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Revisiting the Debt Sustainability Framework for Low-Income Countries

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ABBREVIATIONS AND ACRONYMS

CIRR	Commercial Interest Reference Rate
CPIA	Country Policy and Institutional Assessment
DRC	Democratic, Republic of Congo
DSA	Debt Sustainability Analysis
DSF	Debt Sustainability Framework
GDP	Gross Domestic Product
GRA	General Resources Account
HIPC	Heavily Indebted Poor Countries
IBRD	International Bank for Reconstruction and Development
ICRG	International Country Risk Guide
IDA	International Development Association
IMF	International Monetary Fund
KN	Kraay and Nehru
LIC	Low-Income Country
MAC	Market-Access Country
MAMS	Maquette for MDG Simulations
MDB	Multilateral Development Bank
MDGS	Millennium Development Goals
MDRI	Multilateral Debt Relief Initiative
MIC	Middle Income Country
MTDS	Medium Term Debt Management Strategy
NPV	Net Present Value
OECD	Organisation for Economic Co-operation and Development
PPG	Public and Publicly Guaranteed
PPP	Public-Private Partnership
PRGT	Poverty Reduction Growth Trust
PV	Present Value
SOE	State Owned Enterprise
UN	United Nations
VAR	Vector Autoregressive
WDI	World Development Indicator
WEO	World Economic Outlook

Executive Summary

Introduced in 2005, the joint World Bank-IMF Debt Sustainability Framework (DSF) is a standardized framework for conducting public and external debt sustainability analysis (DSA) in low-income countries (LICs). It aims to help guide the borrowing decisions of LICs, provide guidance for creditors' lending and grant allocation decisions, and improve World Bank and IMF assessments and policy advice. The framework was previously reviewed in 2006 and 2009.

This paper provides a comprehensive review of the framework to assess whether it remains adequate in light of changing circumstances in LICs. It reviews the DSF's performance to date, presents the results of recent analytical work by World Bank and IMF staffs, and discusses a number of areas in which the framework could be improved. The main conclusions are as follows:

- **Analytical work by staff broadly validates the indicative policy-dependent thresholds currently used in the framework.** Staff recommends making modest revisions to the thresholds for debt service to revenue and for the PV of debt to the sum of exports and remittances, while maintaining all other thresholds at their current values.
- **The analysis of total public debt and fiscal vulnerabilities needs to be strengthened.** This analysis should focus on those vulnerabilities deemed most relevant by country teams. The paper makes a number of recommendations in this area, including introducing benchmarks for total public debt that could be used to determine when to conduct deeper analysis.
- **For countries with significant vulnerabilities related to domestic public debt or private external debt, an additional risk rating would inform the macroeconomic and structural policy dialogue with country authorities.** The additional risk rating would provide an overall assessment of vulnerability and would complement the existing assessment of external public debt.
- **The link between debt-financed investment and growth is integral to the quality of DSAs.** The paper proposes greater use of models developed by IMF and World Bank staffs to better capture investment-growth linkages.
- **Stress tests could be refined to better reflect dynamic linkages between macroeconomic variables.** It is proposed to introduce this methodological refinement on an experimental basis.
- **Simplifying the template would facilitate use by country authorities and help reduce resource costs.** This simplification could be achieved by introducing a modular approach, built around a baseline scenario and simple stress tests. The paper further proposes that full joint DSAs be produced every three years, with lighter joint updates in the interim years.

I. INTRODUCTION

1. **A formal framework for conducting public and external debt sustainability analysis (DSA) in low-income countries (LICs) was put in place in 2005** (Box 1).^{1,2} The main objectives of the debt sustainability framework (DSF) are to:

- Guide the borrowing decisions of LICs in a way that matches their financing needs with their current and prospective repayment ability, taking into account each country's circumstances;
- Provide guidance for creditors' lending and grant allocation decisions to ensure that resources are provided to LICs on terms that are consistent with both progress toward their development goals and long-term debt sustainability;
- Improve World Bank and IMF assessments, policy advice, and program design; and
- Help detect potential crises early so that preventive action can be taken.

2. **The objective of this paper is to review the DSF comprehensively and assess whether it remains adequate given the evolving needs of LICs.** There is a large investment gap in LICs, particularly in infrastructure. Addressing it is critical to increasing potential growth. Aid is limited and LICs will likely rely increasingly on domestic resources and nonconcessional external borrowing. A wide range of DSA issues—some of which were raised in previous reviews of the framework—merit attention in this context.³ Should there be

¹ This paper was prepared by an IMF team led by Laurence Allain, consisting of Andrew Jewell, François Painchaud, Kadima Kalonji, Karina Garcia, and Douglas Hostland, under the overall guidance of Dominique Desruelle. Hervé Joly (AFR) provided substantial input in the early stages of the paper. Malina Savova and Yan Sun-Wang provided very able research assistance. The paper has benefitted from discussions with Saul Lizondo (IMF-AFR), Andrew Berg (IMF-RES), and Aart Kraay (WB-DECMG) at various stages of the project. The World Bank team was led by Sudarshan Gooptu under the overall guidance of Jeffrey Lewis, and consisted of Juan Pradelli, Luca Bandiera, and Sona Varma. Ralph van Doorn, Mona Prasad, Tihomir Stucka (PRMED) also provided key input, and Vivian Norambuena provided very able research assistance.

² See the following joint IMF-World Bank staff papers: "[Debt Sustainability in Low-Income Countries—Proposal for an Operational Framework and Policy Implications](#)," February 3, 2004; "[Debt Sustainability in Low-Income Countries—Further Considerations on an Operational Framework and Policy Implications](#)," September 10, 2004; and "[Operational Framework for Debt Sustainability Assessments in Low-Income Countries—Further Considerations](#)," March 28, 2005. See also "The Debt Sustainability Framework in Low-Income Countries," IMF Occasional Paper 266.

³ The DSF was previously reviewed in 2006 and 2009. See "[Review of Low-Income Country Debt Sustainability Framework and Implications of the Multilateral Debt Relief Initiative](#)," March 24, 2006; and "[Review of Some Aspects of the Low-Income Country Debt Sustainability Framework](#)," August 5, 2009.

Box 1. The Debt Sustainability Framework for Low-Income Countries

The DSF, a standardized framework for analyzing debt-related vulnerabilities, was introduced in 2005 and reviewed in 2006 and 2009. Under the DSF, joint Fund-Bank DSAs are prepared for all PRGT-eligible, IDA-only countries. For PRGT-eligible countries that are not IDA-only, DSAs are prepared by Fund staff only.¹

How the DSF works

The DSF consists of a set of indicative policy-dependent thresholds against which projections of external public debt over the next 20 years are compared in order to assess the risk of debt distress. Vulnerability to external and policy shocks is explored in alternative scenarios and standardized bound tests. The indicative threshold for each debt burden indicator depends on each country's policy and institutional capacity, as measured by the World Bank's Country Policy and Institutional Assessment (CPIA) index. The specific thresholds are as follows:

Debt Sustainability Framework: Indicative Policy-Dependent Thresholds
(Applicable to public and publicly guaranteed external debt)

	PV of debt in percent of			Debt service in percent of	
	GDP	Exports	Revenue	Exports	Revenue
Weak policy (CPIA \leq 3.25)	30	100	200	15	25
Medium policy (3.25 < CPIA < 3.75)	40	150	250	20	30
Strong policy (CPIA \geq 3.75)	50	200	300	25	35

Based on the assessment, one of four possible risk of debt distress ratings is assigned:

- *Low risk:* All the debt burden indicators are well below the thresholds.
- *Moderate risk:* Debt burden indicators are below the thresholds in the baseline scenario, but stress tests indicate that the thresholds could be breached if there are external shocks or abrupt changes in macroeconomic policies.
- *High risk:* One or more debt burden indicators breach the thresholds on a protracted basis under the baseline scenario.
- *In debt distress:* The country is already experiencing difficulties in servicing its debt, as evidenced, for example, by the existence of arrears.

The DSF also includes a public sector DSA, which assesses public domestic debt risks and overall fiscal sustainability. The risk of debt distress rating, however, is guided solely by an analysis of external public debt relative to the thresholds in the external DSA.

What is the CPIA?

The CPIA is an index of 16 indicators grouped into four categories: (1) economic management; (2) structural policies; (3) policies for social inclusion and equity; and (4) public sector management and institutions. Countries are rated on their current status in each of these performance criteria, with scores from 1 (lowest) to 6 (highest). The index is updated annually for all IDA-eligible countries, including blend countries.

¹ Some PRGT-eligible countries are classified by the World Bank as middle-income countries. See <http://data.worldbank.org/about/country-classifications/country-and-lending-groups>.

more emphasis on total public debt, and how can fiscal sustainability analysis be improved? Are the indicative thresholds on external public debt still appropriate? Does the DSF adequately reflect the growth dividend of public investment? Are risks around the baseline scenario, including contingent liabilities, adequately captured through stress testing? Can the DSA template be simplified to facilitate its use by country authorities?

3. **This paper presents the results of recent analytical work and discusses a number of areas in which the framework could be improved.** Its purpose is to seek the views of the Executive Boards on the merits of possible changes, bearing in mind that some options could have major operational implications, including, for instance, the way aid is allocated. The paper draws, where relevant, on the IMF staff paper on *Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis*, published earlier this year.⁴ The paper is organized as follows. Section II reviews the DSF's performance to date and identifies areas that could be improved. Section III presents options for improving the analysis of total public debt and fiscal vulnerabilities. Section IV reconsiders the thresholds that guide the assessment of the risk of debt distress. Section V looks at improving the coverage of external debt. Section VI discusses ways to better capture the investment-growth nexus in the DSF. Section VII considers options for redesigning stress tests. Section VIII presents options for simplifying the framework. Finally, Section IX raises issues for Board discussion.

II. WHAT ARE THE MAIN ISSUES TO RECONSIDER?

The DSF's performance to date

4. **Since the DSF was introduced in 2005, 367 DSAs have been produced for 73 different countries.** Joint Fund-Bank DSAs have generally been produced for all IDA-only, PRGT-eligible countries on an annual basis. In some instances, more than one DSA was produced for the same country in a single year. In other cases, there are gap years where no DSA was produced. Since 2007, nearly all DSAs have contained both an external and a public sector DSA. Eighty-eight percent of DSAs have been published on the IMF or World Bank's external website.

5. **An explicit rating denoting the risk of external public debt distress has been assigned in all but 27 cases, most of which date back to the early years of the framework** (Table 1). Nearly all cases of "in debt distress" have been pre-HIPC completion point countries with poor institutional capacity, as measured by the CPIA index (Table 2). Cases of high risk of debt distress have been evenly split between HIPCs and non-HIPCs with predominantly poor CPIA ratings. Most cases of low or moderate risk have been post-HIPC completion point and non-HIPC countries with medium to strong CPIA ratings.

⁴ See "[Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis](#)," August 5, 2011.

Table 1. DSA Risk Ratings by Year

Risk Rating	Number of DSAs							Total
	2005	2006	2007	2008	2009	2010	2011 ¹	
In debt distress	1	5	8	6	8	6	3	37
High risk	6	12	12	15	15	16	7	83
Moderate risk	8	20	16	16	21	24	15	120
Low risk	4	12	14	15	17	22	16	100
No rating	13	7	2	3	2	0	0	27
Total	32	56	52	55	63	68	41	367

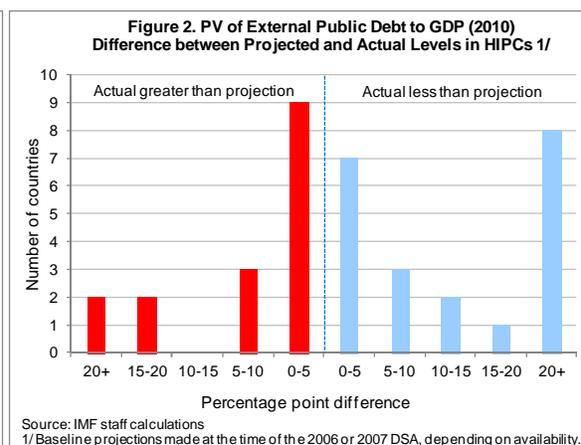
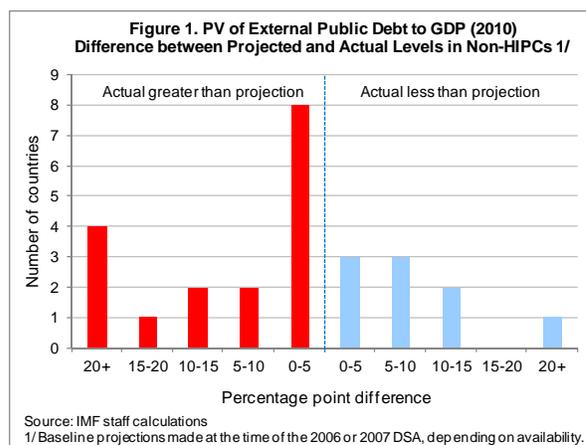
Source: IMF

Table 2. DSA Risk Ratings by Country Characteristics

Risk rating	Total	HIPC Status				CPIA			
		Pre-DP	Pre-CP	Post-CP	Non-HIPCs	Strong	Medium	Poor	No rating
In debt distress	37	10	19	0	8	0	0	26	11
High risk	83	6	14	24	39	3	14	55	11
Moderate risk	120	6	5	58	51	27	54	25	14
Low risk	100	0	1	52	47	30	51	7	12
No rating	27	4	3	5	15	5	3	6	13
Total	367	26	42	139	160	65	122	119	61

Source: IMF

6. **Although suitably long data series do not exist to rigorously evaluate the accuracy of DSAs, a preliminary analysis suggests that DSA debt projections have not shown any evident bias.** As illustrated in Figures 1 and 2, DSAs produced in 2006 and 2007 projected levels of external public debt to GDP in 2010 that fell short of actual 2010 levels in about half the cases and surpassed actual levels in the other half. In 60 percent of the cases, the difference between the actual level of debt in 2010 and the level projected in the baseline scenario of the 2006 or 2007 DSA was 10 percentage points or less. Large differences between actual and projected debt levels in HIPC cases reflect uncertainty about the timing of debt relief when the projections were made. These uncertainties, in turn, were related mostly to the timing of required policy actions. For non-HIPCs, the differences mostly reflect larger-than-anticipated macroeconomic shocks related to the global financial crisis.



7. **Since the DSF was introduced, debt sustainability in LICs has been broadly maintained.** Only two non-HIPC LICs have experienced debt distress since 2005, both of which were already in debt distress at the time of their 2006 or 2007 DSA. An April 2010 IMF-IDA report concluded that, while the global financial crisis had had a significant impact on LIC debt vulnerabilities, the crisis was not expected to result in systemic debt difficulties across LICs, a finding corroborated by the lack of systemic evidence that debt vulnerabilities among LICs have intensified over the last 18 months ⁵

8. **The DSF is used by a growing community of donors and lenders to help inform their financing decisions.** Since 2005, IDA has used DSA risk ratings to determine the share of grants and loans in its assistance to each LIC (Box 2). Regional development banks have similarly geared their lending practices to DSA risk assessments.⁶ The Paris Club group of official creditors relies on DSAs in the context of debt restructurings under the Evian Approach, and member countries of the OECD Working Group on Export Credit and Credit Guarantees agreed in 2008 to take DSAs into account when providing official export credits to LICs.

9. **The DSF has enabled IMF and World Bank staff to integrate fiscal and debt issues more effectively into their analysis and policy advice.** The framework has raised the profile of fiscal and debt issues in LICs through the annual frequency of DSAs, the improved quality and transparency of assessments, and the comparability of DSAs across countries. With the introduction of IDA's Non-Concessional Borrowing Policy in 2006 and the review of the IMF's external debt limits policy in 2009, DSAs were integrated into frameworks that offer countries flexibility to borrow on nonconcessional terms, depending on their debt vulnerability, debt management capacity, and capacity to manage public resources.⁷

⁵ See "[Preserving Debt Sustainability in Low-Income Countries in the Wake of the Global Crisis](#)," April 1, 2010; and "[Heavily Indebted Poor Countries \(HIPC\) Initiative and Multilateral Debt Relief Initiative \(MDRI\)—Status of Implementation and Proposals for the Future of the HIPC Initiative](#)," November 8, 2011.

⁶ These include the African Development Bank, the Asian Development Bank, the Inter-American Development Bank, the European Bank for Reconstruction and Development, the European Investment Bank, and the International Fund for Agricultural Development.

⁷ See "[Debt Limits in Fund-Supported Programs—Proposed New Guidelines](#)," August 5, 2009; and "[IDA Countries and Non-Concessional Debt: Dealing with the 'Free Rider' Problem in IDA14 Grant Recipient and Post-MDRI Countries](#)," World Bank, Resource Mobilization Department, June 19, 2006.

Box 2. The International Development Association’s Grant Allocation Framework

IDA’s grant allocation framework was adopted during the IDA14 Replenishment agreement in mid-2005. Its objective is to proactively mitigate the risks of external debt distress revealed by the DSF. Under the framework, IDA provides grants to countries facing a high probability of debt distress. Eligibility for IDA grants is limited to IDA-only countries. IBRD/IDA blend countries and “gap” countries are not eligible for grants, irrespective of their external debt situation.¹

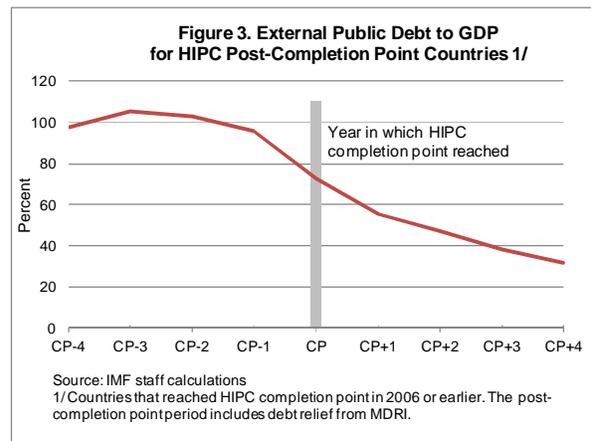
Grant eligibility is determined by the assessment of the country-specific risk of external debt distress emerging from DSAs conducted under the DSF. For countries assessed to be at a low risk of external debt distress, IDA provides its financing on standard IDA credit terms (40-year maturity, including a 10-year grace period, leading to a grant element of over 60 percent). For countries assessed to be at a moderate risk of external debt distress, IDA provides 50 percent of its financing on standard IDA credit terms and 50 percent on grant terms. Countries assessed to be “in debt distress” or at a high risk of external debt distress receive all of their assistance on grant terms. To mitigate equity and moral hazard concerns, the grant portion of a country’s allocation is discounted by 20 percent.

Nineteen countries at high risk of debt distress received their entire FY2011 allocation on grant terms. Of total IDA FY 2011 commitments of US\$16.3 billion, 17 percent was provided on grant terms.

¹ “Gap” countries are IDA-only countries with a GNI per capita that has been above the operational cut-off for IDA eligibility for more than two consecutive years.

To what extent can the framework be improved?

10. **Although experience with the DSF to date suggests that it has performed relatively well, the question is whether it remains suitable in light of changing circumstances.** Public finance in many LICs, as well as the range of available financing options, has changed significantly since the DSF was introduced. Debt relief under the HIPC Initiative and MDRI has lowered debt vulnerabilities—on a sustained basis (Figure 3)—and created new borrowing space. Many LICs are seeking to exploit this borrowing space to finance public investment and are relying increasingly on borrowing on nonconcessional terms. External public debt, though still the main component of overall public debt, is not as dominant as it once was, mainly as a result of debt relief. Domestic debt is likely to grow in importance as domestic savings increase and governments seek to develop domestic debt markets. LICs will face new risks as the universe of creditors and debt instruments continues to expand.



11. **A range of stakeholders have provided feedback on the DSF since the framework was introduced.** The IMF and IDA Executive Boards recommended further

work in certain areas when the DSF was reviewed in 2006 and 2009. With the benefit of several years of experience with the framework, users and outside observers have identified other elements that could be improved. The main issues that have been raised are as follows:

- *Improving the analysis of total public debt and fiscal vulnerabilities.* The discussion of total public debt (both external and domestic) has tended to be less rigorous than the discussion of external public debt, reflecting both data limitations and the fact that the DSA risk rating is based exclusively on external public debt levels. With domestic debt playing an increasingly important role in some countries, public debt sustainability requires more attention
- *Reconsidering the thresholds.* Policy-dependent thresholds for external public debt are at the core of the DSF and guide the assignment of risk ratings. Do the thresholds remain accurate predictors of debt distress in light of more recent data? Should thresholds be formally adapted to take into account workers' remittances?⁸ How can the framework make better use of country-specific information? Should there be thresholds for total public debt in addition to external public debt, and if so, should they inform the risk rating?
- *Improving the coverage of external debt.* The DSF has traditionally focused on public external debt while paying less attention to private external debt. Does the latter merit closer scrutiny? In cases where private external debt is large and poses risks, should this be reflected in the risk rating?
- *Accounting for the impact of public investment on growth.* The DSF has been criticized by some observers for being overly conservative in its assessment of the risk of debt distress, thereby constraining LICs from undertaking the borrowing necessary to finance growth-enhancing investments. This criticism is not new, but with the newly gained borrowing space after debt relief, the stakes appear to have increased as LICs seek to finance infrastructure projects critical for achieving development goals. While not an issue of DSA design per se, but rather a matter pertaining to the macroeconomic assumptions used in DSAs, the link between debt-financed investment and growth is integral to the quality of DSAs.
- *Redesigning stress testing.* An often-heard criticism is that stress tests in DSAs are too mechanistic. Key macroeconomic variables (e.g., real GDP, exports, inflation) are

⁸ The IMF and IDA Executive Boards in 2009 recommended exercising greater flexibility in taking into account the size of remittances when assigning country risk ratings. This flexibility has been exercised in a limited number of cases to arrive at a lower risk rating than would have been the case had remittances not been considered. See "[Review of Some Aspects of the Low-Income Country Debt Sustainability Framework](#)," August 5, 2009.

shocked one at a time, without allowing for feedback between variables. While standardized stress tests facilitate cross-country comparisons necessary for operational purposes, they can also lead to situations where the most relevant shocks for a given country are not captured. What can be done to improve stress testing in DSAs?

- *Simplifying DSAs.* Producing a LIC DSA can be a time-consuming, data-intensive exercise that competes with other priorities. One of the purposes of the DSF is to enable country authorities to produce their own DSAs. However, very few LICs use the current template, owing to its complexity and associated data challenges. Is there scope for simplifying the template? Would it be useful to divide the DSA into different modules that can be used flexibly, depending on the needs and the capacity of the user?

III. IMPROVING THE ANALYSIS OF TOTAL PUBLIC DEBT AND FISCAL VULNERABILITIES

12. **Although the DSF recognizes the importance of domestic debt, the framework emphasizes the risks associated with external public debt.** All LIC DSAs must include both an external DSA and a public sector DSA. The external DSA covers external debt contracted by the public and private sectors; the public sector DSA covers external and domestic debt contracted by the public sector.⁹ The risk of debt distress rating is based solely on an analysis of external public debt in the external DSA. The central role of external public debt in the DSF stems from the fact that, historically, external public debt has been the largest component of debt in LICs and the largest source of risk.

13. **The analysis of total public debt has tended to be less thorough compared to the analysis of external public debt.** The disparity in the analysis is most common—and to be expected—in countries where domestic public debt is negligible, or where data is unavailable. In countries where domestic public debt is relatively important and data is available, the discussion of total public debt is generally more detailed but remains overshadowed by the discussion of external public debt.

14. **The changing context in LICs suggests a need to strengthen the analysis of total public debt and fiscal vulnerabilities.** Although external public debt remains the largest component of debt in most LICs, domestic debt is becoming more prominent. Domestic debt carries benefits (e.g., development of local financial markets, no exchange rate risk) but also costs (e.g., crowding out of private investment, incentives for financial repression). Compared to external debt, domestic debt tends to be more expensive and have shorter

⁹ External debt is defined on a residency basis may therefore include domestic currency-denominated debt. In practice, because of difficulties in record keeping (e.g., secondary market trading) and data limitations in LICs, domestically-issued debt or debt denominated in domestic currency is often used as a proxy for domestic debt.

maturities (Box 3). Since the introduction of the DSF in 2005, the share of domestic public debt in total public debt has increased from 19 percent to 29 percent on average across all LICs, largely reflecting external debt relief under the HIPC Initiative (Figure 4). Domestic debt as a ratio to GDP has remained flat on average, but this masks the fact that, in some countries, the level of domestic debt is already substantial (Figure 5) or is growing rapidly. In 11 LICs, the domestic debt-to-GDP ratio has more than doubled since 2006, albeit from low levels in some cases (Figure 6). During the global financial crisis, LICs relied heavily on domestic sources to finance larger fiscal deficits. This trend is expected to continue as domestic financial markets develop. In more advanced LICs, market development could be fueled by growing foreign investor interest in domestically-issued local currency debt.

15. **We outline below a number of ways to improve the analysis of total public debt and fiscal vulnerabilities in LIC DSAs.** These echo many of the recommendations made in the IMF staff paper on [Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis](#). That paper highlighted the need to improve the analysis of fiscal policy and public debt sustainability in the wake of large, unanticipated increases in public debt in many market-access countries (MACs). While circumstances in MACs differ from those in LICs, the LIC DSF, like the MAC framework, needs to adapt to a changing environment. Possible ways to strengthen LIC DSAs include:

- **Explicitly discussing the financing mix assumptions,** between domestic and external debt on the one hand, and concessional and nonconcessional debt on the other. Currently, DSAs foresee a declining reliance on domestic debt in the medium term. Is this realistic? An assumption of continuous borrowing on highly concessional terms needs to be explained, particularly if a country has already begun to borrow nonconcessionally.
- **Giving greater scrutiny to assumptions about large fiscal adjustments.** Fiscal adjustment in LICs is often rendered more difficult by the need to address large infrastructure gaps, pressures stemming from important social needs, and shallow tax bases that limit the scope for increasing revenue. For these reasons, a large fiscal adjustment assumed in the DSA needs to be well justified.
- **Assessing the realism of interest rate and growth assumptions.** A strongly negative interest rate-growth differential has been a key benign force for debt sustainability in LICs. Given the sensitivity of debt dynamics to interest rate and growth assumptions, the realism of these assumptions should be systematically assessed. Domestic debt financing underlying the interest rate assumption should be explicitly discussed. Growth projections should try to capture the impact of public investment on growth while being mindful of historical trends. A significant acceleration in growth compared to past performance needs to be justified, if possible using model-based analysis (see Section VI).

Box 3. Costs and Risks of Domestic Debt Financing

An analysis of the debt structure in 12 LICs shows that the domestic debt portfolio is subject to substantial refinancing and interest rate risks, as only few countries have been able to issue long-term domestic debt.

The World Bank and the IMF are providing technical assistance to help LICs improve debt management through the formulation of medium-term debt management strategies (MTDS). An MTDS complements the LIC DSA and helps operationalize a country's debt management objectives by outlining cost-risk tradeoffs in meeting the government's financing needs and payment obligations.¹

An analysis of 12 MTDSs elaborated by authorities of IDA-eligible countries in 2010–11 helps define the cost and risk indicators that characterize the domestic debt portfolio of LICs (see table). In the two years considered, the median interest rate on domestic debt was 9 times higher than on external debt. The sample median of the average time to maturity of the domestic debt portfolio was only 2.5 years, compared to an average time to maturity of more than 13 years for external debt, reflecting the latter's concessional component. In addition, the share of domestic debt maturing within one year was much higher compared to external debt. Although most of the domestic debt was issued at fixed rates, the short maturity structure implies that most interest rates would refix every year.

Cost and Risk Indicators of the Debt Portfolio in 12 IDA-Eligible Countries				
Cost-Risk Indicator		External debt	Domestic debt	Total debt
Cost of debt	Weighted-average interest rate (percent) 1/	1.1	8.9	3.0
Refinancing risk	Average time to maturities (years) 2/	13.4	2.5	10.1
	Debt maturing in one year (percent of total) 3/	3.5	45.1	10.4
Interest rate risk	Average time to refixing (years) 4/	13.3	2.0	10.1
	Debt refixing in one year (percent of total) 3/	5.2	53.5	18.2
	Fixed-rate debt (percent of total) 5/	99.2	94.0	96.6

Source: Medium-term debt management strategies prepared during 2010–11.

¹ Interest payments in 2010 or 2011 divided by the debt stock at the end of the previous year, in local currency.

² Average of the years of repayment weighted by the share of principal payments in the debt portfolio.

³ Domestic (external and total) debt maturing and refixing in one year in percent of domestic debt (external and total), respectively.

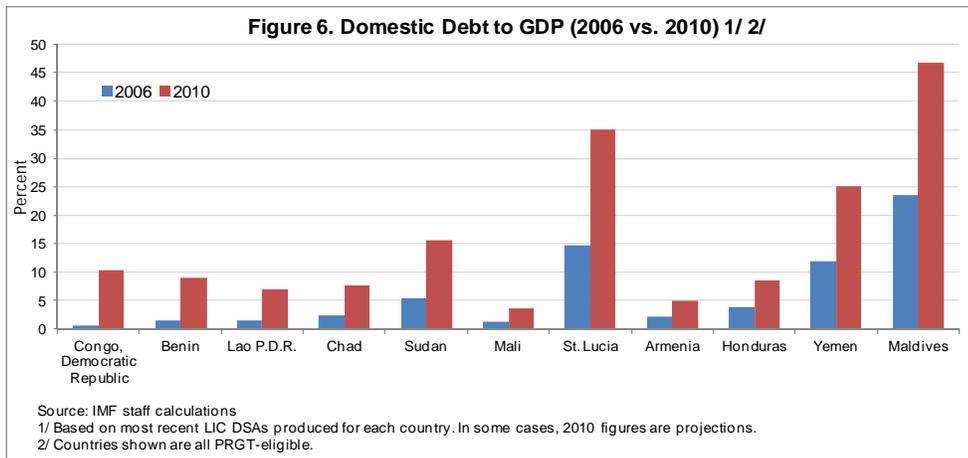
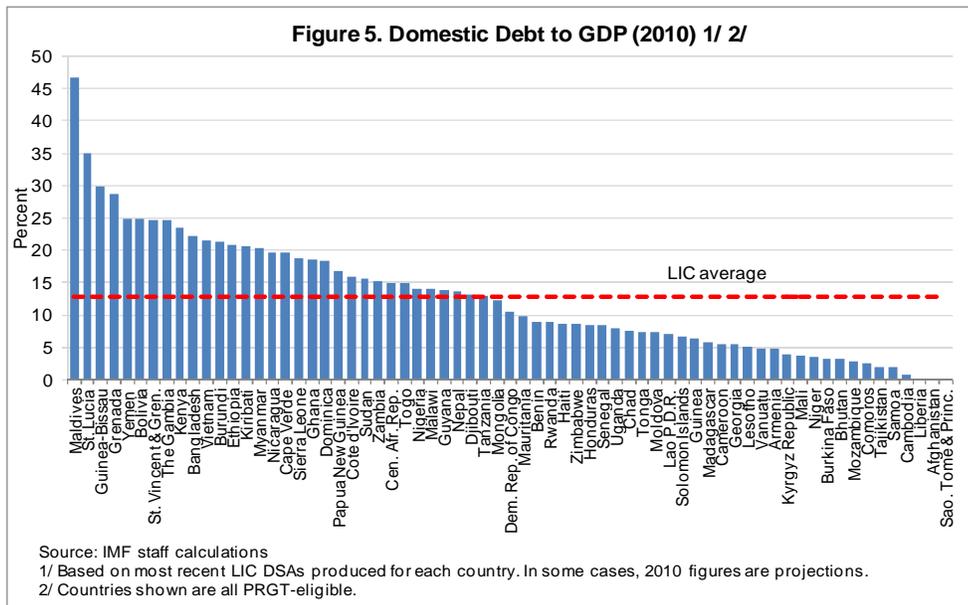
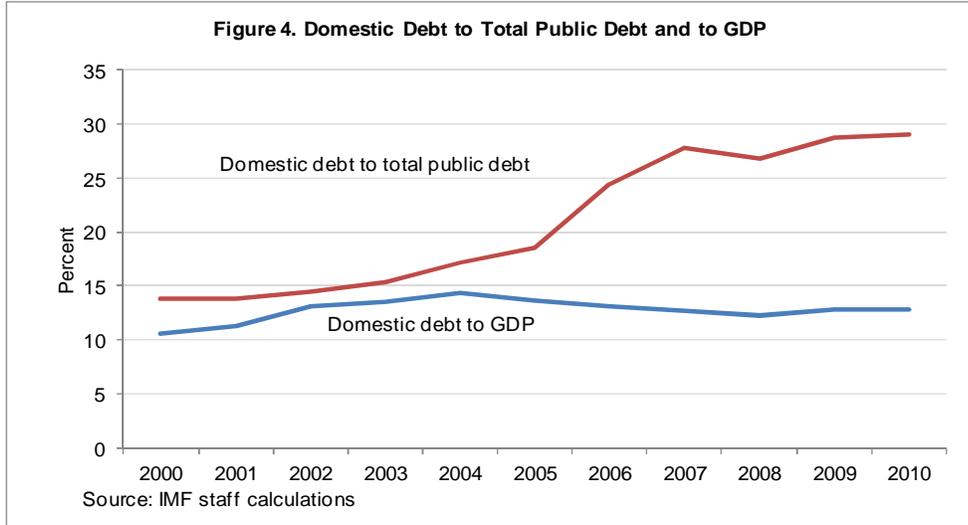
⁴ Average time until all principal payments in the debt portfolio become subject to a new interest rate.

⁵ Percent of debt issued at a fixed rate, for any maturity.

The current debt structure of LICs is subject to substantial refinancing risk. Few LICs have been able to issue domestic debt at maturities longer than 10 years. As domestic markets in LICs are usually shallow, with few participants (mainly from the banking sector), a short maturity structure increases refinancing and interest rate risks, particularly in the event of negative shocks to the economy, or if government domestic borrowing needs increase abruptly.

Developing the domestic debt market through the introduction of instruments with longer maturities and expanding the domestic creditor base could lower refinancing and interest rate risks, but also comes at a cost for governments, depending on the liquidity and inflation risks perceived by domestic debt market participants.

¹ See "[Developing a Medium-Term Debt Management Strategy \(MTDS\)—Guidance Note for Country Authorities](#)," February 24, 2009.



- **Strengthening the analysis of contingent liabilities.** Data on contingent liabilities in LICs tends to be scarce. The current framework includes one stress test—a 10-percent-of-GDP increase in debt-creating flows—that resembles a generic contingent liability shock. Where information is available, a more country-specific approach may be warranted to capture contingent liabilities arising from state-owned enterprises (SOEs), public-private partnerships (PPPs), and weaknesses in the financial sector.¹⁰
- **Considering tail risks.** Stress tests in the DSF are intended to capture the most likely risks to debt sustainability. Enhancing the analysis of tail risks—that is, low probability events with potentially severe consequences, such as the impact of severe crisis or climate related risks—could complement the current focus on more likely risks. Since tail risks represent events that, by definition, are unlikely to occur, they should not inform the risk rating. Nevertheless, the sudden increase in debt levels in many advanced economies in recent years is a reminder that tail risks should not be ignored altogether.¹¹
- **Expanding the analysis to cover all obligations of the public sector.** The DSF covers, inter alia, public and publicly-guaranteed external debt and thus should include debts from the central government, regional and local governments, the central bank, and public enterprises. While most borrowing in LICs is done at the central government level, some regional and local governments as well as SOEs have been able to either borrow externally or issue debt domestically. DSAs should strive to incorporate all debt, including domestic arrears, which can be substantial but are often not reported. However, given data limitations and capacity constraints, initial efforts should focus on encompassing debt of entities that may pose the largest fiscal risk.
- **Assessing the risks associated with the public debt profile.** For more advanced LICs with a high level of debt contracted on market terms, both the level and the profile of the debt are relevant when assessing vulnerabilities. In such cases, a fuller discussion of the risks linked to debt structure characteristics—including maturity,

¹⁰ Obligations arising from PPPs and SOEs can be reflected in DSAs in a number of ways that depend on the extent of available information. Country teams could add to the stock of public debt the present value of future payments under PPP contracts or other concession arrangements, or count known and potential costs of non-debt obligations as primary spending. Guidance on the identification and quantification of fiscal risks due to contingent liabilities can be found in Cebotari (2008), Cebotari et al (2009), Everaert et al (2009), Hemming (2006), and Irwin (2007).

¹¹ For a discussion of using historical episodes to calibrate tail risks, see Annex IV in “[Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis](#),” August 5, 2011.

currency composition, and the creditor base—is warranted. This analysis would consider cost and risk indicators of the domestic debt portfolio, as discussed in Box 3.

16. **Similar to the approach adopted for MACs, the depth and breadth of the analysis should be tailored to identified country-specific risks.** Under such a risk-based approach, the DSA should focus on those vulnerabilities deemed most relevant by country teams for which information is available. Adding benchmarks for total public debt would help frame the discussion and indicate when to conduct a more detailed assessment of public debt vulnerabilities. This idea is discussed in more detail in the next section.

IV. REVISITING THRESHOLDS

A. Current Thresholds on Public and Publicly-Guaranteed External Debt

17. **Thresholds for public and publicly guaranteed (PPG) external debt rest on empirical analyses by Kraay and Nehru (KN) and IMF and World Bank staff (Staff 2004).**¹² Thresholds for the present value (PV) of debt to GDP, debt to exports, and debt to revenue were calibrated using Staff 2004, while thresholds for debt service to exports and debt service to revenue were calibrated using KN. Both KN and Staff 2004 used a probit model to explain the probability of distress on PPG external debt as a function of (i) a country’s debt burden; (ii) the quality of a country’s policies and institutions, as measured by the CPIA index; and (iii) real GDP growth.¹³

18. **The methodologies used by KN and Staff 2004 to estimate the probability of debt distress, while broadly similar, differed in certain technical respects** (Box 4). In particular, KN and Staff 2004 defined debt distress and non-distress episodes differently, resulting in different estimation samples and different frequencies of debt distress episodes within the samples. KN used a more stringent definition of debt distress and had fewer debt distress episodes in their sample. Nevertheless, the studies came to similar conclusions: countries with higher debt burdens are more likely to experience debt distress, and countries with strong policies can sustain a higher debt burden than those with weak policies.

¹² See Kraay and Nehru (2004) and “[Debt Sustainability in Low-Income Countries: Proposal for an Operational Framework and Policy Implications](#),” February 3, 2004.

¹³ The analysis by Staff 2004 also includes the logarithm of real GDP per capita and a dummy variable for African countries.

Box 4. Comparing Previous Methodologies Used to Calibrate Thresholds for PPG External Debt

The calibration of debt burden thresholds based on Staff 2004 and KN differ in certain technical aspects:

First, **different definitions of debt distress and non-distress episodes were used.** Staff 2004, which used data on LICs only, defined a non-distress episode as at least three consecutive years in which the stock of arrears to official creditors was smaller than five percent of the total debt stock. All other years were defined as debt distress episodes. The KN study, which used data for both LICs and middle-income countries, relied on three distress signals: arrears on PPG external debt to all creditors (official and private), a Paris Club rescheduling, and IMF GRA financing on a commitment basis. KN characterized a debt distress episode as a period of three years or longer during which at least one of the three distress signals was observed. A non-distress episode was defined as a non-overlapping five-year period without any debt distress signal. As a result of these definitional differences, the unconditional probability of debt distress (i.e., the frequency of debt distress episodes observed in the sample) was higher in Staff 2004 than in KN.

Second, the **choice of the probability of debt distress used to calibrate the thresholds differed.**

In KN, the probability of debt distress was roughly in line with the unconditional probability of debt distress (25 percent). By contrast, Staff 2004 used a probability of debt distress (around 20 percent) that corresponded to the median PV of debt-to-GDP ratio observed in LICs immediately prior to an outbreak of debt distress (43 percent of GDP).

	Thresholds under the DSF (Applied to external public and publicly guaranteed debt)									
	PV of debt in percent of						Debt service in percent of			
	GDP		Exports		Revenue		Revenue		Exports	
	DSF	Staff 2004	DSF	Staff 2004	DSF	Staff 2004	DSF	KN	DSF	KN
Weak Policy	30	31	100	102	200	204	25	25	15	15
Medium Policy	40	40	150	150	250	239	30	30	20	20
Strong Policy	50	49	200	198	300	275	35	35	25	24
Probability used to calibrate thresholds		19%		19%		22%		22%		18%

B. Re-estimating Thresholds for PPG External Debt

19. **IMF and World Bank staff updated the thresholds for PPG external debt based on more recent data, and using a single methodology applied consistently across all debt burden indicators** (Annex 1). This exercise provided staff with the opportunity to address several technical issues, including controlling for the presence of middle-income countries in the estimation sample, using debt service data on PPG external debt instead of total external debt, and using consistent definitions of debt distress and non-distress episodes for all regressions. As in the current DSF, thresholds were calculated for three values of the CPIA (3.25, 3.5, and 3.75) associated with weak, medium, and strong performance in terms of the quality of policies and institutions.

20. **The thresholds were calibrated using different methods to fix the probability of debt distress.** As in previous analysis, the calibration of the thresholds rests on the historical

values of the variables used in the analysis as well on the choice of the probability of debt distress. Staff derived thresholds using three different concepts of probability of debt distress: (1) the unconditional probability of debt distress; (2) the probability of debt distress corresponding to the median value of the relevant debt burden indicator immediately prior to an outbreak of debt distress; and (3) the probability of debt distress that minimizes the number of missed crises and false alarms.¹⁴ The first two methods replicate what was used in KN and Staff 2004, respectively. The third method, preferred by staff, balances the two possible types of errors produced by the model, thus ensuring that the resulting thresholds are neither too permissive nor unduly conservative. Under this method, the probability of debt distress ranges from 13 to 15 percent, depending on the debt burden indicator. The other two methods yield probabilities ranging from 11 to 16 percent and lead to thresholds that are broadly similar.¹⁵ The full results of all three methods are presented in Annex 1.

21. **The re-estimated thresholds are roughly in line with the current DSF thresholds, with the exception of the threshold for debt service to revenue.** Table 3 shows re-estimated thresholds based on staff's preferred method of minimizing the number of missed crises and false alarms. The re-estimated thresholds for the PV of debt to GDP and debt service to exports are fairly close to the current ones. The re-estimated thresholds for the PV of debt to exports are slightly higher than in the DSF, while the thresholds for the PV of debt to revenue are slightly lower. In the latter two cases, the differences are not large enough to warrant a change to the thresholds, in staff's view. However, the re-estimated thresholds for debt service to revenue are significantly lower (in percentage terms) than current thresholds. Staff proposes lowering these thresholds to 18, 20, and 22 percent from the current values of 25, 30, and 35 percent. The results across debt burden indicators are robust to different measures of governance and macroeconomic shocks. Notwithstanding the proposed adjustment to the debt service-to-revenue thresholds, the re-estimated thresholds strongly support the main conclusions of KN and Staff 2004—namely, that countries with higher debt burdens are more likely to experience debt distress, and countries with strong policies can sustain a higher debt burden than those with weak policies. Staff estimates that only 2 out of 66 countries would receive a higher risk rating (moving from medium to high) if the proposed debt service to revenue thresholds were applied.¹⁶

¹⁴ For this approach, the reported probability used to calibrate thresholds is the average probability minimizing type I and II errors over the different weights (see Annex 1). A type I error (i.e., a missed crisis) occurs when the model fails to predict a debt distress episode. A type II error (i.e., a false alarm) occurs when the model mistakenly predicts a debt distress episode.

¹⁵ The range of probabilities cited here cannot be directly compared to the probabilities (18–22 percent) that underlie the existing DSF thresholds. Probabilities used to calibrate thresholds reflect the data samples used in the regressions. The data samples differ across studies, depending on how debt distress and non-distress episodes are defined.

¹⁶ The analysis was conducted for DSAs produced prior to June 2011.

22. **The sensitivity of the results to definitional changes is a reminder that judgment should be used when interpreting breaches of thresholds.** As discussed in Annex 1, re-estimated thresholds vary to some extent depending on the definition of debt distress and non-distress episodes. While the overall results largely validate existing thresholds, they also highlight that a balance should be struck between due attention to debt levels rising above thresholds and the need for judgment when assessing the risk of distress. A marginal or temporary breach of a threshold may not necessarily imply a significant vulnerability. Conversely, a near breach should not be dismissed without careful consideration.

	PV of debt as a percent of						Debt service as a percent of			
	GDP		Exports		Revenue		Revenue		Exports	
Probability minimizing type I and II errors	13.5%		12.5%		14.8%		15.2%		14.1%	
Implied Thresholds	DSF 1/	Updated 2/	DSF 1/	Updated 2/	DSF 1/	Updated 2/	DSF 1/	Updated 2/	DSF 1/	Updated 2/
Weak (CPIA=3.25)	30	28	100	131	200	184	25	18	15	17
Medium (CPIA=3.5)	40	36	150	179	250	217	30	20	20	20
Strong (CPIA=3.75)	50	44	200	226	300	250	35	22	25	24

1/ Thresholds currently in the DSF.

2/ Updated thresholds calibrated using the probability minimizing type I and II errors.

C. Including Remittances in External Debt Thresholds

23. **Debt burden indicators discussed in the previous section focused on the typical measures of repayment capacity (GDP, exports, and revenues).** However, remittances can also affect the probability of debt distress by enhancing a country's capacity to repay its external debt.¹⁷

24. **At the time of the last review of the DSF, Executive Directors agreed that remittances should be taken into account when assigning risk ratings.**¹⁸ Following that decision, remittances were incorporated into the analysis without a formal re-estimation of the thresholds. Specifically, modified debt burden indicators—the PV of PPG external debt to the sum of GDP and gross remittances, the PV of PPG external debt to the sum of exports and gross remittances, and debt service to the sum of exports and gross remittances—were included in the analysis. The inclusion of remittances in the denominator lowers the debt burden indicators. Mirroring this decrease, indicative thresholds for countries with significant remittances were lowered by 10 percent. The new thresholds allowed countries with large remittances to carry higher levels of debt without breaching the indicative thresholds.

¹⁷ See "[Review of Some Aspects of the Low-Income Country Debt Sustainability Framework](#)," August 5, 2009.

¹⁸ See "[Staff Guidance Note on the Application of the Joint Fund-Bank Debt Sustainability Framework for Low-Income Countries](#)," January 25, 2010.

25. **Staff re-estimated the basic econometric models, taking remittances explicitly into consideration.**¹⁹ Due to the limited availability of data on remittances, the number of observations in the estimation sample was reduced significantly, thus affecting the results. Since it would be misleading to compare the re-estimated thresholds presented in the previous section (full sample) to ones incorporating remittances (small sample), staff compared thresholds excluding remittances to thresholds with remittances using a common (small) sample.

26. **Explicitly including remittances in the model results in lower debt burden thresholds.** After controlling for sample size, the threshold for the PV of debt to the sum of GDP and remittances is approximately 10 percent lower than the corresponding threshold without remittances, while export-based thresholds with remittances are roughly 20 percent lower than their counterparts without remittances (Table 4). This suggests that the current DSF threshold for the PV of debt to the sum of GDP and remittances is appropriate, while the export-based thresholds with remittances included should be 20 percent lower than the corresponding thresholds without remittances, instead of 10 percent lower.

Table 4. Including Remittances: Impact on External Public Debt Thresholds

	PV of debt-to-GDP				PV of debt-to-exports				Debt service-to-exports			
	Without remittance		With remittances		Without remittance		With remittances		Without remittance		With remittances	
	Full sample	Small sample	Small sample	% Change in small sample	Full sample	Small sample	Small sample	% Change in small sample	Full sample	Small sample	Small sample	% Change in small sample
Implied Thresholds (minimizing type I and II errors)												
Weak (CPIA=3.25)	28	39	36	-8%	131	168	136	-19%	17	15	12	-20%
Medium (CPIA=3.5)	36	51	47	-8%	179	216	176	-19%	20	17	14	-19%
Strong (CPIA=3.75)	44	63	58	-8%	226	264	216	-18%	24	19	16	-19%
Number of Observations	740	315	315		743	318	318		659	307	307	

27. **For countries with large remittances, staff proposes to adjust the thresholds to reflect the updated analysis.** Specifically, the export-based thresholds should be lowered by 20 percent compared to their counterparts without remittances, while the current threshold for the PV of debt to the sum of GDP and remittances would remain unchanged. For countries where remittances are large and represent a reliable source of foreign exchange, adjusted thresholds could be used, resulting in the possibility of carrying higher level of debts without breaching the thresholds. As under the current guidelines, judgment should be used when determining the impact of remittances on the external risk rating. This judgment should be informed, inter alia, by recent developments in remittances and their prospects for the

¹⁹ The analysis used workers' remittances, which is the most appropriate concept of remittances to be used within the context of DSAs, as it represents a periodic transfer of resources from a nonresident to a resident.

future.²⁰The retroactive application of the proposed remittance-adjusted thresholds would lead to minimal changes in the assessment of the risk of debt distress.²¹

D. Use of Country-Specific Information

28. **The current methodology to calibrate thresholds leads to a manageable number of thresholds, but at the cost of losing country-specific information.** The methodology defines thresholds for each of the five debt burden indicators considered in the DSF (a “one-debt-variable-at-a-time” approach). Thresholds are derived by fixing real GDP growth at the sample mean for all countries, and by using one of three CPIA cutoff values (3.25, 3.5, or 3.75) corresponding to a country’s policy performance classification (weak, medium, or strong). Using discrete CPIA cutoffs gives rise to CPIA threshold effects, whereby a small change in a country’s CPIA score near the boundary of two policy performance categories results in a large shift in debt burden thresholds. The implied debt distress tolerance (as represented by debt burden thresholds) may thus be too high or too low depending on the divergence between a country’s actual CPIA score and the CPIA cutoff value used. The current methodology also makes no use of country-specific growth information in setting debt burden thresholds. The paragraphs below consider whether greater use of country-specific information is warranted.

29. **The case for using country-specific growth rates is not compelling.** Real GDP growth is included in the underlying model as a proxy for macroeconomic shocks to the economy. Recent growth performance is not a robust predictor of future shocks or of a country’s ability to sustain higher levels of debt in the medium term. Since country-specific growth rates already enter the framework through their impact on debt dynamics, using them to calibrate the thresholds would also risk overstating the impact of growth on debt sustainability and could impart a pro-cyclical bias to the policy.

30. **The benefits of using country-specific CPIA information have to be weighed against the operational complexity it would entail.** Country-specific thresholds could be derived using country-specific CPIA scores rather than discrete cutoff values. This would more closely relate debt distress thresholds to country-specific assessments of institutional and policy quality. It would also eliminate CPIA threshold effects. However, country-specific thresholds imply a large number (5 times the number of countries) and a wide range of thresholds rather than the current set of 15. In discussions on the initial design of the DSF, the IMF and IDA Executive Boards had expressed concerns about an initial proposal by staff

²⁰ Staff will develop precise guidelines to account for remittances based on the newly estimated thresholds.

²¹ In 2010 and 2011, only eight countries had their risk of debt distress assessed using remittances. The application of the proposed export-based thresholds with remittances implies that one country could be reclassified from moderate to high risk of debt distress.

that generated a wider dispersion of thresholds than the figures that were ultimately agreed.²² Subsequently, the Boards also expressed little support for a proposal to mitigate CPIA threshold effects by increasing the number of thresholds from 15 to 20. Directors opted for an alternative approach that they deemed more manageable and easier to implement.²³

31. **An alternative approach for incorporating country-specific information would be to express thresholds in terms of the probability of debt distress** (see Annex 1). In this case, the DSA would focus on the evolution of the probability of debt distress over time rather than the evolution of various debt burden indicators, thus more transparently conveying the probabilistic nature of the DSF. In addition to eliminating CPIA threshold effects, such an approach would allow for richer specifications and a fully country-specific assessment of risk. However, extensive econometric analysis has so far failed to yield an evidently superior approach to the one-debt-variable-at-a-time approach underlying the current framework. Given this, it is not clear that the potential benefits of a probability-based approach outweigh the costs involved in replacing a framework that has become widely adopted and understood by development partners and country authorities. On balance, therefore, staff does not advocate changing the basic architecture at this time.

32. **Instead, staff sees substantial merit in strengthening the use of judgment based on country-specific information when assessing the risk of debt distress.** This approach is also in line with the original intent of the DSF to provide a practical tool to help detect and measure potential debt-related vulnerabilities, rather than mechanically generate risk ratings. Staff proposes to reinforce this principle and to foster its more consistent application by developing clearer guidance on the use of judgment. For example, for countries with minor or temporary breaches of thresholds, staff would advocate taking into consideration whether their CPIA score is significantly higher than the cutoff value used to calibrate the threshold when determining the rating. Staff also proposes to carry out further analytical work on probability thresholds, and the use of specifications that combine different debt measures, to assess whether such analysis could usefully complement the information provided by the five debt-burden indicators, particularly in cases where the latter give conflicting indications on the risk of debt distress. If it proves useful, the analysis based on probability thresholds could be incorporated as part of the toolkit for capturing country-specific information in the

²² See “Information Note on Options for Revising Debt Thresholds in the Joint Bank-Fund Framework for Debt Sustainability in Low-Income Countries,” (OM2004–0091 and SM/04/399). Staff’s initial proposal used CPIA cutoffs of 3.0 and 3.9, while DSF thresholds were ultimately based on CPIA cutoffs of 3.25 and 3.75.

²³ For the 2009 review of the LIC DSF, IMF and IDA staff presented two options for reducing CPIA thresholds effects: (1) introducing greater granularity in the policy-dependent debt thresholds by dividing the CPIA medium performer category into two equally-sized categories; and (2) increasing the inertia in changes to thresholds relative to changes in CPIA scores. The IMF and IDA Executive Boards ultimately adopted the second option. See “[Review of Some Aspects of the Low-Income Country Debt Sustainability Framework](#),” August 5, 2009.

assessment of risks of debt distress, in which case staff would seek to reflect this in the revised guidance note.

E. Benchmarks for Total Public Debt

33. **Introducing benchmarks for total public debt, in addition to existing thresholds for external public debt, could further strengthen public sector DSAs.** In the absence of benchmarks, public sector DSAs have tended to focus somewhat simplistically on the projected path of public debt, often without drawing firm conclusions about the risk of debt distress. By comparison, in external DSAs, thresholds have anchored the analysis and helped country teams make judgments about the risk classification, based not only on the path but also the level of debt. In addition, thresholds have facilitated discussions with country authorities by clearly demarcating “danger zones” that are easily understood by broad audiences.

34. **IMF and World Bank staffs have previously argued that benchmarks for total public debt are difficult to derive.** The main empirical difficulty has been the absence of reliable and comprehensive historical data on domestic debt stocks (including arrears to suppliers) and associated debt service. A key conceptual challenge is determining when a domestic debt distress event has occurred. When governments face serious domestic debt difficulties, they often do not overtly default on domestic debt, but rather resort to other actions such as inflating debt away or financial repression. Domestic debt is also a highly heterogeneous concept across countries, which complicates cross-country comparisons.

35. **While these considerations are still valid, the need to improve the analysis of public debt and the availability of new debt data present an opportunity to estimate benchmarks.** Using the same probit model that underpins the thresholds for external public debt, IMF staff derived a set of policy-dependent benchmarks for public debt to GDP (Box 5 and Annex 2). This work draws on a new database on public debt compiled by the IMF’s Fiscal Affairs Department and on recent studies and surveys documenting episodes of domestic debt default. The results suggest that public debt to GDP in excess of about 40 to 70 percent in PV terms, or 50 to 75 percent in nominal terms, signals heightened debt vulnerabilities, with the actual benchmark varying according to the CPIA score. Similar to the case of external public debt, the regressions clearly show that the higher the level of total public debt, or the lower the quality of policies and institutions, the higher the risk of debt distress.

Box 5. Estimation of Indicative Public Debt Benchmarks

The probit model used to derive thresholds on PPG external debt was expanded to include domestic debt. A sample was compiled covering the period 1971- 2007 and containing 155 countries, of which 79 were classified as middle-income countries (MICs) at end-2007.^{1, 2} Debt distress signals and debt distress episodes are defined as follows:

- **External debt distress signals** are defined as (i) PPG external arrears in excess of five percent of external PPG debt; (ii) a Paris Club restructuring;³ and (iii) IMF GRA financing disbursed in excess of 50 percent of quotas.
- **Domestic debt distress signals** are defined as instances of outright sovereign defaults – that is, the failure by the sovereign to meet a principal or interest payment on the due date (within a specified grace period). This includes debt restructurings (e.g., converting a note to a different currency of less than equivalent value, rescheduling payments at less favorable terms, discounting an obligation). Defaults are identified using studies by Reinhart and Rogoff, Standard and Poor’s, and Moody’s, as well as IMF staff reports.^{4,5} Data on domestic arrears is largely missing and thus was not systematically included in the definition of a domestic debt distress signal.
- **Debt distress episodes** are defined as non-overlapping periods in which either an external or domestic debt distress episode occurs. External debt distress episodes are defined as a period lasting three years or more in which at least one of the external debt distress signals is observed. Any instance of domestic default constitutes a domestic debt distress episode. **Normal time episodes** are defined as non-overlapping periods of three consecutive years in which in which no public debt distress signal (external nor domestic) is observed. A total of 99 public debt distress episodes are observed. Most of the episodes are linked to either external events or domestic events that coincide with external ones.

Detailed results of this analysis can be found in Annex 2. The table below shows the implied policy-dependent public debt sustainability thresholds.⁶ These thresholds were calculated based on probabilities that minimize type I and type II errors for the mean of the public debt ratios.

Indicative Policy-Dependent Public Debt Thresholds		
	Public debt to GDP	
	PV	Nominal
Probability minimizing type I and type II errors	12.3%	12.7%
Weak (CPIA=3.25)	38	49
Moderate (CPIA=3.5)	56	62
Strong (CPIA=3.75)	74	75

¹ LICs are defined as IDA-only countries. A country’s income classification can change within the sample period. For example, a country can move from LIC to MIC status as it graduates from IDA.

² See IMF Fiscal Affairs Department’s [Historical Public Debt Database](#) for a description of data sources and methodology. Public debt is expressed in percent of GDP and is defined as gross general government debt, although in many cases (especially before 1980) only central government data are available.

³ Paris Club restructurings are assumed to last three years, with the exception of completion point treatments, which are assumed to last only one year.

⁴ See Reinhart and Rogoff (2009); Standard and Poor’s *Sovereign Defaults and Rating Transition Data* reports; and Moody’s *Sovereign Default and Recovery Rates* report.

⁵ For countries not included in the aforementioned sources, IMF staff reports were used to determine any instance of domestic debt defaults.

⁶ Thresholds were also estimated for public debt to revenue, but the results were not robust and therefore are not presented.

36. **While the estimated benchmarks represent progress over past econometric efforts, the results should be interpreted with caution.** The results are sensitive to the definition of debt distress and normal time episodes (i.e., the length of each). Despite improvements in the data, comprehensive data on domestic arrears still does not exist, which implies that the stock of domestic debt could be underestimated and debt distress events overlooked. Another reason to interpret the results with caution is the lack of homogeneity in the coverage of the public sector debt across countries. Moreover, the underlying probit did not perform significantly better when domestic debt was included as an explanatory variable, reflecting the fact that, in most cases, domestic debt events have coincided with external debt events.

37. **The empirical analysis carried out by staff could, however, serve to define reference points for triggering a deeper discussion of total public debt.** As noted earlier, these benchmarks could be used to determine when to conduct deeper analysis, thus providing an anchor to help frame the analysis. When total public debt moves toward, or exceeds, the relevant benchmarks over the projection horizon, a detailed discussion of potential risks to debt sustainability arising from high public debt levels would be expected—particularly in cases where external public debt indicators remained below their respective thresholds.

38. **A key question is whether the assessment of total public debt should inform the risk rating.** The risk rating is arguably the most important outcome of the DSA: it facilitates cross-country comparisons, provides critical guidance to lenders and donors on the appropriate terms of financing, and has implications for the grant-loan allocation decision of IDA and other multilateral institutions and for IMF program design through the Fund's debt limits policy. The public sector DSA allows staff to provide detailed analysis of public debt, including domestic debt. That analysis can lead to a different conclusion from the assessment of external public debt only. However, this overall assessment of debt vulnerability does not currently affect the risk rating.²⁴ The growing prominence of domestic debt in some countries, and the need to strengthen public sector DSAs, raises the question of whether the risk rating should continue to be determined by an assessment of external public debt only. If external public debt is low but domestic public debt is high, the external risk rating could send a misleading signal about overall debt sustainability.

39. **Staff believes that risk ratings derived from external DSAs could be supplemented in cases where the public sector DSA identifies significant vulnerabilities.** For the majority of LICs, where external public debt remains dominant, the risk rating would continue to be assigned by comparing the projected path of external public debt indicators against policy-dependent thresholds. For those LICs with total public debt moving toward or

²⁴ See "[Staff Guidance Note on the Application of the Joint Fund-Bank Debt Sustainability Framework for Low-Income Countries](#)," January 25, 2010.

exceeding benchmarks, country teams would be expected to conduct in-depth analysis to determine the extent of domestic debt vulnerabilities. In the event that the analysis uncovered significant domestic debt vulnerabilities, an additional risk rating providing the overall assessment of debt vulnerability would be assigned. If the IDA and IMF Executive Boards agree with this approach, staff will develop detailed guidance.

40. **The additional risk rating would not be a substitute for the risk rating on external public debt.** Governments with high domestic debt vulnerabilities would need to design macroeconomic and structural policies to reduce these vulnerabilities and to avoid the negative consequences of excessive domestic debt on the economy. Maintaining or increasing access to concessional financing can be an important element to help governments implement the required policies. For this reason, the assessment of the risk of external debt distress would continue to inform the financing decisions of IDA, while the additional risk rating on the overall assessment of debt vulnerability would inform the macroeconomic and structural policy dialogue with country authorities.

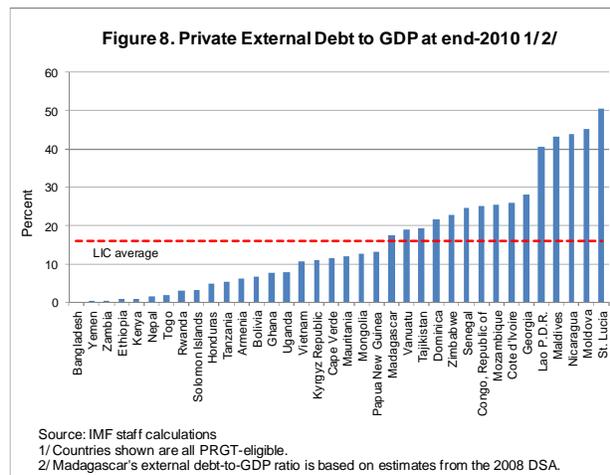
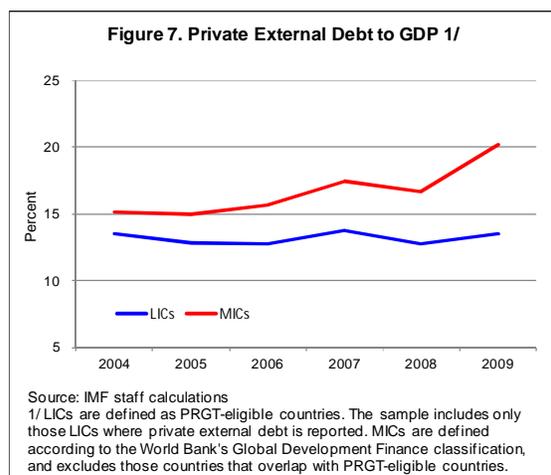
V. IMPROVING THE COVERAGE OF EXTERNAL DEBT

41. **External DSAs capture both public and private external debt, but in practice the analysis has focused almost exclusively on public external debt.** This reflects both the dominant share of public external debt in total external debt in most LICs as well as limited information on private external debt. Nevertheless, an increase in external private investor interest in LICs, including for the financing of infrastructure, begs the question of whether a greater focus on private external debt is warranted. Increasing levels of private sector external debt from a low base, while generally a positive sign of growing business activity, could increase external debt vulnerabilities. High levels of private external debt could create balance of payments pressures by competing with the public sector for foreign exchange and could also increase exposure to risks stemming from the accumulation of contingent liabilities.

42. **While private external debt is unlikely to pose an immediate concern in most LICs, some exceptions apply.** Private sector external debt has remained broadly stable across LICs, compared to a growing trend in MICs (Figure 7). In many LICs, private external debt is negligible, or data is unavailable. In a sample of 70 LICs, only half report any private external debt in their most recent DSA. There are, however, some cases where private external debt is already substantial in relation to GDP (Figure 8), and one can expect the number of such cases to rise in the coming years.

43. **The presence of high levels of private external debt in only a few LICs suggests that a country-specific approach would be appropriate.** To assist teams in monitoring private external debt dynamics, additional charts could be added to the standard template showing, for instance, the pace of accumulation of private external debt or the path of total external debt. Where private external debt is significant, the DSA should discuss the risks to

overall external debt sustainability, as exemplified in a few recent cases.²⁵ In the event that the risks associated with private external debt were judged to be significant, they would be reflected in the additional risk rating denoting the overall assessment of debt vulnerability. As stated earlier, this overall assessment of debt vulnerability would not be a substitute for the risk rating on external public debt.²⁶



VI. STRENGTHENING THE ANALYSIS OF THE PUBLIC INVESTMENT AND GROWTH NEXUS

44. **To achieve accelerated and sustained growth, LICs will require much higher investment, particularly in infrastructure.** By raising productivity and encouraging private investment, closing the present large infrastructure gap could substantially increase rates of per capita income growth. According to a World Bank report, the cost of addressing Sub-Saharan Africa's infrastructure needs is estimated at around US\$93 billion a year, equivalent to 15 percent of the region's GDP, or 22 percent of GDP for the region's low-income countries.²⁷ This raises the twin challenges of investing efficiently in infrastructure to get the biggest possible growth dividend and financing that investment in a sustainable manner.

45. **In November 2011, the G20 leaders committed to help scale-up and diversify sources of financing for infrastructure in LICs, particularly in Sub-Saharan Africa.** Leaders endorsed the recommendations of the High Level Panel on Infrastructure to (i) increase the funds that multilateral development banks (MDBs) dedicate to facilities to help prepare and finance investments; (ii) build an enabling environment for private and public infrastructure financing, especially for regional projects; and (iii) improve access to funding, notably through the strengthening of local intermediaries and financial markets,

²⁵ See, for instance, the [January 2010 Moldova DSA](#).

²⁶ Staff will develop guidelines to ensure a consistent assessment of risks arising from private external debt.

²⁷ See Briceño-Garmendia, Smits, and Foster (2008).

and through more effective use of MDB capital, including the use of credit enhancement and guarantee instruments.

46. **A recurring criticism of the DSF is that it does not adequately capture the benefits of debt-financed public investment.** Proponents of scaling up public investment maintain that productive investment, while increasing debt ratios in the short run, can lead to higher growth, revenues, and exports—and therefore to lower debt ratios—over time. Some argue that LIC DSAs, by failing to take sufficiently into account the assets and future income that public investment may generate, lead to overly pessimistic risk assessments, which in turn discourage potential investors while constraining how much LICs can borrow in accordance with the Fund’s external debt limits policy and the Bank’s external non-concessional borrowing policy.

47. **IMF and World Bank staffs have long recognized the importance of gaining a better understanding of the public investment-growth nexus.** The issue was discussed in detail by the IMF and IDA Executive Boards in 2006 and 2009. Staff presented evidence that, despite the difficulties in assessing the growth effect of public investment, recent DSAs had attempted to take into account such effects. Although suitably long data series did not exist to systematically evaluate the criticism that growth projections in DSAs were too conservative, staff analysis comparing actual versus projected GDP growth for the period 2004–2008 did not reveal a tendency to underpredict growth in countries with high levels of public investment. Executive Boards saw the need for more work and agreed that analyzing the investment-growth nexus required a country-specific approach, using a broad range of indicators, supplemented with model-based approaches where appropriate.

48. **Work on the investment-growth nexus is ongoing and goes beyond the scope of the DSF.** Financing investments to help countries achieve higher and sustained growth is at the core of the World Bank development model. The growth dividend from additional debt-financed investment depends on a number of country-specific factors, including the quality of public investment, the crowding-in effect of public investment for private investment, and the capacity of the government to increase revenues to repay the initial debt.

49. **IMF staff has developed a dynamic general equilibrium model that analyzes the linkages between public investment and growth and the implications for debt sustainability.** The model is designed to include features and shocks that are common in LICs. It incorporates a production function with private and public capital, so productive government spending can raise output directly and crowd in as well as crowd out private investment.²⁸ It takes into account potential inefficiencies in translating a dollar of public investment into a dollar of public capital, as well as absorptive and capacity constraints. It

²⁸ The production function can be calibrated to match, for instance, the median rate of return for World Bank projects in Sub-Saharan Africa, which is around 20 percent. Crowding out can occur when investment is financed via tax increases or with domestic borrowing.

allows for government concessional and nonconcessional borrowing and states explicitly the fiscal policy reactions that may ensure debt sustainability. The framework was piloted in Togo and presented to the IMF's Executive Board in the context of Togo's 2011 Article IV consultation (Box 6). In Togo's case, the model showed that a gradual investment path was preferable, to reduce inefficiency losses due to capacity constraints and to allow time for reforms in public financial management.

Box 6. Modeling the Links Between Public Investment and Economic Growth

The model developed by IMF staff was applied to Togo in the context of the Article IV consultation (EBS/11/112, Appendix III) to evaluate the authorities' investment plan, worth 192 percent of GDP over 10 years. The model was used to simulate scenarios and to assess the current DSA projections. The model showed that with good structural conditions—rates of return of 25 percent, efficiency of public investment similar to that of the average Sub-Saharan African country and high capacity to collect user fees and to tax revenues—this surge could be self-financing and could increase output by more than 8 percent in the long run. But the model also highlighted formidable transition problems, with total debt exceeding 55 percent of GDP and required tax pressure increasing by 2 to 4 percent of GDP in the medium-term. Non-concessional borrowing could smooth the adjustment but the strategy would be risky: high costs of borrowing raise the stakes as small changes in rates of return or in the efficiency of public investment can lead to unsustainable debt dynamics. Overall, the model suggested that a gradual investment path is preferable, to reduce inefficiency losses due to capacity constraints and to allow time for reforms in public financial management.

The Togo pilot highlighted that judgment is critical when applying the model. The model allows policymakers to quantify the investment-growth nexus, but requires a careful choice of parameters and scenarios. In this sense, the model helps apply empirical information where available and makes explicit the assumptions underlying the projections, furthering discussions internally and with stakeholders.

Country studies based on MAMS have been carried out by the World Bank and its development partners in 16 LICs since 2008, mainly in Sub-Saharan Africa. MAMS is a dynamic computable general equilibrium model that includes fiscal spending across sectors (including infrastructure) and financing options (taxation, domestic and foreign borrowing, and foreign aid). Economic performance is measured by the evolution of macro indicators such as GDP, the budget, and the balance of payments, and other indicators such as poverty or MDG targets.

The Spatial Approach model, presented in the 2009 World Development Report, has been applied to the Republic of Congo and the Democratic Republic of Congo (DRC). By geo-referencing data on productive sectors and infrastructure networks, the analysis portrays the economic geography of a country and allows for evaluating the returns associated with existing and proposed investment packages, as well as the synergy effects of creating spatially coordinated bundles of infrastructure.

In the DRC case, the Spatial Approach indicated that infrastructure investment would lead to higher growth rates. The model estimated that priority public infrastructure projects would raise real GDP growth by 0.7 percentage points on average during the construction phase 2009–13, mainly through the impact on domestic demand, and by 0.2 percentage points following completion of the projects, reflecting gains in total factor productivity associated with improved public infrastructure. The higher growth projections have been incorporated in the baseline scenario of the DRC's annual LIC DSAs since 2009. The model highlighted a large variation in economic rates of return across different investments, including cross-border investments, underscoring the importance of project screening.

50. **IMF staff intends to pilot the framework in five more countries over the next year.** The model would be particularly useful in countries considering different financing options to finance large investment projects. To facilitate broader use in DSAs, IMF staff intends to develop a user-friendly apparatus in the coming months. As staff gains more experience with this tool, an explicit assessment of the trade-offs between the usability and the complexity inherent to the calibration and use of dynamic general equilibrium models will be needed before mainstreaming this approach can be envisaged.

51. **To inform lending operations and policies for economic and social development, World Bank staff has developed a broad set of analytical tools and instruments that touch upon the growth-investment nexus.** The Bank's analytical work takes a comprehensive approach to development, with growth and investment being key elements along with poverty alleviation and social inclusion. To inform medium- and long-term government development policies for reducing poverty and achieving the Millennium Development Goals (MDGs), the Bank has developed the Maquette for MDG Simulations (MAMS), which quantifies investment levels needed to meet the MDGs and estimates their impact on growth (Box 6). Another example is the Spatial Approach model, created to help countries assess their proposed infrastructure investment plans by identifying priorities and formulating an adequate sequencing of projects.

52. **These various models are complementary.** A single model cannot accommodate the heterogeneity of country-specific circumstances with regard to growth and investment. Different analytical tools are needed to inform the macroeconomic projections underlying the DSA, and country teams should choose the tools that best suit each particular case. The IMF's model is focused on producing macroeconomic frameworks for DSAs that explicitly incorporate public investment and growth linkages. It incorporates fiscal reaction functions and produces trajectories for growth, the real exchange rate, and debt stocks that can be compared to DSF thresholds. MAMS focuses on the linkages across different sectoral investments and looks at the implications for growth and development outcomes. The Spatial Approach model estimates the rate of return of groups of investment projects from a micro-sectoral perspective. The available tools thus offer complementary views on the investment-growth nexus and could be used jointly. Where appropriate, future DSAs will include specific references to analytical work carried out by IMF and the World Bank staff to anchor expected growth rates, taking into account planned public investments.

53. **The available tools could also be used to enhance the analysis of the growth dividend of regional projects.** The macroeconomic frameworks underpinning the DSAs are country-specific in nature, and as such may not appropriately reflect the growth impact generated by large regional infrastructure projects. The Spatial Approach can estimate the economic return from synergies between cross-country investment projects. The other models could be expanded to take these positive externalities explicitly into account, thereby allowing for a more comprehensive analysis of the expected costs (in terms of debt

accumulation) and benefits (in terms of higher growth path) of such projects and of alternative financing options.

VII. REDESIGNING STRESS TESTS

54. **The DSF features a series of stress tests used to assess the impact of shocks that could result in a significant deterioration in the debt outlook.** The baseline scenario is based on explicit macroeconomic assumptions deemed to be the most likely outcome, taking into account the authorities' intended policies. Stress tests, consisting of alternative scenarios and bound tests, illustrate the sensitivity of baseline debt projections to changes to key assumptions. The alternative scenarios entail permanent changes to key assumptions—for example, setting variables at historical levels, or assuming less favorable financing terms. Bound tests show the impact of temporary adverse deviations in key assumptions, with the size of the shock calibrated to match each country's historical experience. Standardized stress tests simplify the analysis, facilitate cross-country comparisons, and ensure a degree of consistency in the assessment of the risk of debt distress across countries. In addition to these standardized stress tests, country teams are encouraged to design customized scenarios to highlight key country-specific risks.

55. **Stress tests were originally calibrated to illustrate the degree of uncertainty surrounding debt projections.** The bound tests were calibrated to yield roughly a 25 percent probability of shock occurrence at a 10-year horizon based on stochastic simulations for a representative PRGT-eligible country.²⁹ The 10-year horizon was intended to strike a balance between the uncertainty of long-term projections and the desire to capture debt service on loans with long maturities and grace periods.

56. **The DSF's broadly satisfactory track record suggests that stress tests have met their main objective.** A comparison of actual levels of debt in 2010 to projections made in LIC DSAs conducted in 2006 and 2007 reveals that in only 7 out of 60 cases did the actual level of debt in 2010 exceed the level projected by the most extreme stress test.³⁰ Comparing the baseline scenario to an alternative based on a country's historical record provides a useful "reality check," drawing attention to cases where the underlying macroeconomic assumptions may be overly optimistic. Bound tests are designed to help identify key vulnerabilities and gauge the impact of remedial policy options.

²⁹ The shocks are set at one standard deviation for each variable individually; one-half standard deviation for the combined shock. Shocks persist for two periods in each case.

³⁰ The seven cases here overlap to a large extent with the non-HIPC cases described in paragraph 6. The unexpectedly high levels of debt in 2010 mostly reflect larger-than-anticipated macroeconomic shocks related to the global financial crisis.

57. **Stress tests have been criticized for being too standardized and lacking interaction between key variables.** For example, the bound test that simulates a one-time 30 percent permanent depreciation of the domestic currency has no impact on exports or the current account balance. Furthermore, the persistence of shocks is constrained to be the same across countries even though the dynamic adjustment process is generally believed to depend on various country-specific attributes (the exchange rate regime being a prime example).

58. **Possible methodological refinements must consider limitations imposed by data availability and the need to maintain some degree of cross-country comparability.** One way to address criticisms of the current framework would be to estimate country-specific dynamic interaction between key variables and the covariance between shocks using vector autoregressive (VAR) models (Annex 3). Such models have been used to assess public debt sustainability in a number of advanced and emerging market countries.³¹ However, several issues limit the widespread application of such methods across all LICs. First among these is the lack of adequate data.³² Moreover, estimates can be sensitive to model specification and the sample period used, and may be misleading in cases where there have been structural shifts (for example, in the conduct of fiscal and monetary policy and the exchange rate regime), which tend to be frequent in LICs.

59. **One way to address the issue of data limitations would be to estimate dynamic linkages between variables using panel data.** Pooling observations across countries would increase the degrees of freedom required to attain reasonably reliable estimates, while maintaining some degree of cross-country comparability. Such an approach has the added benefit of reducing the resource intensity of the empirical exercise. A more granular approach could entail estimating VARs for different groups of countries based on economic characteristics, such as the exchange-rate regime or the dependence on a specific commodity export. This would not preclude country teams from using alternative model specifications tailored to capture country-specific attributes.³³

³¹ Most applications to date have modeled public debt dynamics using VAR models estimated with quarterly data, which are available for around 40 countries, the majority of which are advanced economies. Stochastic simulation methods are applied to estimated VAR models to generate fan charts for public debt projections. See, for example, the [November 2010 Fiscal Monitor](#) (Greece, the UK, Germany, and the United States) and various staff reports, including [South Africa](#) (2005), [Morocco](#) (2008), [Mauritius](#) (2010), [El Salvador](#) (2010), [Indonesia](#) (2010), [Israel](#) (2011), and [Costa Rica](#) (2011). A tool to perform fiscal sustainability analysis under uncertainty has been developed by the World Bank and applied to [Russia](#) (2010), [Turkey](#) (2009), [Nigeria](#) (2007) and [Azerbaijan](#) (Country Economic Memorandum, 2009). A description of the tool is included in “[The ‘How to’ of Fiscal Sustainability: A Technical Manual for Using the Fiscal Sustainability Tool](#),” (2007).

³² Quarterly data on the balance of payments and national accounts are not available in most LICs, but annual data are available going back to 1970 in 50 of the 72 LICs.

³³ A prime example would be incorporating world commodity prices into models for countries that are highly dependent on resource exports.

60. **Staff proposes introducing methodological refinements of stress tests on an experimental basis, which would enable users to become familiar with new techniques.** The innovations would provide country teams with a broader menu of options available to enrich their analysis, but would not have a formal role in determining the risk rating. The innovations would not be incorporated into the standard template, in keeping with the objective of simplification, as discussed below.

VIII. SIMPLIFYING THE DSA TEMPLATE

61. **The review of the DSF provides an opportunity to look for ways to simplify the LIC DSA template.** Feedback from staff indicates that producing a DSA is a resource-intensive exercise, largely due to the complexity of the template and the extensive data input requirements. According to a staff survey, the time it takes to produce a DSA can range from a few weeks to well over a month, depending on the country case and the experience of the staff member with the template. Another indication of the template's complexity is the fact that few country authorities are able to use it to produce their own DSAs, despite many workshops provided by IMF and World Bank staffs over the years.

62. **The template has already undergone numerous changes since the DSF was introduced.** Major changes include the unification of the external DSA and public sector DSA templates and the introduction of additional tools to better incorporate remittances into the analysis. Overall, these changes have increased the template's complexity. Introducing new features could enhance the analysis of debt sustainability but risks increasing the template's complexity even further.

63. **Adopting a modular approach could address the tradeoff between sophistication and ease of use.** Some technical aspects of the template could be simplified without sacrificing any functionality. In particular, staff is considering: (i) introducing a core module consisting of a simplified macroeconomic framework input sheet, a baseline scenario, and basic stress tests³⁴; and (ii) grouping customized scenarios and additional stress tests in optional modules.³⁵

64. **A simpler template with the aforementioned characteristics would allow country authorities to more easily produce their own DSAs and enhance discussions between**

³⁴ A redesigned input sheet would significantly facilitate use of the template. Users would be required to make explicit assumptions about external and domestic public borrowing as well as private external borrowing, and to differentiate between borrowing and guaranteeing by the public sector. Taken together, these changes would narrow the scope for inconsistencies and unexplained debt dynamics.

³⁵ Some have argued that the DSF's 20-year projection horizon should be shortened, given uncertainties surrounding long-term macroeconomic projections. Staff's view is that a long projection horizon is necessary to capture returns on investment and the long maturities and grace periods associated with concessional debt.

country authorities and staff. The core DSF module as described above would be more intuitive and would ensure consistency of the macroeconomic framework with the underlying economic and financing assumptions. Its output would be limited to a set of standard tables and charts. IMF and World Bank staffs could continue to use most or all of the modules, depending on the complexity of the case, thus avoiding a loss of sophistication and accuracy.

65. **Staff proposes that full joint DSAs be produced every three years, with lighter joint updates in the interim years.** This would reduce the resource intensity of the DSA exercise through more streamlined written analysis, while still providing an in-depth look at debt sustainability when warranted.³⁶ A full DSA would still be expected whenever there were significant changes to the global environment or to the authorities' policy stance, particularly if these changes entail a change in the risk rating.

66. **A simpler template and greater focus on identified country-specific risks would help reduce the resource implications of the enhancements proposed in previous sections.** Under a risk-based approach, the depth of the DSA would depend on the extent of identified risks. In countries where public debt and fiscal vulnerabilities are of concern or external private debt is significant, additional resources may be needed to conduct in-depth analysis. In countries where such risks are deemed low, a risk-based approach ensures that resources are not unnecessarily diverted from the analysis of more pressing matters. In countries where scaling up public investment is envisaged, it may be appropriate for country teams to use one of the models developed by IMF and Bank staffs to evaluate the impact of investment on growth. In countries where public investment is relatively small, a model-based approach would not be recommended.

³⁶ This streamlining of the requirement to produce yearly DSAs was already envisaged at the time of the 2009 review. The lighter joint updates would consist of a short write-up and the same set of standard tables and charts included in a full DSA. Risk ratings would still be assigned.

IX. ISSUES FOR DISCUSSION

- Do Directors agree to maintain the indicative policy-dependent thresholds defined in terms of the various debt burden indicators and to introduce revisions to the thresholds for debt service to revenue and for the PV of debt to the sum of exports and remittances?
- Do Directors agree with the need for strengthening the analysis of total public debt and fiscal vulnerabilities in DSAs? Do they agree to introduce an additional risk rating, which would complement the assessment of external public debt, in cases where there are significant vulnerabilities related to domestic public debt or private external debt?
- Do Directors agree that country-specific information should be more systematically taken into account when assessing the risk of debt distress?
- Do Directors support ongoing efforts by IMF and World Bank staffs to develop models and tools that will strengthen the treatment of investment-growth linkages in DSAs?
- Do Directors support the inclusion, on an optional basis, of a new stress test reflecting dynamic linkages between macroeconomic variables?
- Do Directors see merit in developing a simplified DSA template, built around a baseline scenario and simple stress tests, to facilitate its use by country authorities?

Annex 1. External Public Debt Thresholds

Overview of previous methodologies used to derive external debt thresholds

The DSF thresholds for public and publicly guaranteed (PPG) external debt are based on studies by Kraay and Nehru (KN) and IMF and IDA Staff (Staff 2004).¹ The calibration of these thresholds comprises three main steps:

- (i) Identification of debt distress and non-distress episodes on the basis of ‘signals’ of external debt servicing difficulties such as arrears, Paris Club reschedulings, and IMF GRA financing.
- (ii) Estimation of a parsimonious econometric model (probit) to explain the incidence (probability) of debt distress. The probit model takes the following form:

$$P(\text{debt distress}) = \Phi(\beta_1 * \text{debt burden} + \beta_2 * \text{governance} + \beta_3 * \text{shock} + \beta_4 * \text{other}) \quad (1)$$

- where “debt distress” is a binary variable taking the value of 1 if the country experiences debt distress and zero otherwise; Φ is the cumulative distribution function (CDF) of the standard normal distribution; “debt burden” is a measure of indebtedness (PV of debt or debt service) scaled by a measure of repayment capacity (GDP, exports, or government revenue); “governance” is a measure the quality of policies and institutions (the World Bank’s CPIA index); “shock” is a proxy for macroeconomic shocks to the economy (real GDP growth); and “other explanatory variables” in Staff 2004 included GDP per capita and a dummy variable for Africa.²
- (iii) Calibration of indicative debt burden thresholds. This is achieved by fixing in equation (1) the values for the probability of debt distress, governance, and macroeconomic shock, and solving for the debt burden. In the DSF, the probability of debt distress was set between 18–22 percent, depending on the debt burden indicator.³

$$\text{Threshold} = \frac{\Phi^{-1}(P(\text{debt distress})) - \hat{\beta}_2 * \text{governance} - \hat{\beta}_3 * \text{shock} - \hat{\beta}_4 * \text{other}}{\hat{\beta}_1} \quad (2)$$

While the studies share the same basic methodology, they differ significantly in several technical respects. Staff 2004 focuses on LICs and considers only arrears on PPG external debt to official creditors as a signal of debt distress. It defines a non-distress episode as at least three consecutive years in which there is no signal of debt distress (i.e. arrears). All other individual

¹ See Kraay and Nehru (2004) and “[Debt Sustainability in Low-Income Countries—Proposal for an Operational Framework and Policy Implications](#),” February 3, 2004.

² In both studies, for debt distress episodes, the explanatory variables are lagged one period in order to reflect the conditions prevailing before these episodes and to limit estimation bias due to endogeneity.

³ Thresholds are calibrated in Staff 2004, but not in KN.

years are defined as debt distress episodes. In contrast, the KN study uses data for both LICs and MICs and relies on three distress signals: arrears on PPG external debt to all creditors (official and private), Paris Club reschedulings, and IMF GRA financing on a commitment basis. KN characterizes a debt distress episode as a period of three years or longer in which at least one of the three distress signals is observed, while a non-distress episode is a non-overlapping five-year period showing no distress signal. Table A1 summarizes the main differences between the two studies.

Despite these technical differences, the studies find similar results. Empirical results indicate that countries with higher debt burdens are more likely to experience a debt distress episode, and countries with strong policies can sustain a higher debt burden than those with weak policies. These findings are robust to alternative model specifications, including a broader set of explanatory variables. Furthermore, the KN study finds that the basic model has a good out-of-sample predictive power.

The DSF used these empirical analyses to introduce indicative debt burden thresholds. In particular, thresholds were calibrated for five debt burden indicators: PV of debt to GDP, PV of debt to exports, PV of debt to revenue, debt service to exports, and debt service to revenue. The calibration of thresholds for the PV of debt indicators mainly followed the econometric results reported in Staff 2004, whereas those for the debt service indicators used estimates from KN. In line with the robust empirical result that policies matter, specific debt burden thresholds were calibrated for CPIA scores associated with strong (3.75), medium (3.5), and weak (3.25) performers. Thus, a country with strong policies can have debt burden thresholds higher than those of a country with weak policies, acknowledging that the former can carry more debt than the latter. Probabilities ranging from 18 percent to 22 percent, depending on the debt burden indicator, were used to calibrate the thresholds. The probabilities were essentially based on the median PV of debt-to-GDP ratio in LICs immediately preceding an outbreak of debt distress, as observed in the Staff 2004 sample, and were fairly close to the unconditional probability (i.e., the frequency) of debt distress episodes found in the KN study.⁴ The resulting thresholds were broadly consistent with the results of other studies of the impact of debt on macroeconomic performance (Cohen (1997) and Pattillo, Poirson and Ricci (2002)).

There are three main areas where the technical analysis underlying the DSF thresholds could be improved:

- Debt distress and non-distress episodes are not uniformly defined across the debt thresholds since thresholds on PV of debt are calibrated using Staff 2004 while thresholds on debt service are calibrated using KN. Lack of uniformity in the definition of episodes implies that the probabilities (18-22 percent) underlying the DSF thresholds refer to the occurrence of events that are rather different, and therefore direct comparisons can be misleading. For

⁴ The unconditional probability of debt distress is 25 percent in the KN's sample and roughly 36 percent in Staff 2004. The median PV of debt-to-GDP ratio observed in LICs immediately prior to an outbreak of debt distress is 43 percent in Staff 2004, and such a figure implies a probability of debt distress of 20 percent for a country with average CPIA score.

example, a country breaching the thresholds on PV of debt (calibrated using Staff 2004) would have a probability of 18–22 percent (or larger) of experiencing distress in the next year, while a country breaching the thresholds on debt service (calibrated using KN) would have a probability of 18–22 percent (or larger) of experiencing protracted distress over the next three or more years.

- Debt service thresholds (calibrated using KN) apply to LICs but were calibrated on the basis of regressions estimated using a sample of LICs and MICs without controlling for differences between the two groups. LICs tend to borrow on more concessional terms than MICs, resulting in higher debt service obligations for the latter. As a result, the lack of control for both country groups could lead to estimation biases.
- Debt service thresholds (calibrated using KN) apply to the debt service on PPG external debt but were calibrated on the basis of regressions estimated using the debt service on total external debt (private and public). The current thresholds on PPG external debt service could be inflated by the debt service on private external debt.

Staff has re-estimated the econometric models underlying the LIC-DSF using updated data and a single methodological framework to identify debt distress and non-distress episodes.

The new Staff 2011 estimations: (i) rely on a sample of developing countries (LICs and MICs) over 1970–2007; (ii) use a consistent methodology to identify debt distress and non-distress episodes; (iii) control for the presence of MICs in the database; and (iv) use debt service on PPG external debt rather than total external debt. The new estimations, therefore, address the three areas discussed above: the probabilities of experiencing debt distress refer to episodes defined homogeneously across regressions and thresholds, the regressions permit calibrating thresholds applicable to LICs only, and the explanatory variables in the regressions coincide with those used in the DSF.

The Staff 2011 estimations: description of episodes and basic statistics

Staff focuses on three indicators related to exceptional external financing to signal whether a country is experiencing debt distress: (i) the accumulation of arrears on PPG external debt in excess of five percent of the PPG external debt stock outstanding; (ii) a rescheduling of obligations due to Paris Club creditors; or (iii) the disbursement by the IMF of GRA resources exceeding 50 percent of IMF quota.⁵

A debt distress episode is defined as a period lasting three or more years in which at least one distress signal is observed. As in KN, by imposing a three-year minimum duration requirement on distress episodes, the analysis captures severe and persistent debt service difficulties, and rules out temporary events.⁶ A non-distress episode is defined as a non-

⁵ Resources under Stand-By Arrangements or Extended Fund Facilities.

⁶ In addition, a debt distress episode must not be preceded by another episode ending in any of the three previous years. With such a requirement, the analysis retains the outbreak of severe repayment difficulties following a prolonged non-distress period, and rules out the mere re-emergence of difficulties that had started much earlier but were temporarily avoided during a few ‘good years.’

overlapping three-year period during which none of the distress signals is observed.⁷ Accordingly, the duration of distress episodes is in line with KN while the duration of non-distress episodes is in line with Staff 2004. Debt burdens are taken from the World Bank's Debt Reporting System, in which the PV of debt is calculated by discounting the stream of debt service denominated in original currencies using time-varying currency-specific commercial interest reference rates (CIRRs), as in KN.^{8,9} Staff uses the debt service data from the World Development Indicator (WDI) database, which is on a paid basis, and adjust data by the accumulation of arrears to estimate service on a due basis. Series for real GDP growth, nominal GDP, exports and government revenues were constructed by merging information from different databases: WDI, Global Finance Statistics (GFS), United Nations (UN), and World Economic Outlook (WEO). The database covers LICs and MICs.¹⁰ The World Bank's CPIA is used as a measure of the quality of policy and institutions.¹¹

Staff uses a sample of 130 countries, of which 61 are LICs, and identifies 105 debt distress episodes and 654 non-distress episodes. Compared to KN, the current exercise shortens the duration of non-distress episodes (from five to three years), thus increasing their number in the sample. Compared to Staff 2004, the current exercise lengthens the duration of debt distress episodes (from one to three years), thus reducing their number in the sample. As a result, the frequency of debt distress episodes—and hence the unconditional probability of debt distress—is lower than in previous studies.

The results confirm key findings from earlier studies: countries in debt distress tend to have higher debt levels than countries not experiencing distress, and higher capacity countries are able to carry higher levels of debt. Table A2 reports summary statistics

⁷ Countries that reach HIPC completion point receive debt relief from the Paris Club. However, this treatment is not associated with the beginning of a debt distress episode. In addition, countries that reach completion point may need time to settle arrears with creditors participating in the debt relief initiative. These arrears do not signal debt distress. For these reasons, signals related to Paris Club reschedulings and outstanding arrears are adjusted so that countries that reach completion point are not deemed to be in debt distress.

⁸ The PV of debt used in Staff 2004 was calculated using a fixed discount rate of 7.5 percent.

⁹ The PV of debt in the DSF is calculated by discounting the stream of debt service converted into U.S. dollars, using a uniform discount rate. The discount rate is adjusted only in the event of large and persistent fluctuations in market interest rates.

¹⁰ LICs are defined as IDA-only countries. Countries can move from LICs to MICs (or the reverse) in the sample as they graduate (reverse graduate) from IDA status.

¹¹ CPIA data date back to 1978 for nearly 80 countries and to 1996 for 120 countries. Missing CPIA data in the early 1970s are fitted using a simple regression model in which the annual CPIA score is explained by three covariates: the annual real GDP growth rate of a country relative to the sample average; the annual inflation rate relative to the sample average; and the lead value of the annual CPIA score. The latter captures the high degree of inertia that characterizes the CPIA score series. The model was estimated using a panel of countries with 3147 observations and exhibits a significant goodness of fit.

disaggregated by types of episode (distress and non-distress) and country groups (LIC and MIC). Summary statistics are calculated using values corresponding to the year prior to the outbreak of a debt distress episode, and to the first year of a non-distress episode.¹² The median value of PV of debt-to-GDP ratio is 30 percent in debt distress episodes and 17 percent in non-distress episodes. A similar pattern is observed for the other debt indicators. This finding is also evident when looking at the frequency distribution of debt burden indicators (Figures A2 and A3, for the PV of debt-to-exports and debt service-to-exports ratios, respectively), which show that debt distress episodes are typically characterized by higher debt burden than non-distress episodes. Figure A2 and A3 also show that non-distress episodes for weak performers typically occur at lower debt levels compared to medium and strong performers (i.e., a larger proportion of non-distress episodes can be found at lower debt level for weak performers).

LICs and MICs also exhibit different debt levels between distress and non-distress episodes (Table A2). These differences suggest the econometric estimations should control for country groups if used to calibrate debt thresholds applicable to LICs only.

The new Staff 2011 estimations and calibration of debt thresholds

Staff first investigates the determinants of debt distress by formulating a probit model as in Staff 2004 and KN.¹³ The basic model specification includes a debt burden, the CPIA score, and the real GDP growth as covariates.¹⁴ Interactive dummy variables are included to allow the coefficient associated with the debt burden to vary between LICs and MICs.¹⁵

Estimation results are reported in Table A3. All estimated coefficients have the expected sign and most of them are statistically significant. The (estimated) probability of debt distress increases with the level of debt, whereas it decreases with the quality of policies and institutions and real GDP growth. In the regressions including PV of debt-to-exports and debt service-to-revenue ratios, the interactive dummy variables are significant and thus indicate differences in the coefficients associated with the debt burden in LICs and MICs. This allows calibrating debt thresholds for LICs that are not biased by the presence of MICs in the estimation sample.

¹² Debt data are not available for all 759 episodes identified and hence the summary statistics are computed on the five samples used for estimating the basic specifications of the probit model. As the empirical distributions of debt burden indicators are often skewed and include extreme values, the comparison focuses on the medians.

¹³ Staff 2004 also includes a dummy for African countries and the (log of) GDP per capita (Atlas Method) to capture, respectively, specific factors affecting African countries and the level of development (which in turn might proxy a country's capacity to absorb macroeconomic shocks).

¹⁴ Lagged GDP growth is included among the explanatory variables in the probit model to control for endogeneity generated by the fact that debt service difficulties would lower GDP growth, which would further reinforces debt problems.

¹⁵ The interactive dummy is the result of the multiplication of a dummy variable for MICs by the debt burden indicator.

Indicative debt burden thresholds are calibrated by fixing values for the following variables: (i) a probability of experiencing a debt distress episode; (ii) a CPIA score—specifically, the value characterizing a weak, medium, or strong performer; and (iii) a real GDP growth rate.

As in the current DSF, thresholds are calibrated for three values of the CPIA (3.25, 3.5, and 3.75) associated with weak, medium, and strong performance in terms of quality of policies and institutions. For simplicity, real GDP growth is set to its sample average for LICs, which can be interpreted as the growth rate in the absence of macroeconomic shocks. Calibrated thresholds are reported for three different debt distress probabilities:

(i) The unconditional probability of debt distress. This is the frequency of debt distress experienced by LICs in the estimation sample (for each regression). It depends therefore on the definition of distress and non-distress episodes. This is the approach that was used to calibrate debt service thresholds in the DSF.

(ii) The probability associated with the median debt burden indicator. This probability is calculated by evaluating equation (1) at the median debt burden indicator for LICs in the year prior to a debt distress, and using the median CPIA and real GDP growth for LICs. Intuitively, this approach therefore produces debt burden thresholds that are similar to the median debt burden before a crisis (adjusted for changes in the CPIA). This approach is also conceptually consistent with the one used to calibrate thresholds in Staff 2004.

(iii) The probability that minimizes the occurrence of type I and type II errors. This is the preferred approach of staff. A type I error denotes the failure to predict a debt distress episode (i.e., a missed crisis) whereas a type II error refers to the failure to predict a non-distress episode (i.e., a false alarm).¹⁶ Hence, this probability is the one that performs optimally (on average) when evaluating the in-sample forecasting properties of the estimated probit model. It simultaneously minimizes the number of missed crises and false alarms produced by the model, thus ensuring that the thresholds are neither too permissive nor unduly conservative.

Overall, debt burden thresholds calibrated with the adjusted probabilities are broadly in line with the DSF, except for the debt service-to-revenue threshold.

¹⁶ The in-sample forecasting exercise consists of three steps: (i) forecasting the probability of debt distress using the probit estimation results and historical values; (ii) forecasting episodes by comparing the forecasted probability with different probability cutoff values, such that a distress (non-distress) episode is predicted whenever the forecasted probability exceeds (does not exceed) the cutoff value; and (iii) comparing the forecasted episodes to actual episodes to determine the type I and type II errors for all probability cutoff values. A standard measure of the overall forecasting performance of the estimated probit model is the weighted average of type I and II errors, which depends on the chosen weights. Different combinations of cutoff values and weights were tested in this exercise. In particular, the relative weight of type I errors was gradually increased from one to almost three times the weight of type II errors. For this approach, the reported probability used to calibrate thresholds is the average probability minimizing type I and II errors over the different weights.

Robustness of the basic specifications

Staff assessed the robustness of estimation results and calibrated thresholds by using alternative sample periods, proxy variables for governance and macroeconomic shocks, and definitions of non-distress periods (Table A4). Results suggest the basic specifications are robust in terms of point estimates and statistical significance of the explanatory variables. In addition, numerical values of the debt thresholds calibrated using the alternative regressions are similar to those obtained from the basic specifications.

Staff re-estimated the probit model excluding the 1970s, on the basis that in the early 1970s the integration of LICs and MICs into international financial markets was relatively limited, and that the debt crisis in the 1980s and the waves of financial liberalization during the 1990s might have implied structural breaks with respect to the past.¹⁷ Most of the estimated coefficients and calibrated thresholds are similar to the basic specifications.

Staff also re-estimated the probit model substituting alternative measures of governance and macroeconomic shocks, respectively, for the CPIA score and real GDP growth. Table A4 reports regressions including four selected variables: (i) the World Bank's sub-CPIA index specific to macroeconomic and debt management, which assesses government policies affecting debt and repayment capacity directly; (ii) the International Country Risk Guide (ICRG) index; (iii) the deviation of real GDP growth from the three-year historical average, which controls for differences in growth rates among countries and is consistent with the notion that a shock would deteriorate the current growth outcome vis-à-vis the recent performance of the economy; and (iv) the growth rate of export receipts, which captures external shocks. Estimated coefficients associated with debt burden indicators, governance, and macroeconomic shocks are always significant. The calibrated thresholds, in addition, are close to those resulting from the basic specifications, with a few exceptions in the regressions, including the PV of debt-to-exports ratio.¹⁸

Finally, two alternative definitions of non-distress episodes are considered, in which the length of these episodes is extended from three (in the basic specifications) to four and five years, respectively. Since periods of non-distress last longer, the characterization of the dependent binary variable in the probit model changes accordingly: the number of non-distress episodes decreases, the frequency of distress episodes increases, and the size of the estimation sample drops significantly. Table A4 reports regressions including the two alternative definitions. Increasing the length of non-distress episodes leads to a higher probability used to calibrate thresholds (as the frequency of debt distress in the estimation sample increases). For example, for

¹⁷ Other issues also make it worth excluding the 1970s from the estimation sample: the quality of data is likely to be poorer in the 1970s; the CPIA has been simulated for years before 1978; and Staff 2004 and KN focused on data starting in 1978.

¹⁸ Unreported results show that other variables used to capture macroeconomic shocks—e.g. volatility of GDP growth, real exchange rate volatility, revenue-to-GDP volatility, and inflation volatility—do not affect the statistical significance of coefficients associated with debt burden indicators and governance, but often the coefficients associated with these macroeconomic variables cease to be significant.

the PV of debt-to-GDP ratio, the probability minimizing type I and II errors in the basic specification is 13.5 percent, increasing to 19.5 percent and 24.2 percent when the length of non-distress episodes is increased to four and five years, respectively. Estimated coefficients for governance and macroeconomic shocks are similar to those in the basic specifications, whereas estimated coefficients for debt burden indicators are higher.

Remittances

Remittances constitute a source of income and foreign exchange for a country, along with its GDP and exports. It has been argued that remittances should therefore be added to measures of repayment capacity when assessing the risk of debt distress. To address formally the impact of remittances on debt distress probability, staff estimated a probit model including GDP plus gross remittances and exports plus gross remittances as denominators of the debt burden indicators.

Because of limited availability of data on remittances, comparability between the regressions excluding and including remittances requires controlling for possible changes in the sample size. For example, the sample for the regression on the PV of debt-to-GDP ratio has 315 observations when including remittances compared to 740 observations when remittances are excluded.¹⁹ For that reason, directly comparing the re-estimated thresholds presented in the previous section (full sample) to the ones which incorporate remittances (small sample) may be misleading. Staff therefore compared thresholds excluding remittances (small sample) to thresholds for debt burden indicators with remittances (small sample).

Adding remittances to GDP or exports results in higher estimated coefficients associated with debt burdens vis-à-vis the regressions excluding remittances. Consequently, the corresponding calibrated thresholds are lower than those found in the basic specifications, which excludes remittances (Table A5). Such a result implies that for a country adding remittances to GDP or exports in the debt burden indicators, the predicted probability of debt distress would be lower only if the amount of remittances is sufficiently large to offset the lower threshold. In other words, the country can carry a higher debt level only if it receives a large flow of remittances.

Probability thresholds

The current methodology to calibrate thresholds is relatively simple. As mentioned above, once debt distress and non-distress episodes are identified, a probit model is estimated:

$$P(\text{debt distress}) = \Phi(\beta_1 * \text{debt burden} + \beta_2 * \text{governance} + \beta_3 * \text{shock} + \beta_4 * \text{other}) \quad (1)$$

Thresholds are then calibrated by solving equation (1) for debt burden and fixing the values for the probability of debt distress, governance, and macroeconomic shock:

¹⁹ Of the 315 observations, there are 142 LIC observations 173 for MIC observations. There are 45 debt distress episodes of which 22 are associated with LICs.

$$\text{Threshold} = \frac{\Phi^{-1}(\text{P}(\text{debt distress})) - \hat{\beta}_2 * \text{governance} - \hat{\beta}_3 * \text{shock} - \hat{\beta}_4 * \text{other}}{\hat{\beta}_1} \quad (2)$$

Evaluating equation (2) at a specific level of CPIA gives rise to CPIA threshold effects: small changes around the fixed CPIA scores (3.25, 3.5, and 3.75) can lead to discrete jumps in debt burden thresholds. For example, a country with a three-year average CPIA score of 3.24 would have a threshold for the PV of debt-to-exports ratio of 100 percent (consistent with a CPIA score of 3.25 for weak performers), but a country with a CPIA score of 3.26 would have a threshold of 150 percent (consistent with a CPIA score of 3.5 for medium performer). The slight difference in the quality of polices and institutions is disproportionate to the large difference in thresholds.

Alternatively, countries with very different CPIA scores can have the same thresholds. For example, a country with a three-year average CPIA score of 3.74 (close to a strong performer) faces the same debt burden thresholds as a country with a CPIA score of 3.26 (close to a weak performer). Thus, for some countries, the external risk of debt distress may be overestimated (in the example above, the country with a CPIA score of 3.74), and for other countries the risk may be underestimated (in the example above the country with an average CPIA score of 3.26).

In order to eliminate CPIA thresholds effects, one option is to have thresholds in terms of the probability of debt distress. Probability thresholds would use the same estimation methodology (probit) as debt burden thresholds. However, probability thresholds would be based on equation (1) instead of equation (2), avoiding the need to fix the values of explanatory variables. This would allow for country-specific evaluation of risk. That is, the probability of debt distress would be consistent with country-specific values, including the CPIA score, rather than the level used to calibrate thresholds. Under this approach, the DSA would focus on the evolution of the probability of debt distress over time compared to a given probability threshold.

A hypothetical country example illustrates the differences between the probability approach and the current approach. Panel (a) in Figure A1 shows the projected path of the PV of debt-to-GDP ratio under the current debt burden threshold approach for a country with a “medium” policy environment, i.e., with a CPIA score between 3.25 and 3.75. For all medium-policy countries, the indicative policy-dependent threshold of 40 percent is derived using a CPIA score of 3.5. Panels (b) through (d) show the projected path of the probability of debt distress based on the same PV of debt-to-GDP path, but using three different CPIA scores within the medium policy category. In each case, the probability threshold is assumed to be 15 percent. This example illustrates that the overestimation or underestimation of risk under the current approach depends on the extent to which the actual CPIA score deviates from the values used in the calibration exercise (3.25, 3.5, and 3.75).

Under the probability approach, richer specifications could be considered. These specifications could include simultaneously a number of debt burden indicators as well as other variables of interest (e.g., the rate of debt accumulation, exchange rate misalignment, trade openness). Richer specifications would allow for a better differentiation of risk across countries. For example, if large borrowing implies additional risk, perhaps because of capacity constraints, then it should be reflected in the baseline scenario rather than in an alternative scenario, as is presently the case

in the DSF. However, this additional risk can only be incorporated in the baseline analysis if richer specifications are contemplated.

Figure A1. Debt Burden Thresholds vs. Probability Thresholds

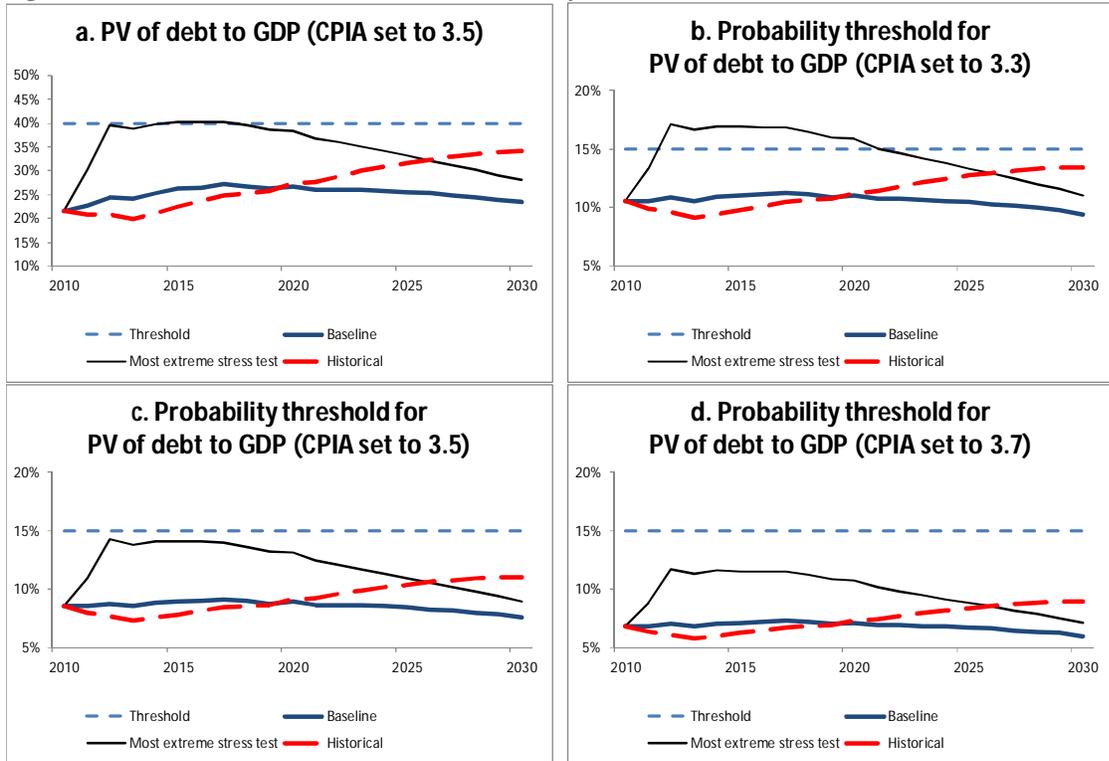


Table A1. Description of Methodologies for Estimating DSF Thresholds

	KN (2004)	IMF-IDA (2004)	IMF-IDA (2011)
Data			
Countries	MICs and LICs	LICs	MICs and LICs
Periods	1980-2002	1978-2002	1970-2007
Distress indicators (signals)			
Arrears	Arrears on PPG external debt to official and private creditors exceeding five percent of total M< external debt.	Arrears on PPG external debt to official creditors exceeding five percent of total M< external debt.	Arrears on PPG external debt to official creditors exceeding five percent of M< PPG external debt. Adjustment for HIPC completion point.
Paris Club debt renegotiation	Yes, assumed to last at least three years. No adjustment for HIPC completion point.	No.	Yes, assumed to last at least three years. Adjustment for HIPC completion point.
IMF financing	IMF GRA financing on commitment basis, exceeding 50 percent of the IMF quota.	No.	IMF GRA financing on disbursement basis, exceeding 50 percent of the IMF quota.
Episodes			
Normal times	Non-overlapping, five-year periods in which none of the three indicators signals distress.	At least three consecutive years in which the stock of arrears to official creditors is smaller than five percent of the total debt stock.	Non-overlapping, three-year periods in which none of the three indicators signals distress.
Debt distress	Periods of three or more consecutive years in which at least one of the three indicators signals distress. All short distress episodes of less than three-year duration are eliminated, as are all distress episodes preceded by periods of distress in any of the three previous years.	All the annual observations not classified as normal times.	Periods of three or more consecutive years in which at least one of the three indicators signals distress. A distress episode is dropped if preceded by a prior episode of debt distress that ends in any of the previous three years.
Determinants of distress episodes			
Debt service (liquidity indicator)	Debt service on total external debt (scaled by exports or revenues).	No.	Debt service on PPG external debt (scaled by exports or revenues).
PV of debt (solvency indicator)	PV of M< PPG external debt computed using time-varying currency-specific commercial interest reference rates (CIRRs).	PV of M< PPG external debt computed using a fixed discount rate at 7.5 percent.	PV of M< PPG external debt computed using time-varying currency-specific commercial interest reference rates (CIRRs).

Table A2. Summary Statistics for Debt Distress and Non-distress Episodes

			Observations	Frequency of debt distress	Debt Burden Indicator 1/	Governance 1/	Real GDP growth 1/
Database							
All countries	Non-distress		654			3.5	5.0
	Distress		105	13.8%		3.0	1.6
LICs	Non-distress		317			3.3	4.8
	Distress		57	15.2%		2.9	2.8
MICs	Non-distress		337			3.6	5.2
	Distress		48	12.5%		3.2	0.2
PV of debt-to-GDP							
All countries	Non-distress		640		17.1	3.5	4.9
	Distress		100	13.5%	29.9	3.0	1.6
LICs	Non-distress		307		17.3	3.3	4.8
	Distress		52	14.5%	31.9	2.9	2.7
MICs	Non-distress		333		17.0	3.6	5.2
	Distress		48	12.6%	27.4	3.2	0.2
PV of debt-to-exports							
All countries	Non-distress		642		61.9	3.5	5.0
	Distress		101	13.6%	119.1	3.0	1.7
LICs	Non-distress		310		63.3	3.3	4.8
	Distress		53	14.6%	111.0	2.9	2.9
MICs	Non-distress		332		59.9	3.6	5.2
	Distress		48	12.6%	119.7	3.2	0.2
PV of debt-to-revenue							
All countries	Non-distress		486		86.4	3.5	4.9
	Distress		71	12.7%	159.1	3.2	1.7
LICs	Non-distress		213		89.6	3.4	4.8
	Distress		34	13.8%	171.4	3.0	2.7
MICs	Non-distress		273		83.8	3.7	4.9
	Distress		37	11.9%	153.2	3.4	0.5
Debt service-to-revenue							
All countries	Non-distress		478		12.5	3.5	4.9
	Distress		65	12.0%	23.2	3.2	1.7
LICs	Non-distress		209		10.2	3.4	4.8
	Distress		30	12.6%	20.7	3.1	2.7
MICs	Non-distress		269		15.4	3.7	5.1
	Distress		35	11.5%	26.5	3.2	0.5
Debt service-to-exports							
All countries	Non-distress		576		9.1	3.5	4.9
	Distress		83	12.6%	19.8	3.1	1.6
LICs	Non-distress		267		7.5	3.3	4.8
	Distress		41	13.3%	15.4	3.0	2.8
MICs	Non-distress		309		10.6	3.7	5.1
	Distress		42	12.0%	24.3	3.2	0.5

1/ Sample median for the debt burden indicator, governance, and real GDP growth.

Table A3. Estimation Results and Calibration of Thresholds (Basic Specifications)

	PV of debt as a percent of						Debt service as a percent of			
	GDP		Exports		Revenue		Revenue		Exports	
Reestimation results /1										
Debt burden indicator	1.912***		0.305***		0.319***		4.877***		3.398***	
Governance	-0.603***		-0.583***		-0.421***		-0.365***		-0.448***	
Shock: Real GDP growth	-6.136***		-5.693***		-7.447***		-7.386***		-5.550***	
Interaction dummy (for MIC debt burden)	0.232		0.197**		0.0511		-1.730**		-0.105	
Constant	0.562*		0.576*		0.0433		-0.434		-0.00442	
Number of Obs.	740		743		557		543		659	
Pseudo R-square	0.188		0.181		0.175		0.224		0.186	
	DSF	Re-estimation	DSF	Re-estimation	DSF	Re-estimation	DSF	Re-estimation	DSF	Re-estimation
Implied Thresholds (unconditional probability)										
Probability used to calibrate thresholds		14%		15%		14%		13%		13%
Weak (CPIA=3.25)	30	30	100	163	200	170	25	16	15	16
Medium (CPIA=3.5)	40	38	150	210	250	203	30	17	20	19
Strong (CPIA=3.75)	50	46	200	258	300	236	35	19	25	23
Implied Thresholds (median debt burden indicator)										
Probability used to calibrate thresholds		15%		11%		12%		16%		12%
Weak (CPIA=3.25)	30	32	100	114	200	161	25	20	15	15
Medium (CPIA=3.5)	40	40	150	162	250	194	30	22	20	19
Strong (CPIA=3.75)	50	48	200	209	300	227	35	23	25	22
Implied Thresholds (minimizing type I and II errors)										
Probability used to calibrate thresholds		14%		13%		15%		15%		14%
Weak (CPIA=3.25)	30	28	100	131	200	184	25	18	15	17
Medium (CPIA=3.5)	40	36	150	179	250	217	30	20	20	20
Strong (CPIA=3.75)	50	44	200	226	300	250	35	22	25	24

1/ *** p<0.01, ** p<0.05, * p<0.1

Table A4. Estimation Results and Calibration of Thresholds (Robustness of the Basic Specifications)

	Basic specification	Macroeconomic shock		Governance		Sample	Definition of non-distress	
		Growth minus 3- year average	Export growth	sub-CPIA	ICRG	1980-2007	4-year non- distress	5-year non- distress
PV of debt-to-GDP								
Coefficients								
Debt burden indicator	1.912***	2.131***	1.993***	1.686***	1.924***	1.511***	2.505***	2.915***
Governance	-0.603***	-0.650***	-0.614***	-0.414***	-0.0244***	-0.587***	-0.624***	-0.623***
Macroeconomic shock	-6.136***	-6.159***	-0.00881**	-6.780***	-6.751***	-6.705***	-5.301***	-6.417***
Number of observations	740	607	662	740	740	500	556	438
Pseudo R-square	0.188	0.185	0.166	0.174	0.173	0.195	0.204	0.228
Probability used to calibrate thresholds	13.5%	13.5%	13.5%	13.5%	13.5%	13.5%	19.5%	24.2%
Implied Thresholds								
Weak (CPIA=3.25)	28	30	28	26	25	28	27	26
Moderate (CPIA=3.5)	36	38	35	32	32	37	34	31
Strong (CPIA=3.75)	44	45	43	38	38	47	40	36
PV of debt-to-exports								
Coefficients								
Debt burden indicator	0.305***	0.308***	0.287***	0.298***	0.302***	0.217***	0.451***	0.558***
Macroeconomic shock	-0.583***	-0.569***	-0.558***	-0.430***	-0.0224***	-0.588***	-0.611***	-0.619***
Governance	-5.693***	-5.971***	-0.0103***	-6.100***	-6.213***	-5.913***	-4.865***	-5.607***
Number of observations	743	611	665	743	743	502	559	440
Pseudo R-square	0.181	0.167	0.158	0.175	0.161	0.188	0.197	0.229
Probability used to calibrate thresholds	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	16.6%	19.3%
Implied Thresholds								
Weak (CPIA=3.25)	131	146	137	111	113	104	110	94
Moderate (CPIA=3.5)	179	192	185	147	150	172	144	122
Strong (CPIA=3.75)	226	239	234	183	187	240	178	149
PV of debt-to-revenue								
Coefficients								
Debt burden indicator	0.319***	0.325***	0.286***	0.312***	0.332***	0.283***	0.474***	0.544***
Macroeconomic shock	-0.421***	-0.552***	-0.463***	-0.296***	-0.0174***	-0.456***	-0.424***	-0.477***
Governance	-7.447***	-6.237***	-0.00859**	-7.696***	-7.592***	-7.203***	-6.768***	-8.011***
Number of observations	557	510	545	557	557	448	408	312
Pseudo R-square	0.175	0.165	0.135	0.168	0.166	0.174	0.202	0.235
Probability used to calibrate thresholds	14.8%	14.8%	14.8%	14.8%	14.8%	14.8%	19.5%	24.2%
Implied Thresholds								
Weak (CPIA=3.25)	184	178	143	166	164	176	146	143
Moderate (CPIA=3.5)	217	220	183	189	190	216	168	164
Strong (CPIA=3.75)	250	263	223	213	217	256	190	186
Debt service-to-revenue								
Coefficients								
Debt burden indicator	4.877***	5.094***	4.915***	4.790***	4.837***	5.758***	7.072***	5.191***
Macroeconomic shock	-0.365***	-0.493***	-0.405***	-0.250***	-0.0145***	-0.418***	-0.363***	-0.398***
Governance	-7.386***	-6.568***	-0.00899**	-7.606***	-7.594***	-7.341***	-7.128***	-8.481***
Number of observations	543	499	531	543	543	436	394	301
Pseudo R-square	0.224	0.219	0.190	0.218	0.216	0.249	0.266	0.250
Probability used to calibrate thresholds	15.2%	15.2%	15.2%	15.2%	15.2%	15.2%	20.4%	23.9%
Implied Thresholds								
Weak (CPIA=3.25)	18	17	15	18	18	16	15	16
Moderate (CPIA=3.5)	20	20	17	19	19	18	16	18
Strong (CPIA=3.75)	22	22	19	21	21	20	18	20
Debt service-to-exports								
Coefficients								
Debt burden indicator	3.398***	4.048***	3.647***	3.501***	3.338***	3.517***	5.080***	5.857***
Macroeconomic shock	-0.448***	-0.415***	-0.415***	-0.326***	-0.0182***	-0.462***	-0.470***	-0.492***
Governance	-5.550***	-5.700***	-0.00771**	-5.656***	-5.752***	-5.876***	-4.774***	-5.934***
Number of observations	659	591	640	659	659	487	478	360
Pseudo R-square	0.186	0.180	0.164	0.181	0.176	0.209	0.207	0.244
Probability used to calibrate thresholds	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	19.0%	24.7%
Implied Thresholds								
Weak (CPIA=3.25)	17	16	14	16	17	15	14	15
Moderate (CPIA=3.5)	20	19	17	18	20	19	17	17
Strong (CPIA=3.75)	24	21	19	20	22	22	19	19

Table A5. Estimation Results and Calibration of Thresholds with Remittances

	PV of debt-to-GDP				PV of debt-to-exports				Debt service-to-exports			
	Without remittance		With remittance		Without remittance		With remittance		Without remittance		With remittance	
	Full sample	Small sample	Small sample	% Change in small sample	Full sample	Small sample	Small sample	% Change in small sample	Full sample	Small sample	Small sample	% Change in small sample
Debt burden indicator	1.912***	1.463**	1.567***		0.305***	0.348***	0.425***		3.398***	5.837***	7.338***	
Governance	-0.603***	-0.700***	-0.695***		-0.583***	-0.674***	-0.688***		-0.448***	-0.550***	-0.587***	
Shock: Real GDP growth	-6.136***	-4.666**	-4.637**		-5.693***	-4.704**	-4.439**		-5.550***	-6.666***	-5.943**	
Interaction (MIC)	0.232	0.0397	0.00782		0.197**	0.125	0.102		-0.105	-3.093**	-3.934***	
Constant	0.562*	1.021*	0.997*		0.576*	0.837	0.867		-0.00442	0.295	0.354	
Number of Obs.	740	315	315		743	318	318		659	307	307	
Pseudo R-square	0.188	0.159	0.160		0.181	0.170	0.176		0.186	0.220	0.231	
Implied Thresholds (unconditional probability)												
Weak (CPIA=3.25)	30	33	30	-9%	163	154	124	-19%	16	13	10	-19%
Medium (CPIA=3.5)	38	45	41	-8%	210	202	164	-19%	19	15	12	-19%
Strong (CPIA=3.75)	46	57	52	-8%	258	250	204	-18%	23	18	14	-19%

Annex 2. Total Public Debt Benchmarks

A. Introduction

While the debt sustainability framework recognizes the importance of public sector domestic debt for assessing the risk of debt distress, several empirical and conceptual challenges led to the decision in the past not to derive thresholds for total public debt.^{1,2} The main challenge was the absence of reliable and comprehensive historical data on domestic debt stocks and debt service. Domestic debt is also different from external debt in many ways. To avoid overt default on domestic debt, governments often resort to indirect default through seigniorage or financial repression. In addition to budget financing, domestic debt is often used to conduct monetary policy, manage the exchange rate, or support the development of financial markets. Another complicating factor is that the coverage of domestic debt differs across countries.

Following the April 2006 review of the DSF, IMF and World Bank staff developed guidance on how to integrate domestic debt more systematically into the assessment of debt sustainability and the risk of external debt distress. In light of the challenges described above, staff did not incorporate domestic debt into existing thresholds, but instead proposed ways to strengthen public sector DSAs, including giving greater scrutiny to the pace of domestic debt accumulation and more thoroughly assessing vulnerabilities related to domestic debt.³

This appendix presents the results of work by IMF staff to derive thresholds for total public debt. The motivation for revisiting total public debt thresholds stems from the growing importance of domestic debt in LICs, particularly those that have benefitted from external debt relief or have begun to develop domestic financial markets. Several studies have shed light on the importance of domestic debt, with some concluding that domestic debt can explain external debt default events or high inflation.⁴ The analytical work by IMF staff was facilitated by recent progress in gathering domestic debt data spanning several decades.⁵

¹ See "[Debt Sustainability in Low-Income Countries—Further Considerations on an Operational Framework and Policy Implications](#)," September 10, 2004.

² DSAs use a residency concept to distinguish external and domestic debt. In many LICs, however, the residency of holders of domestically-issued debt is not known. As a result, domestic debt may actually correspond to domestically-issued debt.

³ See "[Applying the Debt Sustainability Framework for Low-Income Countries Post Debt Relief](#)," November 6, 2006.

⁴ See, for example, Reinhart and Rogoff (2009).

⁵ The IMF's Fiscal Affairs Department has recently compiled a comprehensive database on gross government debt-to-GDP ratios, covering 174 countries and spanning 130 years. Reinhart and Rogoff have collected data on domestic debt for 70 countries over a hundred years.

B. Data Sources

The sample contains 123 countries, of which 81 are classified as low income. A country's income classification can change within the sample period.⁶ The sample period covers 1971-2007. Data sources are described in Table A6.

Table A6. Data Sources and Coverage

Indicator/Variable	Period	Source
Governance indicator: CPIA Index	1971–2007	World Bank
Nominal GDP	1971–2007	World Development Indicators (WDI); UN COMTRADE; World Economic Outlook (WEO)
Real GDP growth	1971–2007	World Development Indicators (WDI); UN COMTRADE; World Economic Outlook (WEO)
Domestic revenue	1971–2007	World Development Indicators (WDI), Government Financial Statistics (GFS), UN COMTRADE and the World Economic Outlook (WEO)
Public Debt-to-GDP ratio	1971–2007	FAD's Historical Public Debt Database (HPDD) ¹
Domestic debt (share of total public debt)	1971–2007	Abbas et al ²
Domestic debt distress events	1971–2007	Reinhart and Rogoff: Variety of Crisis Database ; Standard and Poor's; Moody's; and IMF staff reports ³

¹ Abbas, S.M. A., N. Belhocine, A. A. ElGanainy, M. Horton (2010) "A Historical Public Debt Database," IMF WP No. 10/245.

² Abbas, S.M. Ali and Jakob E. Christensen (2009) "The Role of Domestic Debt Markets in Economic Growth: An Empirical Investigation for Low-Income Countries and Emerging Markets", IMF Staff Papers, December, pp. 1–47.

³ See Reinhart and Rogoff (2009), Standard and Poor's Sovereign Defaults and Rating Transition Data reports (covering the period 1975–2007), and Moody's Sovereign Default and Recovery Rates report (1983–2007). When data were not available, IMF staff reports were used to determine any instance of domestic debt defaults.

C. Methodology

Following the approach adopted for the estimation of external debt thresholds, a probit model is used to explain the incidence of debt distress (see Annex 1). The explanatory variable is a measure of indebtedness (the stock of total public debt, expressed either in nominal or present value terms),⁷ scaled by a measure of repayment capacity (GDP), a measure of policy and institutional capacity (the World Bank's CPIA index), and real GDP growth as a proxy for macroeconomic shocks to the economy. An interactive dummy variable is included to

⁶ LICs are defined as IDA-only countries. Countries can move from LICs to MICs (or the reverse) in the sample as they graduate (reverse graduate) from IDA status.

⁷ Because of the lack of reliable data on domestic debt service, thresholds are only derived for indicators of the stock of total public debt.

differentiate between LICs and MICs. The present value of total public debt is calculated by adding the nominal value of domestic debt to the PV of external debt.⁸

External and domestic debt distress signals are defined as follows:

- **External debt distress signals** are defined as (i) PPG external arrears in excess of five percent of external PPG debt; (ii) existence of a Paris Club rescheduling, with an adjustment made for HIPC countries;⁹ and (iii) IMF GRA financing disbursed in excess of 50 percent of quota.
- **Domestic debt distress signals** are defined as instances of outright sovereign defaults, understood as the failure by the sovereign to meet a principal or interest payment on the due date (within a specified grace period) as prescribed under the original loan terms. As a result, debt restructurings (e.g., converting a note to a different currency of less than equivalent value, rescheduling payments at less favorable terms, discounting the note) constitute domestic debt distress signals. While the existence of domestic arrears such as those owed to suppliers of goods and services may also signal debt distress, the unavailability of reliable data led to the exclusion of domestic arrears accumulation from the definition of domestic events.

Normal time episodes and debt distress episodes are defined as follows:

- **Normal time episodes** are defined as non-overlapping periods of three consecutive years in which no public debt distress signal (external nor domestic) is observed.¹⁰
- **Debt distress episodes** are defined as non-overlapping periods in which either an external or domestic debt distress episode occurs. External debt distress episodes are defined as a period lasting three years or more in which at least one of the

⁸ The assumption is made that domestic debt is not concessional and thus has a zero or near zero grant element; hence nominal and PV are equal. The lack of reliable data on domestic debt service and the difficulty in determining which discount rate should be used prevented the derivation of the PV of domestic debt.

⁹ Countries that reach HIPC completion point receive debt relief from the Paris Club. However, this treatment is not associated with the beginning of a debt distress episode. In addition, countries that reach completion point may need time to settle arrears with creditors participating in the debt relief initiative. These arrears do not signal debt distress. For these reasons, signals related to Paris Club reschedulings and outstanding arrears are adjusted so that countries that reach completion point are not deemed to be in debt distress.

¹⁰ In addition, a debt distress episode cannot be preceded by another such episode ending in any of the three previous years.

external debt distress signals is observed. Because of the nature of domestic defaults, any instance of default constitutes a domestic debt distress episode.¹¹

Table A7 presents summary sample statistics. A total of 99 public debt distress episodes are observed over the sample period. Most of the episodes are linked to either external events or simultaneous domestic and external events. About 90 percent of all episodes are due solely to external events, while about 3 percent are due solely to domestic events and 7 percent to a combination of both.¹² The unconditional probability of debt distress for the entire sample (i.e., the frequency at which debt distress episodes are observed) is 14 percent, consistent with the results of the external thresholds analysis. On average, LICs have a higher frequency of distress (16 percent) than MICs (11 percent).

Sample means disaggregated by episodes (distress and non-distress) and income levels (LICs and MICs) indicate that the governance indicator and real GDP growth are higher during non-distress episodes and for middle income countries.¹³ For the sample as a whole, the nominal debt-to-GDP ratio is around 60 percent in the year before distress, implying a “tipping point” at around that level. Although derived using a different methodology, this result is broadly consistent with the reference value used in the recent paper on [“Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis.”](#)

¹¹ The requirement of having some persistence in external debt events before classifying them as an episode is used to avoid falsely identifying debt distress episodes such as the appearance of “technical” arrears (which typically disappear quickly and might have been the result of other factors rather than the inability to meet a payment). By contrast, a domestic debt restructuring operation is typically a one-time event which might not appear over several years but is still a clear case of a default.

¹² When public debt distress episodes reflect a combination of both external and domestic events, external debt events were generally the first to be observed.

¹³ Debt burden indicators for debt distress episodes are measured during the year immediately preceding the episode.

Table A7. Summary Sample Statistics

		Count	Frequency of distress	Means			
				Debt burden	Governance	Real GDP growth	Domestic debt
Full sample							
All countries	Non-distress	628			3.48	4.69	14.13
	Distress	99	14%		2.94	0.72	16.29
LICs	Non-distress	303			3.27	4.50	13.71
	Distress	57	16%		2.81	1.34	16.92
MICs	Non-distress	325			3.67	4.86	14.46
	Distress	42	11%		3.12	-0.13	15.67
NPV of debt to GDP							
All countries	Non-distress	434		38%	3.48	4.69	14.13
	Distress	63	13%	47%	2.94	0.72	16.29
LICs	Non-distress	187		39%	3.27	4.50	13.71
	Distress	31	14%	46%	2.81	1.34	16.92
MICs	Non-distress	247		37%	3.67	4.86	14.46
	Distress	32	11%	48%	3.12	-0.13	15.67
Nominal debt to GDP							
All countries	Non-distress	517		43%	3.48	4.69	14.13
	Distress	80	13%	63%	2.94	0.72	16.29
LICs	Non-distress	238		47%	3.27	4.50	13.71
	Distress	43	15%	66%	2.81	1.34	16.92
MICs	Non-distress	279		40%	3.67	4.86	14.46
	Distress	37	12%	58%	3.12	-0.13	15.67

D. Results

Table A8 shows the results of the econometric analysis described above, as well as the implied policy-dependent debt-burden thresholds calibrated from these estimates.¹⁴ The coefficients associated with debt burden indicators, as well as with the governance and shock variables, are generally highly significant and have the expected sign. A comparison with the results from the external debt threshold exercise shows that the explanatory power of the model does not increase with the addition of domestic debt, reflecting the fact that the vast majority of debt distress episodes are due to external events.

Thresholds are calibrated using three different probabilities of distress: the unconditional probability of debt distress observed in LICs, the probability associated with the medium debt burden indicators in LICs in the year prior to a debt distress episode, and the probability that simultaneously minimizes the risk of “false alarms” and “missed crisis” (type I and II errors). The probability range (12–15 percent) is broadly in line with the one used for the external public debt threshold exercise. The resulting policy-dependent thresholds, calibrated for weak, medium, and strong performers, stand at 49, 62, and 75 percent, respectively, when expressing the debt-to-GDP ratio in nominal terms, and at 38, 56, and 74 percent, respectively, when expressing the debt burden indicator in PV terms. The nominal threshold for medium performers is in line with the “tipping point” of 60 percent for the nominal debt-to-GDP ratio, as described above, and the thresholds expressed in PV terms are broadly consistent with those derived in the external debt analysis.

To test the robustness of these results, estimations were also run using alternative measures of macroeconomic shocks (deviation of real GDP growth to its three-year trend and export growth) and of governance (the International Country Risk Guide index and the sub-CPIA index related to macroeconomic and debt management). In addition, an alternative sample period excluding the 1970s—a period when most LICs and MICs had little integration into global markets and did not have developed domestic debt markets—was tested. Table A9 shows the results of these alternative specifications. Estimated coefficients are generally significant and exhibit the expected sign, and calibrated thresholds remain broadly in line with the baseline results.

¹⁴ For a detailed discussion of the calibration method used, see Annex 1.

Table A8. Pubic Debt Indicative Thresholds Estimation Results

	PV to GDP	Nom to GDP
Estimation results ¹		
Debt burden indicator	0.807**	1.008***
Governance	-0.586***	-0.526***
Shock: Real GDP growth	-6.508***	-6.150***
Interaction dummy (for MIC debt burden)	0.0597	0.0214
Constant	0.701*	0.336
Number of Obs.	497	597
Pseudo R-square	0.138	0.154
<hr/>		
Implied Thresholds (unconditional probability)		
Probability used to calibrate thresholds	14%	15%
Weak (CPIA=3.25)	49	60
Moderate (CPIA=3.5)	68	73
Strong (CPIA=3.75)	86	86
Implied Thresholds (median debt burden indicator)		
Probability used to calibrate thresholds	12%	14%
Weak (CPIA=3.25)	37	56
Moderate (CPIA=3.5)	55	69
Strong (CPIA=3.75)	73	82
Implied Thresholds (minimizing type I and II errors)		
Probability used to calibrate thresholds	12%	13%
Weak (CPIA=3.25)	38	49
Moderate (CPIA=3.5)	56	62
Strong (CPIA=3.75)	74	75

1/ *** p<0.01, ** p<0.05, * p<0.1

Table A9. Robustness Checks

	Basic specification	Macroeconomic shock 3-year average	Export growth	Governance sub-CPIA	ICRG	Sample 1980-2007
PV of debt-to-GDP						
Coefficients 1/						
Debt burden indicator	0.807**	0.747**	0.588*	0.604*	0.803**	0.517
Governance	-0.586***	-0.613***	-0.622***	-0.357***	-0.0233***	-0.548***
Macroeconomic shock	-6.508***	-5.939***	-0.00754*	-6.703***	-6.809***	-5.403***
Number of observations	497	433	460	497	497	379
Probability used to calibrate thresholds	12%	12%	12%	12%	12%	12%
Implied Thresholds						
Weak (CPIA=3.25)	38	30	24	33	31	38
Moderate (CPIA=3.5)	56	50	50	48	46	65
Strong (CPIA=3.75)	74	71	77	63	60	91
Nominal debt-to-GDP						
Coefficients 1/						
Debt burden indicator	1.008***	1.010***	0.810***	0.929***	1.057***	0.807***
Macroeconomic shock	-0.526***	-6.592***	-0.00864**	-6.352***	-6.419***	-5.469***
Governance	-6.150***	-0.602***	-0.568***	-0.342***	-0.0200***	-0.500***
Number of observations	597	505	547	597	598	441
Probability used to calibrate thresholds	13%	13%	13%	13%	13%	13%
Implied Thresholds						
Weak (CPIA=3.25)	49	41	39	44	44	42
Moderate (CPIA=3.5)	62	56	57	54	53	57
Strong (CPIA=3.75)	75	71	74	63	63	73

1/ *** p<0.01, ** p<0.05, * p<0.1

Annex 3. Developing More Realistic Bound Tests

This annex outlines an empirical methodology for making bound tests more realistic by incorporating dynamic interaction between key variables and comovement between shocks into the framework.

The Status Quo

The bound tests in the current framework use descriptive statistics (means and standard deviations) calculated over a fixed historical period (ten years). This can be depicted using the following set of equations:

$$\begin{array}{lll}
 (1a) & g_t = \mu_g + \varepsilon_{gt} & \varepsilon_{gt} \sim (0, \sigma_g^2) \\
 (1b) & \pi_t = \mu_\pi + \varepsilon_{\pi t} & \varepsilon_{\pi t} \sim (0, \sigma_\pi^2) \\
 (1c) & i_t = \mu_i + \varepsilon_{it} & \varepsilon_{it} \sim (0, \sigma_i^2) \\
 (1d) & p_t = \mu_p + \varepsilon_{pt} & \varepsilon_{pt} \sim (0, \sigma_p^2) \\
 (1e) & b_t = \mu_b + \varepsilon_{bt} & \varepsilon_{bt} \sim (0, \sigma_b^2)
 \end{array}$$

where g_t is real GDP growth, π_t is the inflation rate (GDP deflator measured in U.S. dollar terms), i_t is the nominal interest rate (the average implicit interest rate on external debt), p_t is non-debt incurring capital inflows as a percent of GDP, and b_t is the non-interest current account balance as a percent of GDP. Equations (1a) to (1e) can be thought of as stochastic processes that generate the forcing variables in the conventional debt accumulation equation:¹

$$(2) \quad d_t = (1+i_t)/[(1+g_t)(1+\pi_t)]d_{t-1} - b_t - p_t$$

where d_t is external debt as a percent of GDP.²

The magnitude and persistence of the shocks were calibrated using stochastic simulation methods.³ The calibration methodology allows the magnitude of shocks to vary across countries by calculating standard deviations of outcomes over the historical period on a country-by-country basis. The basic approach has the appeal of being relatively simple to implement and transparent for upholding the principal of equal treatment across countries.

¹ Exceptional financing and reserve accumulation are excluded from the analysis to simplify the discussion.

² The analysis can be generalized to incorporate other debt indicators such as external debt relative to exports and debt service relative to exports as well as public debt indicators.

³ This entailed estimating autoregressive processes for five macro variables for 20 LICs over the period 1985–99. Estimates of autoregressive parameters were averaged across countries; repeated simulations were generated and analyzed using the LIC DSA template. The results indicated that the combined shock had the greatest impact on debt indicators at horizons beyond one year. Setting the combined shock at one half of a standard deviation for two consecutive periods resulted in a probability of 26 percent at the ten-year horizon. See “[Debt Sustainability in Low-Income Countries—Proposal for an Operational Framework and Policy Implications](#),” February 3, 2004, pp. 75–78.

However, one shortcoming is that the underlying dynamic interaction between variables and comovement between shocks are rather arbitrary—shocks persist for two periods and are introduced separately and then combined.

Incorporating More Realistic Shocks into the Framework

This shortcoming can be addressed by applying relatively simple empirical methods to estimate the dynamic interaction between variables and comovement between shocks on a country-specific basis. To illustrate, consider the vector autoregressive (VAR) representation for the five-variable system represented by:

$$(3) \quad X_t = \mu + B(L)X_{t-1} + \varepsilon_t \quad \varepsilon_t \sim (0, \Sigma)$$

where X_t is a vector comprised of the five forcing variables $[g_t \pi_t i_t b_t p_t]'$, $B(L)$ represents a 5-by-5 matrix of polynomial lag operators and ε_t is a vector of reduced-form residuals $[\varepsilon_{gt} \varepsilon_{\pi t} \varepsilon_{it} \varepsilon_{bt}, \varepsilon_{pt}]'$ with a covariance structure given by the 5-by-5 symmetric matrix Σ . The VAR representation captures dynamic interaction between all five variables; the covariance matrix Σ captures comovement between the shocks.

To illustrate, the approach outlined above is applied to the case of Ghana. The VAR model represented by the system of equations (3) is estimated using annual data over the period 1971–2010. Shocks were applied to each of the five reduced-form residuals to generate dynamic responses of the five forcing variables; the debt accumulation equation (2) then generates a dynamic profile for the debt indicator d_t . Figure A4 compares the largest shock generated by the VAR model to three bound tests generated using the current framework. In this particular example the largest shock from the VAR is quite similar to the non-debt creating flows shock over the medium term (2011–15) but closer to the combination shock and the GDP deflator shock over the longer term.⁴

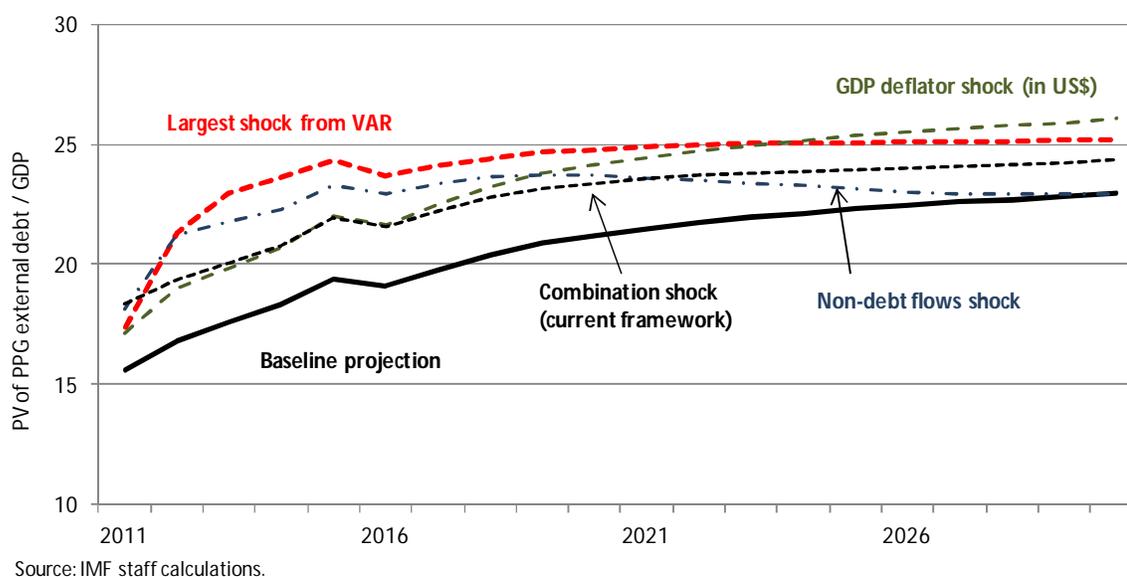
The VAR modeling strategy provides rich dynamic structure that gives the shocks a well-defined interpretation, making the analysis more realistic. One downside of such an approach is that it may be difficult to get reliable estimates of the parameters, particularly in countries where data availability is limited. In such cases panel (pooled cross-section/time series) data could be used to obtain more reliable parameter estimates. In the most basic form, this would entail estimating the VAR model (3) for a group of countries with similar attributes. The cross-country dimension of the estimation procedure increases the degrees of freedom, resulting in more reliable parameter estimates. One shortcoming of such an approach is that shocks would have the same impact on all countries in the grouping, thereby sacrificing the country-specific aspect of bound tests.⁵ This can be alleviated by incorporating some country

⁴ Bound tests in the current framework entail reducing non-debt creating flows and the GDP deflator (in U.S. dollar terms) by one standard deviation for two periods individually and reducing real GDP growth, the change in the GDP deflator (in \$US terms), non-debt creating flows, exports, and current transfers each by one-half of their respective standard deviations simultaneously.

⁵ The magnitude of shocks in the current framework is based on standard deviations calculated over the historical period for each country.

specific features into the estimation strategy. To illustrate, consider a two-step estimation procedure where the covariance matrix Σ is estimated using panel VAR model and then a standard VAR is estimated for each country with the same covariance structure Σ imposed. This would allow the dynamics and volatility of shocks to vary across countries while imposing the same comovement between shocks (implied by the common covariance structure Σ).

Figure A4. Bound Tests for Debt Indicator in the Case of Ghana



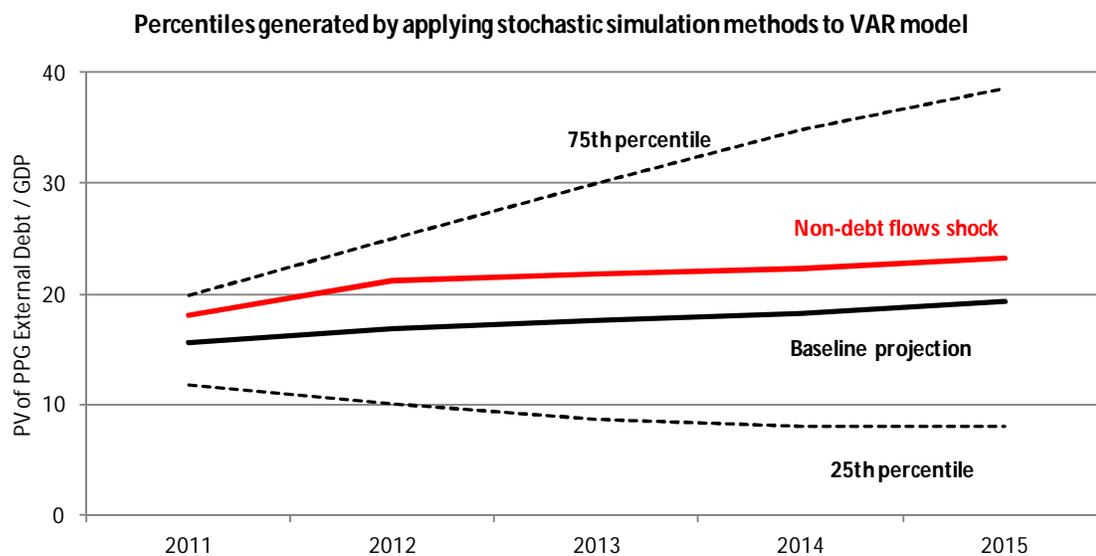
Using Confidence Intervals to Help Gauge Uncertainty

The configuration of bound tests in the current framework provides a rough estimate of uncertainty surrounding debt projections. Confidence intervals generated by applying stochastic simulation methods to VAR models can provide better-defined measures of uncertainty. This is illustrated for the case of Ghana shown below in Figure A5. Stochastic simulation methods were applied to the VAR model outlined above to generate a probability distribution for the debt-to-GDP ratio over the projection period 2011–2015. In the baseline scenario, the PV of debt-to-GDP ratio is projected to increase by 5 percentage points over the five-year period. Under the most extreme bound test—the non-debt flows shock—the PV of debt increases by 9 percentage points by 2015. Stochastic simulations indicate that there is a 25 percent probability that the PV of debt would increase to 38.5 percent of GDP by 2015 (the 75th percentile), implying that the most extreme bound test has a likelihood of much less than 25 percent.

A few caveats merit attention. First, applying stochastic simulation methods to a VAR model does not result in reliable estimates of uncertainty over projection periods beyond a few years. This is mainly due to the fact that the VAR model does not include an exchange rate adjustment mechanism or endogenous fiscal policy rules that respond to shocks, which can serve to limit the degree of uncertainty over the longer term. Second, estimates of confidence intervals can be sensitive to model specification issues and the sample period used for

estimation, and may be misleading in cases where there have been structural shifts (for example in the conduct of fiscal and monetary policy and the exchange rate regime).

Figure A5. Confidence Intervals for Debt Indicator in the Case of Ghana



Further Enhancements⁶

The VAR framework outlined above can be generalized in a number of dimensions to improve the overall quality of risk assessments. For example, exogenous variables (such as world commodity prices, output growth and interest rates) as well as variables omitted from the debt accumulation equation for simplicity (including capital grants, net portfolio equity flows, changes in international reserves, and exceptional financing) can be incorporated into the basic VAR model. Extensions along these lines would enable users to consider a broader set of issues with a focus on the key risks for the country of interest. For example, uncertainty surrounding world oil prices would play a prominent role in models used to gauge the risks surrounding borrowing in countries where export earnings and fiscal revenues are highly dependent on oil production.

The methodology can also be modified to encompass various aspects of the complex linkages underlying debt distress episodes. For example, confidence intervals are often generated using Monte Carlo simulations that draw from a normal distribution. The Monte Carlo simulation methodology can be implemented using more general probability distributions, or bootstrapping methods could be used to allow for the possibility of skewness

⁶ This section is based on “Using Pooled Information and Bootstrap Methods to Assess Debt Sustainability in Low Income Countries,” C. Hevia; forthcoming in the Policy Research Working Paper Series of the World Bank.

and excess kurtosis (“fat tails”) in the residuals, which may be an important feature of the underlying data.

Finally, data limitations are an important constraint in many LICs, resulting in unreliable parameter estimates and potentially misleading confidence intervals. One approach to address this entails pooling parameter estimates across countries. This can be illustrated with reference to a panel VAR model represented by:

$$(4) \quad X_{it} = \mu_i + B(L)X_{it-1} + \varepsilon_{it} \quad \varepsilon_{it} \sim (0, \Sigma)$$

where X_{it} represents the vector of variables defined above in the standard VAR for each country in the panel. The parameters, $B(L)$ and Σ , are identified over time (t) and across country dimensions ($i = 1$ to n for n countries in the panel), resulting in more degrees of freedom.⁷ This line of research could enable us to generate reliable estimates of uncertainty surrounding debt projections for countries where data limitations preclude the application of conventional methods.

⁷ The constant terms μ_i will typically be allowed to vary across countries (fixed effect model) to allow for differences in conditional means across countries.

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