¹ Stars indicate statistical significance at the (i) one percent level (three stars); (ii) five percent level (two stars); and (iii) ten percent level (one star).

² Distance between (i) the CPIA public debt threshold and (ii) the calibrated country-specific initial debt level that does breach the CPIA threshold under shocks over a six-year time horizon with a 95 percent probability.

47. The application of this approach is illustrated for an emerging market economy in Europe subject to the 60 percent debt ceiling in force in the European Union (Figure 9). In this case, the initial debt level of 40 percent of GDP might suggest that the country is at a negligible risk of breaching the EU debt ceiling in the foreseeable future. However, the stochastic projections—represented in the conventional form of a fan chart—indicate a non-trivial probability of 15 percent that public debt exceeds 60 percent by the end of the conventional forecasting horizon. Of course, the perceived risk embedded in such a probability and any corresponding decision to take action will depend on policymakers’ priorities. Ultimately, a quantitative assessment of risk can only inform judgment about whether such risk is benign and worth taking, or whether it commands an adjustment in the policy path after taking into account the potential costs of such adjustment. Similar considerations could also be formalized in well-defined escape clauses or regular reviews of the appropriate level of the debt ceiling.



48. The probabilistic approach described here could usefully complement those currently used in the Fund’s DSA (see, IMF 2011, IMF2012, IMF 2013a). In particular, the use of country-specific VARs captures the persistence of shocks over time and the correlation between different shocks, which is representative of the nature of fiscal risks (see earlier section).²² In addition, the incorporation of a fiscal reaction function allows for a realistic characterization of how policies may respond in the face of shocks, based on previous historical episodes. Still, as mentioned earlier, the validity of such an approach remains strongly conditioned on the quality of the statistical model used to produce the forecast. In particular, the possibility that relationships estimated using past

²² This approach goes beyond the standard practice of generating fan charts that assume either unchanged policies and non-persistent shocks (as in the DSA) or fan charts based on past forecast errors.

data may not be relevant for the future, the importance of a satisfactory goodness-of-fit of the forecasting model, and the need for a dynamically stable VAR are all considerations that should receive careful scrutiny.

49. The framework can be broadened to incorporate the effects of low-frequency, high-impact events, such as the realization of contingent liabilities. As discussed earlier in the context of fiscal stress testing, these can have a significant impact on the debt ratio and are surprisingly frequent (e.g., the average financial sector intervention has entailed fiscal costs of roughly 10 percent of GDP). There are a number of options for incorporating these risks into the model. For example, following Debrun (2005), the cost of a contingent liability shock occurring in the middle of projection period could be simulated. The effect of this shock on the evolution of public debt would depend on a number of factors, including the country's past fiscal behavior and how it has reacted to similar shocks.

IMPLICATIONS FOR FISCAL RISK MANAGEMENT

50. The foregoing discussion underscores the benefits of a risk-based approach to fiscal policy-making. This final section identifies priorities for countries wishing to strengthen fiscal risk disclosure, analysis, and management. Efforts to build capacity in these areas should be tailored to countries' level of development and constellation of risks, within which:

- Low-income countries and others with limited disclosure of risks should prioritize the development of macro-fiscal sensitivity analysis, especially to understand the fiscal implications of indicative shocks to prices and volumes of their main export commodities. Efforts should also be made to construct a basic financial balance sheet, with the initial focus on debt liabilities and liquid financial assets and progressive recognition of other financial assets and liabilities. This is especially important for those countries with significant sovereign wealth or development funds. Finally, these countries also need to improve their understanding and disclosure of major explicit contingent liabilities such as guarantees, PPPs, and disaster insurance schemes.
- As countries collect more information on sources of risk and build their analytical capacity, they should begin to construct alternative macro-fiscal scenarios based on plausible shocks to a range of macroeconomic variables underpinning their fiscal forecasts. Countries with significant natural resource assets and/or public pension liabilities could also look to bring them into their balance sheets and consider their implications for long-run fiscal sustainability. These countries should also not only report but also forecast developments in government financial assets, liabilities, and financial liquidity and net worth given the importance these data have for market confidence and sovereign bond yields (see earlier section and Appendix 3). They should also prepare comprehensive and quantified fiscal risk statements disclosing the value of both the *explicit* contingent liabilities discussed above as well as *implicit* contingent liabilities, especially those arising from SOEs, subnational governments, and the financial sector.

- Countries with comprehensive information on risk and developed risk-modelling capacity should focus on better integrating fiscal risk analysis into policymaking. This involves disclosure of confidence intervals (or “fan charts”) around forecasts for key macroeconomic and fiscal variables; preparation of comprehensive balance sheets of all assets and liabilities (including social benefits); publication of fiscal risks statements showing not only the size of explicit and implicit contingent liabilities but also estimates of their likelihood of realization where possible; and undertaking periodic stress tests of the public finances that combine stochastic shocks to key macro-economic variables with realizations of related contingent liabilities. This analysis should explore the implications of these shocks to government liquidity, sustainability, and solvency. It should also be used to inform the setting of long-term fiscal anchors as well as the determination of the fiscal stance in medium-term fiscal plans and annual budgets.

51. In addition to improving their understanding of the sources and magnitude of fiscal risks, governments could expand their capacity to manage and mitigate risks. As with analysis, priorities for strengthening fiscal risk management will depend upon a country’s capacity, specific exposures and the costs-benefit trade-off of mitigation measures. However, the above discussion points to the following priorities:

- Low-income countries, especially, would likely benefit most from approaches that rely on stronger direct controls over the creation of potential exposures including through legally-binding limits and centralized authorization of guarantees, PPPs, sub-national and SOE borrowing, and other explicit contingent liabilities.
- Emerging market economies and those with basic risk management in place could make more effective use of risk mitigation and transfer tools such as partial guarantees, risk-based fees, disaster reinsurance, and hedging instruments to incentivize better risk management and reduce their exposure in the event of risks materializing.
- Countries that already have sophisticated risk management systems could more explicitly recognize their residual exposure in their fiscal plans. This includes recognizing in budgets and financial statements potential future expenses related to expected calls on guarantees, payments under PPPs, subsidies to public enterprises, or restitution of environmental damage.
- All countries could strengthen institutional capacity to understand and manage risk at the center of government. This would entail the tasking of macro-fiscal units with ministries of finance with the monitoring and analysis of fiscal risks and development of risk mitigation policies. Their output could feed into regular discussions with senior officials and policymakers to evaluate emerging risks and agree on mitigating actions.

52. Greater use of probabilistic methods can help strengthen fiscal policy formulation. The experience of the past decades has illustrated that the public finances are subject to significant shocks, stemming from unexpected macroeconomic developments and from the materialization of explicit and implicit contingent liabilities. In addition, these shocks typically are tilted to the downside and can have highly nonlinear effects on public debt ratios. Therefore, when governments choose to anchor policies on a debt ceiling, it will be important to bear these risks in mind when setting policies and recognize that allowing debt ratios to remain too close to the ceiling may leave

the fiscal authorities at a greater risk of a breach, and impair their ability to exercise desirable countercyclical and growth enhancing policies in the face of an adverse shock.

53. The Fund is playing an important role in supporting improvements in fiscal risk analysis and management among its members. One important step in this regard is assistance in constructing public sector balance sheets, which is also a key element of the G20 Data Gaps Initiative, where the IMF is playing a significant role. A second step is in helping to develop institutions and capacity to identify specific fiscal risks and to better quantify their potential impact. IMF technical assistance actively supports members' efforts, and participation in Fiscal Transparency Evaluations provides an excellent starting point for countries in evaluating their fiscal risk analysis and defining priorities for enhancing fiscal risk disclosure and management. Third, countries are benefiting from technical assistance in building integrated fiscal risks analysis frameworks like the Fiscal Stress Test discussed above, and incorporating probabilistic methods into their fiscal projections. Finally, integrating risk analysis into the design of medium-term fiscal targets is given in the context of the Fund's assistance to countries in developing medium-term fiscal frameworks. This support to member countries is being provided within the current capacity development resource envelope.

Appendix 1. Managing Specific Fiscal Risks

A fiscal risk management framework can provide practical guidance for policymakers in managing specific risks. This section elaborates on the summary toolkit included in the main paper for the main categories of risks.

Financial sector risks

Systemic banking crises have been associated with significant fiscal costs. Public finances can have direct exposure to the banking system through state ownership of banks or guarantees of bank deposits, as well as indirect exposures, often realized in the form of bank recapitalizations, associated with securing liquidity and the flow of credit during systemic crisis. The average cost of government intervention in the financial sector across a sample of crises over the period 1990–2014 amounted to 9.7 percent of GDP, with the maximum fiscal cost exceeding 55 percent of GDP.¹

Governments have a number of options to manage fiscal risks from the banking sector, many of which have been identified and built upon since the great recession.² Examples include:

- Directly reducing financial sector exposure by reducing state participation in banks;
- Indirectly reducing exposure by strengthening financial sector regulation and supervision, for example by increasing bank loss-absorbing capacities and reducing excessive pro-cyclicality in banking systems through macro prudential measures, and reducing the bias that incentivizes the accumulation of debt in the tax system and attractiveness of leverage;
- Transferring risks to others, by requiring banks to finance deposit insurance and put in place effective resolution mechanisms (living wills); and
- Ensuring governments have capacity to absorb residual risk by creating buffer funds in the form of pre-funded deposit insurance schemes or through the setting of prudent debt level.

Guarantees

Government guarantees can expose governments to significant fiscal risks. Guarantees are often not subject to the same degree of budget scrutiny as regular expenditures, partly because their potential costs are typically deferred and there has been a traditional bias towards minimal reporting of their size and expected costs. Because they are off budget, budgets may inadequately provide for meeting obligations when they arise. The global stock of government-guaranteed bonds

¹ Data is from Bova and others (2016) which examined contingent liability realizations from 82 financial crisis episodes. Amaglobeli and others (2015) also found that the median direct fiscal cost of 65 banking crisis episodes during 1980-2011 was about 6 percent of GDP, while the median increase in public debt was more than 14 percent of GDP. Laeven and Valencia (2008) found the direct fiscal costs of 147 banking crisis episodes during 1970-2011 was 7 percent of GDP, while the median increase in public debt was about 12 percent of GDP.

² See also IMF (2015a) for a discussion in good practices for monitoring, measuring and reporting fiscal risks from the banking sector.

was estimated at US\$1.4 trillion in 2012 (IMF (2005)). Among European countries, 11 have notional exposures in excess of 10 percent of GDP.

Governments should develop systems to monitor and manage fiscal risks emanating from guarantees. Measures to manage risks include:

- Directly limiting exposure by controlling the issuance of guarantees through a central authorizing point and putting a quantitative limit on either the stock of outstanding guarantees (Philippines) or on the flow of new guarantees that can be issued during the year (Canada and Hungary). A ceiling can have particular merit where the government's risk exposure from guarantees is difficult to quantify.
- Charging risk related guarantee fees to reduce adverse selection of those participating in guarantee schemes (see Box A1.1 for the example of Sweden),
- Ensuring beneficiaries share some of the risk to minimize moral hazard, for example by requiring collateral to be posted or providing only partial guarantees (Canada).
- Ensure adequate budget provisions to meet calls on guarantees (and remove the bias in favor of their issuance over traditional subsidies). Governments can expense the cost of guarantees in the budget at the time the guarantee is provided (US, Colombia), or for countries with cash-based budgets, include a contingency provision for expected calls on guarantees.
- If sizeable, policymakers should consider whether exposures warrant the establishment of a guarantee reserve fund (notional or actual) to ensure sufficient space to accommodate future payments.

Box A1.1. Sweden: Managing Fiscal Risks from Guarantees

Sweden has a well-developed framework for managing guarantees. There are controls on the issuance of guarantees; decisions to issue guarantees are integrated into the budget process and guarantees require Parliamentary approval.

A fee must be charged for all guarantees, equal to the expected loss and other costs relating to the undertaking, unless Parliament determines otherwise.¹ The government retains the right to renegotiate the fee if the company takes a decision to change its risk profile. Where the Parliament determines that no fee should be charged or that it should be lower than the level reflecting the expected costs, funds must be allocated from the central budget to cover the fee, in connection with the regular budget assessment. This ensures that any subsidy element of the guarantee is treated in the same way as a grant or subsidy in the budget process.

Guarantee fees are paid into a notional contingency fund. If a guarantee is called, the government also maintains a claim on the guaranteed company to recover costs.

The Swedish Debt Management Office (DMO) is responsible for assessing the risks of guarantees and pricing the guarantee fee that will cover the risk. It also monitors changes in risk over the life of the guarantee. The DMO uses a variety of techniques to estimate the expected loss of the guarantee including reference to rating analysis, option pricing, and simulation models.

¹ The fee level charged must also reflect EU State Aid requirements.

Public Private Partnerships

Public Private Partnerships (PPPs) have the potential to improve the efficiency of infrastructure provision, but they can also be a major source of fiscal risk. PPPs can create debt-like obligations for the government where the government commits to paying for services over the life of the contract and may commit the government to a range of contingent obligations. Frequently, these debt- and guarantee-like obligations are not included in the government's fiscal aggregates. Controlling for these risks could involve:

- Ensuring there are central controls over approval of PPPs, quantitative ceilings on overall fiscal exposure, including direct service payments and contingent liabilities (Brazil, Peru, Hungary and El Salvador) and that there is an appropriate gatekeeping role for the Ministry of Finance in assessing risks and fiscal sustainability.
- Systematically subjecting projects to careful appraisal and value for money checks, undertaking independent review of project feasibility (e.g., Korea) and charging risk-related guarantee fees where they are provided (see Box A1.2 for the example of Chile).
- Ensuring the risk-allocation framework allocates risks to the parties best able to influence or control the risk, and introducing upper bounds where payments are linked to demand.
- Ensuring that the full lifetime costs and the potential fiscal exposure are transparently identified and budgeted for during the decision-making process.

Natural disasters

Natural disasters are a significant source of fiscal risk for disaster-prone countries. Between 1994 and 2013, total economic losses globally from natural disasters were estimated to be in the order of US\$2.6 trillion (equivalent to 4 percent of 2015 world GDP).³ Reconstruction of public infrastructure and provision of disaster relief have also incurred significant additional costs. The average country-specific fiscal cost of natural disasters across a sample of events over 1990-2014 was 1.6 percent of GDP, with the largest resulting in fiscal costs of 6 percent of GDP.⁴ Climate change has the potential to increase the frequency and severity of natural disaster.

In managing fiscal risks from natural disasters, countries should develop national strategies for natural disaster prevention, mitigation, and management. The strategy should: assess natural disaster risks; establish a framework for monitoring disaster risks including through early warning systems; put in place disaster preparedness and response mechanisms; and identify mitigating measures to reduce exposure to risks.

³ See Guha-Sapir, Below, and Hoyois (2016).

⁴ Bova and others (2016).

Box A1.2. Chile: Managing Fiscal Risks from Public Private Partnerships

Chile has had a long history with public private partnerships and a well-developed framework for their management. Under the Chilean framework, there are controls in place governing the granting of contracts. The law requires the Ministry of Public Works (MPW) to obtain approval from the Ministry of Finance (MoF) at different stages of contract preparation, including the issuing of bidding documents and the tender process. The MoF requires that all risks associated with the project are identified and that the projects economic and social benefits have been evaluated. The Minister of Finance must also approve PPPs through a supreme decree along with the Minister of Public Works, and this decree requires the approval of the comptroller and auditor-general and President.

Most of the project risks are borne by an SPV or transferred to third parties through insurance. Where government provides minimum revenue guarantees, it charges a fee for bearing this risk.

The approach to managing fiscal risks associated with PPPs relies heavily on quantitative analysis. PPPs are subject to cost-benefit analysis, and generally must have an expected annual social rate of return exceeding a specified threshold. The MoF uses a spreadsheet-based model to estimate the cost of possible guarantees, to set guarantee fees and to report information on the costs and risks of guarantees.

An annual appropriation is included in the budget to cover the potential loss from contingent liabilities created by the PPP portfolio. In practice, this appropriation represents a small fraction of the budget. However, the government has also initiated a long-term planning system for the PPP portfolio, covering all PPP commitments, an estimation of commitments for PPP under tendering or feasibility study, and provisions for future contract modifications and disputes to assess budget affordability of new projects and provide a long-term view of sustainability.

All PPP contracts are published. The Government also includes in various annual reports financial information on PPPs including the net present value of availability payments and estimates of the net present value of the guarantees, along with some value-at-risk information and partial information on the probability distribution of payments (although, these reports could be better integrated into the budget documentation).

Sources: Irwin and Makdad (2010) and Aslan and Duarte (2014).

Measures to mitigate natural disaster risks include:

- Directly reducing exposure through sectoral planning to reduce the public footprint in high-risk areas or indirectly by introducing tax premia in high-risk areas to discourage concentration of activity in those areas, and through specifying building codes to strengthen infrastructure.
- Transferring risks to international capital markets through traditional insurance, parametric insurance and reinsurance arrangements (New Zealand, Turkey), or issuing disaster-contingent instruments such as catastrophe bonds which forgive interest and principal in the event of specified catastrophes (See Box A1.3 for the example of Mexico), or weather derivatives that are triggered for example when temperature or rainfall exceeds or falls below a certain level. Risk transfer instruments tend to be costly, and so maybe more appropriate for remote events or where there is a risk that access to financing may be disrupted in the aftermath of a disaster. Risks can also be shared by capping payments and requiring deductibles under government provided insurance schemes or mandating private insurance in high-risk areas.

Box A1.3. Mexico: Managing Fiscal Risks from Natural Disasters

Natural disasters represent a significant fiscal risk in Mexico. Between 1999 and 2011 the costs of post-disaster reconstruction of public assets and low income housing averaged US\$880 million per year. Given these risks, the Federal Government established an institutional framework for disaster preparedness, mitigation and management. This includes a three-pronged financial risk management strategy:

- An annual budget provision in a fund for natural disasters (FONDEN) to meet the costs of disaster relief and reconstruction efforts for the most frequent types of disasters. The Federal Budget Law requires that a minimum 0.4 percent of the annual federal budget be set aside each year;
- Transferring part of public-sector natural disaster risk to international reinsurance markets; and
- Parametric catastrophe bonds to ensure adequate funds are available in the event of a natural disaster occurring.

Mexico was the first sovereign to issue a parametric catastrophe bond in 2006 to cover against earthquakes in three specific zones of the country. Under the terms of the bond, investors receive principal and interest payments unless an event triggers the transfer of the principal amount to the government. Under the initial “cat” bond, this required that: (i) an official state of emergency or disaster declaration be issued and (ii) that an earthquake was registered of a specified magnitude whose epicenter was within the pre-defined zones. In subsequent bond issues, the government expanded its coverage by pooling multiple risks across multiple regions.

- Policymakers should also set aside a contingency provision in the annual budget for retained risks, to meet the costs of moderate but frequent events. Natural disaster funds can also be established to buffer long-term fiscal costs and ensure funds are readily available in the aftermath of larger, more remote events (Mexico, New Zealand, Turkey).

Subnational governments

Liabilities of subnational governments can be a source of fiscal risk for central governments.

In some countries, off-budget activities and associated contingent liabilities of sub-national governments can also be significant. For example, subnational liabilities may be subject to explicit guarantees from the central government, and where they are not, there can be strong expectations the central government will step in to support troubled subnationals. Expectations of bailouts can weaken market discipline and lead to excessive risk taking by subnational authorities.⁵ The materialization of risks from subnational governments can be costly, with the fiscal costs of subnational bailouts averaging around 3.5 per cent of GDP, per event, over the period 1990–2014 (Bova and others (2016)).

The financial health of sub-national governments should be monitored and their risks actively managed.

Local governments could be classified into different risk categories depending on their financial soundness, with varying degrees of autonomy and monitoring requirements attached to each category (See Box A1.4 for Iceland’s risk management framework for sub-national governments). For example, explicit limits could be placed on the stock of liabilities, debt service costs, or limits on certain types of borrowing (e.g., local currency only) or for certain purposes

⁵ For discussion, see Ahmad and others (2005).

(investment only). For economies with well-developed financial markets, these controls could take the form of market-imposed discipline provided this is backed by clear and credible no-bail out provisions. Enforcement mechanisms and sanctions could be imposed on non-compliers, for example by requiring the authorities to enter into restructuring plans, withholding transfers, retaining power to liquidate assets, and ultimately, retaining the power to appoint a financial administrator to manage operations.

Box A1.4. Iceland: Managing Fiscal Risks from Sub-National Governments

In 2011, the Icelandic government implemented extensive reforms to manage fiscal risks from sub-national governments. Fiscal rules were imposed on municipalities, along with enhanced fiscal oversight arrangements and enforcement mechanisms for non-compliers. The Local Government Act of 2011 introduced:

- A three-year rolling balanced budget rule for municipalities and a limit on the ratio of debt and other balance sheet liabilities to revenue of 150 percent;
- A three-tier system for monitoring municipal finances based on the principle of earned autonomy, in which municipalities breaching fiscal rules are subject to increasing monitoring; and
- A Municipal Fiscal Oversight Committee (MFOC), an independent body with the power to impose sanctions on municipalities that breached the rules.

Municipalities are classified into one of three categories depending on the extent to which they comply with the two fiscal rules, with those in higher risk categories subject to increased monitoring and reduced autonomy:

- Municipalities that comply with both fiscal rules are subject to minimal reporting and have full autonomy within the limits of the rules (category 1);
- Municipalities in breach of one of the two fiscal rules, are subject to increased monitoring, need to agree a five- to ten-year fiscal adjustment strategy with the MFOC, and are restricted to borrowing in local currency (category 2); and
- Municipalities with excessive debt (debt in excess of 250 percent of revenues), in addition to the restrictions of category 2 municipalities, must also obtain approval for all major revenue, expenditure (including investment) and borrowing decisions from the MFOC (category 3).

Further sanctions are available to the MFOC in order to enforce compliance, including 'naming and shaming' non-complying municipalities, withholding transfers, and recommending to the Minister of Local Government that a municipality have its fiscal powers vested in a financial management board.

Public Sector Corporations

Public sector corporations are frequently a significant source of risk to government finances as their liabilities are often explicitly or implicitly government guaranteed and they are often required to carry out quasi-fiscal operations. For profitable entities, the main fiscal risks relates to variability in dividends and corporate income taxes, and the absence of information as to potential future market conditions that could impact on corporate finances. Loss-making entities constitute larger fiscal risks, as they may require periodic recapitalization or on-going support. The average cost of government intervention in public sector enterprises across a sample of events over the period 1990–2014 amounted to about 3 percent of GDP (see, Bova and others (2016)).

Financial performance of public corporations can be monitored to inform assessments of fiscal risk and their management. A common set of financial indicators, similar to those used in the corporate sector, can be used to help inform assessments of fiscal risks. Governments can identify the more problematic entities so as to focus their oversight on those that present the largest fiscal risk and ensure monitoring activities are commensurate with the degree of fiscal risk they pose. The institutional framework for fiscal oversight of SOEs should also be supported by sound governance principles and proper accountability mechanisms⁶ (see Box A1.5 for South Africa’s framework for oversight of SOEs).

Box A1.5. South Africa: Managing Fiscal Risks from State-Owned Enterprises

South Africa has a relatively well-developed oversight framework for monitoring state-owned enterprise (SOE) performance. The Public Financial Management Act (PFMA) and Treasury Regulations require that SOEs, submit corporate plans annually, covering a period of three years, and outlining the strategic objectives, agreed with the government, key performance indicators for assessing the entities performance, a risk management plan, and a financial plan. The financial plan must include: projections of revenue, expenditure and borrowings, asset and liability management, capital expenditure programs and dividend policies.

The PFMA sets controls on borrowing and contingent liabilities of SOEs. The Minister of Finance must authorize the issuance of guarantees or indemnities. Some SOEs must also obtain the Minister’s approval before borrowing and all SOEs may not borrow in foreign currency above a prescribed limit set by the Minister. Entities that are permitted to borrow must submit annual borrowing programs to the National Treasury as well as quarterly reports on actual borrowing.

A Fiscal Liability Committee has been established within the National Treasury to advise the Minister on these matters as well as short and medium-term risks related to SOEs. The committee receives reports on the financial performance of SOEs and their compliance with any conditions attached to fiscal support, which are assessed as part of its aggregate fiscal risk monitoring.

SOEs are required to submit audited annual financial statements in accordance with generally accepted accounting practices within five months of the end of the financial year to the shareholder minister and the National Treasury. SOEs are also required to submit quarterly reports to their shareholder Minister.

Governments can reduce their exposure to fiscal risks from public corporations by:

- Reducing overall state participation in commercial activities and reduce the size of quasi-fiscal activities.
- Limit exposure to contingent liabilities by ensuring there is a clearly defined set of criteria to govern the provision of any explicit government guarantees, prohibit or control the issuance of guarantees by SOEs to third parties, and where appropriate, restrict the sale or use of their assets as collateral in financing transactions.
- Strengthening governance arrangements, for example through appointing independent boards based on transparent and merit-based nomination processes, holding them accountable for

⁶ See for example, the OECD (2015) for guidelines on corporate governance of state-owned enterprises.

financial performance, ensuring there is operational autonomy, and legislating high standards of financial reporting and subjecting annual accounts to external audit;

- Legislating explicit no-bail out clauses to reduce exposure;
- Ensuring there is transparent and appropriate compensation for public corporations executing quasi-fiscal activities to achieve government goals and that subsidies for these activities are appropriately expensed in the budget;
- Finally, as for other risks, ensuring there is fiscal space to absorb retained risks through for example, a general contingency reserve to cover any calls on government guarantees to public corporations, or to cover unforeseen cost in case of their restructuring or liquidation.

Appendix 2. Fiscal Risks Stress Test Methodology

The FST applies a large, correlated macroeconomic and asset price shock, combined with a contingent liability realization, to assess what fiscal impact there might be during an extreme macroeconomic event, such as during the global financial crisis. There are three key elements:

- A macro-fiscal shock: identifying an extreme macro scenario, and applying it to the fiscal forecast, in order to account for non-linearities and budget rigidities;
- A contingent liability shock, based on an assessment of those contingent liabilities that might be realized in the event of a macro crisis and their cost;
- An assessment of the impact of the macro-fiscal shock and contingent liability realization on the government's comprehensive balance sheet, incorporating the value of future revenues and expenditures to provide a fuller picture on fiscal solvency.

The FST provides three summary outputs for use in assessing fiscal risk, as well as providing guidance on the channels through which a macroeconomic crisis might impact public finances. The three summary outputs illustrate the impact of the shock scenario on:

- Fiscal solvency, as assessed against the change in the government's net worth or net financial worth, incorporating future fiscal flows;
- Government liquidity needs, as assessed against gross financing needs; and
- The financing burden, in the form of interest expense against revenue collections.

Macro-fiscal

The FST methodology involves the assumption of a large macroeconomic shock. This shock, in turn, is assumed to feed through to the range of key macroeconomic variables that affect individual country public finances—e.g., GDP, inflation, exchange and interest rates, housing and equity prices, and commodity prices. The scenarios are constructed and applied through a formal macro model, such as the IMF's FSGM, country authorities' own models or where neither are available through rule-of-thumb relationships.

The stress tests are intended to examine the impact of very large—e.g., once in twenty- or thirty-year events—rather than typical year-to-year volatility. Decisions on the precise size of the shock for a given country is guided by its historical experience. Typically, the size of the shock will be in the range of two to three standard deviations from the average volatility experience in the past. This means that the stress tests will tend to use shocks that are considerably larger than the shocks used under conventional DSA, which tends to be around one standard deviation (and a quarter standard deviation for the combined scenario, when primary balance, interest rates and exchange rates are all shocked simultaneously).

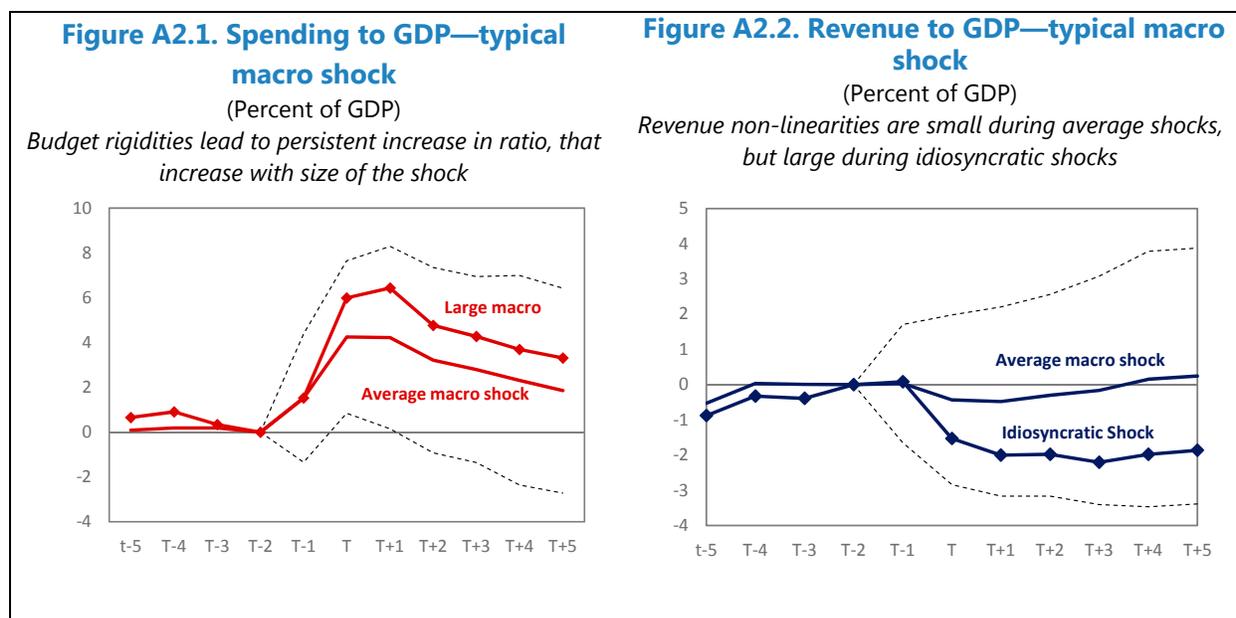
However, the stress scenario also looks beyond individual country experience and is forward-looking. Assumptions that relative macroeconomic stability in the past will necessarily be continued in the future need to be carefully scrutinized, a key lesson from the global financial crisis. Thus, the choice of the stress scenario should also be informed by the experience of comparator countries. Moreover, it is also important to consider the implications of longer lasting, or even permanent, shocks especially in light of cross-country experience that shows that large financial and other crises leave real GDP well below pre-crisis trends.¹

The impact of the macroeconomic shock on the fiscal accounts is then examined by applying it to a detailed fiscal forecasting framework. This framework would largely be based on the fiscal forecasting files commonly maintained by Ministries of Finance and IMF country teams. This has the benefit of a more granular assessment of the impact of the shock on individual revenue and expenditure categories, and helps take into account the budget rigidities and non-linear relationships that may be better captured by a more detailed fiscal projection model, as standard high-level fiscal projections tend to break down during severe macro events.

Fiscal non-linearities relating to both the expenditure and revenue side are addressed by taking the granular forecasting approach. These two sources of fiscal non-linearity can increase the size of and persistence of the fiscal impact of a macro shock beyond what conventional analysis allow for. An analysis of macroeconomic shocks in AEs since 1990 have identified two main non-linearities:

- First, **budget rigidities** mean that expenditure cannot be significantly reduced as nominal GDP falls, due to difficulties in adjusting down nominal wages, pensions, and entitlements. This leads to a persistent increase the expenditure to GDP ratio (averaging 2 percent of GDP), which increases in size with the magnitude of the macroeconomic shock (Figure A2.1).
- Second, **revenue non-linearities** mean that the share of revenue to GDP often declines during crises, as normal revenue elasticities to activity measures break down. During a typical macro shock, the impact on the revenue side is relatively small, at around half a percent point of GDP, and does not increase with the *size* of the shock. However, the nature of the macro shock can have a large ramifications, with idiosyncratic macro shocks, caused by property busts, financial crises and shocks to highly revenue-dependent sectors of the economy (such as commodities), typically lead to significant falls in revenue to GDP ratios, averaging around 2 percent of GDP (Figure A2.2). This is because idiosyncratic shocks can have large impacts on specific, and often important, revenue heads. For instance, commodity price declines can have disproportionately large impacts on corporate tax payments, royalties and dividends; falling house prices can reduce housing transaction and capital gains taxes disproportionately; and equity market contractions can lead to persistent weakness in capital gains taxes through loss carry-forwards on future revenue collections (see IMF, 2015b).

¹ See IMF (2015f).



These non-linearities are considered in a fiscal stress test both in the design of the macro shock and application of it through the fiscal model. The nature of the shock should be designed to fit the country's particular circumstance: commodity exporters should be hit with a commodity price shock; a country experiencing a property boom, or whose financial sector is heavily exposed to household mortgages should be hit by a house price shock. As a guide, any revenue heads that have grown well in excess of nominal GDP over the past half-decade (not due to policy changes), should be tested. On the fiscal side, standard revenue elasticities may be manually increased, and long running loss carryforwards included within the analysis. For expenditures, nominal wage and social security rates can be held constant, rather than allowed to fall in line with lower GDP to account for budget rigidities; and lags applied to expenditures, to account for the inability of annual budgets to be adjusted quickly.

The macro-fiscal analysis, when combined with the contingent liability analysis (see below), provides the key fiscal flows and fiscal aggregate outputs usually included within a standard DSA. These include revenues, expenditures and fiscal balance, public debt and gross financing needs, which are incorporated into the balance sheet analysis in order to identify fiscal solvency implications.

Contingent Liability Analysis

The stress scenario goes beyond looking at the standard macro-fiscal impacts that drive the debt accumulation identity, by factoring in the impact of the contingent liability realizations. Contingent exposures are highly correlated with macroeconomic shocks, but are often ignored or the potential costs associated with their realization are not adequately explored in conventional approaches. Public guarantees, debts of state owned enterprises and the calling of international obligations often have large impacts on the public debt when countries are under stress.

Furthermore, implicit guarantees, such as those enjoyed by the domestic banking sector also have serious implications for the public finances as governments are forced to act to recapitalize banks, create bad banks to house non-performing loans, or take over banks entirely, bringing their liabilities within the general government.

The assessment and impact of the shock on major contingent liabilities extends the existing approach in the IMF’s fiscal transparency evaluations by identifying their likelihood and risk.

The first stage of contingent liability analysis requires the identification and quantification of contingent liabilities, both implicit and explicit, as is already being done by a number of countries and as performed in the third pillar of the Fiscal Transparency Evaluation. The stress tests require a number of additional steps to incorporate this into the analysis:

- An assessment of the **likelihood** of realization under the stress scenario, by identifying the risk factors of each of the major contingent liabilities, to determine whether the shock (or feedback from the shock) would lead to a realization event. Where possible, these are linked to macroeconomic variables.
- A **quantification** of the stress-scenario related costs of the contingent liability realization, or the loss given default. This will often vary from the reported maximum loss amounts, as the cost of recapitalization are often lower than reported losses due to factors such as existing capital buffers, potential recovery costs (though these are usually realized sometime after the event) and bail-ins of other creditors.

Where data exist, the contingent liability analysis can be extended further to provide a probabilistic assessment of risk realization. Identifying fiscal risk factors and linking them to the key macro shock inputs allows varying degrees of contingent liability realization to be tested. For instance, the size of the losses of a state-backed housing fund holding mortgages can be assessed against the two macro factors of unemployment and house prices to determine losses against a range of stress scenarios. These ranges can provide policy makers with guidance as to the size of fiscal buffer they may need to provide for, under more or less likely stress scenarios dependent on their appetite for, and level of willingness to absorb the identified risks. This approach is both data and resource intensive, but can work off existing analytics, such as undertaken for the banking sector stress tests, contingent claim analysis (see Box 1) or assessments of the financial health of state owned enterprises.

The results of the contingent liability analysis feeds into the other two elements of the stress test. For the macro-fiscal analysis, the impact of contingent liability realizations on deficit and public debt will affect the fiscal aggregates, while the need for additional financing (as distinguished from the assumption of another entities’ debts, such as occurs when guarantees are called) has important implications for GFNs. On the balance sheet, realization of contingent liabilities often brings accompanying assets, which need to be accounted for. These assets can be macro critical in size, partially—and in some cases completely—offsetting the cost of the contingent liability realization.

Balance Sheet Analysis

In addition to being applied to the fiscal flows and debt stock data, the overall government balance sheet is subjected to the fiscal stress. The first impact is increased debt liabilities stemming from the macro-fiscal analysis. The second impact is on the valuation changes of existing assets and liabilities. To do this, rules of thumb are applied to the value of particular asset and liability classes in line with the macro parameters. For instance, government equity holdings—both direct and those held by sovereign wealth and pension funds—are impacted by equity price changes, valuations of land holdings reduced by housing price and commodity price declines. This provides a sense of how a government’s net worth, or net financial worth may vary, but can also reveal offsetting impacts, such as the impact of lower discount rates on pension liabilities, or increases in external asset holdings through exchange rate depreciation.

The comprehensive balance sheet assessed in the FST also incorporates future revenues and expenditures. While balance sheet assessments provide useful information, they are often criticized for ignoring the government’s most valuable asset and liabilities—the ability to levy taxes and the cost of providing goods and services for its citizens in the future. Recognizing this, the fiscal stress tests incorporate future discounted revenue and expenditure flows, with the difference between the two (the fiscal gap) showing up within the net worth figure. This provides a sense of how large future discounted revenues and expenditures are, often many multiples of the size of the existing balance sheet. It also allows a number of pieces of analysis to be undertaken: (i) it incorporates the cost of demographic change, based on long-term fiscal projections or IMF analysis within the balance sheet; (ii) identifies the long-term discounted cost of fiscal shocks to be assessed relative to the baseline; and (iii) provides sensitivity analysis of the balance sheet to commodity price fluctuations.

Solvency, Liquidity and Fiscal Burden

The FST provides three key summary outputs, to provide a guide to solvency, liquidity risk and fiscal burden. The level and change in comprehensive net financial worth, or net worth where non-financial assets are available, provides indicates the state’s solvency under current policies, as a baseline; and the long-run impact of the shock on solvency. The measure of gross financing needs provides a nuanced assessment of liquidity risk. It identifies the financing needs of future fiscal deficits, the amortization needs of existing debt, and the liquidity needs of contingent liability assumption. The latter element can be quite different to the increase in public debt associated with the contingent liability realization, as in many cases, such as guarantees being called, the debt will be assumed, and therefore not need to be financed initially. Finally, the cost of interest relative to revenue gives a guide to the fiscal burden on future taxpayers, as those revenues will not be available to fund public goods. If the fiscal burden becomes too large, political economy pressures may build for some form of strategic default.

Appendix 3. Public Debt and Sovereign Bond Yields— Updated Evidence

A large body of the literature has examined the determinants of sovereign bond yields. These studies have traditionally focused on domestic fundamentals such as countries' fiscal positions (primary balance and public debt), macroeconomic conditions (inflation, real GDP growth, short-term interest rate), and institutional characteristics (e.g., financial developments and political risk). Empirical studies have systematically included global factors since the global financial crisis (see, e.g., Baldacci and Kumar, 2010; Escolano and others, 2014; Jaramillo and Weber, 2013) and tend to find a positive relationship between public debt levels and sovereign bond yields. Estimated coefficient sizes have varied across studies depending on the sample composition, the estimation technique, and the specific controls included in the estimations.

Staff empirical analysis extends the existing literature along two dimensions. First, we present updated estimates for both AEs and EMEs, in a sample spanning the global financial crisis—the empirical analysis is based on 31 AEs and 19 EMEs from 1990–2014.¹ Second, we assess the role of government financial assets on the pricing of sovereign bonds, as a first step towards accounting for the asset side of the public sector balance sheet.

We estimate the following relationship between sovereign bond yields and public debt, controlling for other relevant determinants of bond yields, separately for a panel of AEs and EMEs:

$$r_{it} = \alpha_i + \beta d_{it} + \varphi W_{it} + \gamma_h^D X_{it}^D + \gamma_h^* X_t^* + \varepsilon_{it}$$

Where r is the 10-year bond yields on government bonds; d is the public debt-to-GDP ratio (lagged to avoid reverse causality); W represents government's financial assets (in percent of GDP); X^D is a set of other relevant domestic controls (primary balance, real GDP growth, expected inflation, and short-term interest rate); and X^* comprises selected global factors (10-year U.S. bond yields and global risk aversion). These variables capture different channels through which the macro-fiscal conditions affect sovereign bond yields:

- *Real GDP growth* increases the government tax capacity, therefore improving its ability to service public debt; it also facilitates deleveraging, directly via the denominator effect. At the same time, positive output growth may reflect a positive shift in the economic outlook (higher potential output) and exert upward pressures on bond yields. The net effect of those various factors is uncertain.
- *Public debt-to-GDP ratio.* A higher public debt-to-GDP ratio implies that the government has to devote a larger part of budgetary resources to debt servicing, leaving little room for growth-enhancing spending—the risk of debt overhang is larger at high debt levels. High public debt ratios may also raise concerns over government solvency, as the string of primary balances needed to bring public debt to a sustainable level could be very hard (or impossible) to achieve. Moreover, there is empirical evidence that the likelihood of sovereign debt distress increases

¹ The sample size, however, is significantly restricted when the econometric specification accounts for the size of governments' financial assets, for which data are limited.

beyond certain public debt levels (see Box 5, main text). In light of these channels, investors would request additional risk premium for holding the bonds of highly leveraged governments, all else being equal. The expected sign of the public debt coefficient (β) in the bond yields equation is therefore positive.

- The *short-term interest rate* controls for the stance of monetary policy, especially relevant for the recent episode during which monetary policy has been constrained at the zero lower bound in AEs, with spillovers into EMEs. The no-arbitrage condition implies a positive relationship between short-term rates and long-term interest rates, given that investors have the option to rollover short-term notes.
- The *expected inflation* captures the extent of the inflation tax on domestic bond holders—higher expected inflation lowers the real rate of returns on bonds—and would therefore have a positive impact on bond yields.
- The *Primary deficit* is still one of the main headline barometers for the direction of fiscal policy—public debt is sustainable as long as the government can commit to a string of sustained primary surpluses to service it.² It is however uncertain whether the primary balance would still be significant after accounting for the level of public debt.
- *Financial assets* strengthen governments' balance sheets and would lower government bond yields to the extent that they can be liquidated to service debt.
- *Global risk aversion* (proxied by the VIX).³ Investors seek safe havens at times of heightened market volatility and often use low-risk government paper as a refuge as they await for more tranquil times, while demanding higher returns on more risky ones. The average impact of global risk aversion on sovereign bond yields is therefore uncertain *a priori*.
- *U.S. long-term interest rate*. This is included as a proxy for global financial conditions, given that U.S. rates have traditionally driven global rates, a trend that seems to be confirmed by the response of bond markets to the ongoing policy tightening by the U.S. Fed, starting with the May 2013 taper tantrum (see Escolano and others, 2014). One would expect a positive co-movement between U.S. long-term rate and sovereign bond yields as investors “search for yields”.
- The *country fixed-effect* is included to capture other countries' institutional characteristics (political risk, level of financial development, existence of a fiscal rule, etc.) and structural features such as high domestic savings, that may also affect the pricing of government paper, but move only slowly overtime.

² The primary deficit is used instead of the overall deficit because the later includes interest costs, which are correlated with the dependent variable and would result in reverse causality.

³ The VIX (Chicago Board Options Exchange Market Volatility Index) is a measure of the implied volatility of S&P 500 index options.

Estimations suggest important disparities across AEs and EMEs on the impact of public debt on sovereign bond yields.⁴ An increase of one percentage point of GDP in gross public debt raises sovereign bond yields by about 3 bps in AEs, and by 7 bps in EMEs. This impact emerges after controlling for other relevant factors listed above (Table A3.1).⁵

Table A3.1. Public Debt and Sovereign Bond Yields

	Advanced Economies		Emerging Market Economies	
US 10-year bond yields (in percent)	0.478*** (0.130)	0.641*** (0.123)	0.032 (0.273)	-0.302 (0.634)
VIX (index)	-0.016 (0.014)	-0.003 (0.009)	0.024 (0.019)	-0.004 (0.028)
Short-term interest rate (in percent)	0.551*** (0.082)	0.451*** (0.070)	0.857*** (0.091)	0.820*** (0.087)
Lagged gross debt (percent of GDP)	0.032** (0.013)	0.027** (0.011)	0.073*** (0.016)	0.164** (0.059)
Primary balance (percent of GDP)	-0.060* (0.031)	-0.093*** (0.032)	-0.002 (0.120)	-0.260** (0.104)
Expected inflation	0.070 (0.110)	-0.024 (0.057)	0.168* (0.081)	0.311 (0.253)
Real GDP growth	-0.212* (0.105)	-0.125** (0.058)	-0.024 (0.074)	-0.128 (0.138)
Lagged financial assets (percent of GDP)		-0.021 (0.013)		-0.172*** (0.039)
C	-0.220 (0.724)	-0.257 (0.364)	-3.062*** (0.695)	-3.561 (2.520)
N	552	363	228	99
R2	0.694	0.790	0.797	0.871

Standard errors in parentheses * p-value<0.1; ** p-value <0.05; *** p-value <0.01

Source: IMF staff estimates.

Financial markets seem to account for the size of government financial assets in the pricing of sovereign bond yields in EMEs. An increase in government financial assets by a percentage point of GDP lowers government bond yields by about 17 bps for a given level of gross debt in EMEs, but has no material impact in AEs.⁶ Net debt (gross debt net of financial assets) therefore matters for solvency as perceived by financial markets, a finding that complements existing studies on the determinants of bond yields.

The above result does not account for the liquidity of government financial assets. In practice, however, government assets may take different forms, including investment in pension funds and equity, and cannot always be readily liquidated to meet immediate financings needs if the government comes under financing pressure. Data were not available to judge the liquidity of these assets.

⁴ Data used in the estimations are from the IMF *World Economic Outlook* database and the *Fiscal Monitor* database, except for the VIX, which is obtained from the Chicago Board Exchange (CBOE), and the U.S. 10-year government bond yields from the Federal Reserve Board.

⁵ For instance, flow budget variables (primary deficit) increase bond yields beyond the impact of the debt stock.

⁶ Interestingly, this result is not driven by major oil exporters with large sovereign wealth funds. Data on bond yields are not available for those countries and they are therefore not part of the estimation sample.

Appendix 4. Incorporating Uncertainty into Public Debt Projections

This appendix presents the building blocks of an algorithm that accounts for macro-fiscal uncertainty in tracing public debt dynamics. The algorithm allows for an assessment of the probability that public debt will stay beneath a given debt ceiling (as a share of GDP) between an initial year and the end of the forecasting horizon.

Following Celasun, Debrun, and Ostry (2007), the algorithm simulates a range of debt paths, based on: (i) an economic block; (ii) a fiscal block; and (iii) a debt dynamics and simulation block.¹

- *Economic block*: This provides (a) estimates of country-specific shocks to macroeconomic variables such as the interest rate, growth, and the exchange rate that a country was subject to in the past; and (b) projections for non-fiscal elements of the debt-dynamics equation.
- *Fiscal block*: This estimates/calibrates (a) how the primary balance responds to debt; (b) country-specific shocks to the primary balance; and (c) the maximum primary balance that can be achieved.
- *Debt dynamics and simulation block*: This traces the dynamics of public debt by combining the economic and fiscal blocks into a standard dynamic equation of debt.

Data availability and country-specific factors dictate different approaches for AEs and EMEs on the one hand and LIDCs on the other. These are outlined in the sections below.

Economic block

In the case of AEs and EMEs, we estimate an unrestricted vector autoregression (VAR) at a quarterly frequency for each country describing the joint dynamics of the non-fiscal variables needed to project public debt, namely interest rates, GDP growth, and the exchange rate. Formally, we write:

$$Y_t = A_0 + \sum_{k=1}^p A_k Y_{t-k} + \varepsilon_t,$$

with $Y_t = (r_t^{us}, r_t, g_t, z_t)$. The A 's are vectors of coefficients, while r^{us} represents the real foreign interest rate; r the real domestic interest rate; g the real GDP growth rate; z the (log of the) real effective exchange rate; and ε_t is a vector of normally distributed error terms: $\varepsilon_t \sim N(0, \Omega)$.

The VAR plays two roles. First, the estimated variance-covariance matrix of residuals Ω is the basis to calibrate the generation of random, non-fiscal shocks. Specifically, we produce a sequence of shock vectors $\hat{\varepsilon}_{t+1}, \dots, \hat{\varepsilon}_T$ such that $\forall \tau \in [t+1, T]$, $\hat{\varepsilon}_\tau = \Lambda \mu_\tau$, where Λ is the Choleski factorization of Ω ($\Omega = \Lambda' \Lambda$) and $\mu_\tau \sim N(0, 1)$. Second, we feed the simulated shock sequence in the estimated VAR to obtain consistent forecasts of Y . As shocks occur each period, the VAR produces joint dynamic responses of all elements in Y .

¹ See also Debrun, Jarmuzek, and Shabunina (2016), who build on Celasun, Debrun, and Ostry (2007).

For LICs, random shocks to macroeconomic variables (growth, interest rates, exchange rates, terms of trade, and external financing) are drawn from a multi-variate normal distribution. Interest rates are further differentiated according to the source of financing (domestic versus foreign and concessional versus non-concessional). The relevant series are extracted from the variance-covariance matrix of historical shocks (rather than from the estimated variance-covariance matrix in the VAR) and added to the historical means.

Fiscal block

The fiscal reaction function follows a well-established specification aimed at capturing the main features of typical fiscal policy responses. In line with Bohn (1998), it captures solvency by linking the primary balance to debt, while accounting for current economic conditions reflecting the business cycle. We estimate the reaction function separately for AEs, EMEs, and LICs.

$$pbal_{it} = \alpha + \beta_1 pbal_{it-1} + \beta_2 ygap_pos_{it} + \beta_3 ygap_neg_{it} + \rho debt_{it-1} + \emptyset X_{it} + \delta_i + \varepsilon_{it},$$

where *pbal* is the primary balance in percent of GDP, *ygap_pos* is the positive output gap, *ygap_neg* is the negative output gap,² *debt* represents the lagged debt level as percent of GDP, and *X* represents other variables that are specific to LICs. In the case of LICs, there is no robust evidence that the primary balance respond to changes in the output gap (fiscal policy does not play a stabilization role in general) and, thus, the output gap was omitted. On the other hand, two additional controls were included for LICs: terms of trade and access to external financing.³ Results are presented in Table A4.1.

The reported estimates for AEs and EMEs are in line with the empirical literature.⁴ Importantly, countries have tended to react strongly and in a stabilizing fashion to public debt developments. Furthermore, the primary balance tends to be persistent, and sensitive to economic conditions, but in an asymmetric fashion. When the output gap is negative, a widening of the output gap worsens the primary balance, pointing to a fairly large countercyclical response in bad times for both AEs and EMEs. By contrast, any widening of an already positive output gap is not reflected in a statistically significant improvement of the primary balance for neither AEs nor EMEs, in line with a well-documented tendency to spend revenue windfalls in good times.

In the case of LICs, the primary balance does not react to changes in public debt.⁵ At the same time, terms of trade have a large positive impact on the primary balance but, as expected, only for

² The positive and negative output gaps are included as separate controls in the fiscal reaction function to account for a potentially asymmetric response of fiscal policy over the business cycle (good versus bad times).

³ The specification for LICs also controls for debt relief.

⁴ Among others, see for example, Celasun, Debrun and Ostry (2007) and Mauro and others (2013).

⁵ This result is quite robust and holds even after controlling for debt relief episodes. In principle, this finding can also be consistent with the solvency condition $\rho > \frac{r-g}{1+g}$ given the negative $\frac{r-g}{1+g}$ observed in LICs.

commodity exporters. Access to external financing is also one of the main drivers of primary balances in LICs, and has the expected negative sign.

Table A4.1. Fiscal Reaction Function in Advanced, Emerging, and Low-Income Economies

	AE (1)	EM (2)	LIC (3)
pbal t-1	0.697*** (0.0422)	0.466*** (0.0496)	0.125*** (0.048)
ygap pos	0.00243 (0.0418)	0.0979 (0.0749)	
ygap neg	0.437*** (0.120)	0.199*** (0.0918)	
debt t-1	0.0499*** (0.00794)	0.0646*** (0.00569)	0.009 (0.012)
TOT gap*mineral exporters			0.094* (0.049)
TOT gap*non-mineral exporters			-0.021 (0.024)
financing constraints (external disbursements (% GDP))			-0.397* (0.238)
debt relief (0/1 dummy)			1.419** (0.71)
constant	-2.281*** (0.386)	-2.666*** (0.250)	-0.532 (0.734)
N	611	377	292
adj R2	0.57	0.41	
Standard errors in parentheses	* p-value<0.1; ** p-value <0.05; *** p-value <0.01		

Source: IMF staff estimates.

To account for the possibility that fiscal policy can itself be a source of shocks, the primary balance is subject to a fiscal policy shock $\varphi_{i,t} \sim N(0, \sigma_{\varphi_i}^2)$, where $\sigma_{\varphi_i}^2$ is calibrated on the country-specific variance of the reaction function's residuals.

The fiscal performance that a country is capable of achieving following a shock is capped at the maximum primary balance, which is calibrated separately for the different country groups. Drawing on Escolano and others (2014), the maximum primary balance is set at 4 percent of GDP for AEs and at 2 percent of GDP for EMEs. As Escolano and others (2014) does not cover LICs specifically, the caps for these countries were drawn from the historical distribution and set at 4¼ percent of GDP for commodity exporters and 1¼ percent of GDP for non-commodity exporters.

Debt dynamics and simulation block

A projected debt path is computed for a given set of country-specific shocks, including shocks to the macroeconomic variables from the VAR, and fiscal-specific shocks. We first compute the annualized VAR projections in AEs/EMEs (or draw them from the multivariate normal distribution in LICs), then use the fiscal reaction function and the conventional stock-flow identity recursively, where all the variables embed the corresponding shocks:

$$d_t \equiv \frac{(r_t - g_t)}{(1 + g_t)} d_{t-1} - p_t$$

where r_t is the average effective real interest rate, g_t is the real GDP growth rate, and p_t is the primary balance. In the case of LICs, further distinction is made between domestic and foreign debt (and within the latter, concessional versus non-concessional) while controlling for exchange rate movements.

The algorithm generates a large number of random shock sequences over the forecasting period, and computes for each sequence of shocks the corresponding debt paths as outlined above. For each year of projection, frequency distributions of projected debt-to-GDP ratios allow for a probabilistic analysis of debt trajectories. For example, the algorithm allows one to evaluate the probability that the debt-to-GDP ratio will stay beneath a given debt ceiling. The computed probability, other things being equal, (1) decreases with the average and variance of the growth-adjusted interest rate—countries subject to higher (r-g) and greater volatility in (r-g) will have a higher probability of breaching the debt ceiling; (2) increases with the debt ceiling; and (3) increases with the assumed maximum primary balance that countries can generate to curb public debt.

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