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Debt Sustainability Analyses for Low-Income  
Countries: An Assessment of Projection Performance

by Henry Mooney and Constance de Soyres

I N T E R N A T I O N A L M O N E T A R Y F U N D

**IMF Working Paper**

Finance Department

**Debt Sustainability Analyses for Low-Income Countries: An Assessment of Projection Performance****Prepared by Henry Mooney and Constance de Soyres<sup>1</sup>**

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**Abstract<sup>2</sup>**

This paper develops new error assessment methods to evaluate the performance of debt sustainability analyses (DSAs) for low-income countries (LICs) from 2005-2015. We find some evidence of a bias towards optimism for public and external debt projections, which was most appreciable for LICs with the highest incomes, prospects for market access, and at ‘moderate’ risk of debt distress. This was often driven by overly-ambitious fiscal and/or growth forecasts, and projected ‘residuals’. When we control for unanticipated shocks, we find that biases remain evident, driven in part by optimism regarding government fiscal reaction functions and expected growth dividends from investment.

JEL Classification Numbers: E6, F3, H6, O1

Keywords: debt sustainability analysis (DSA), sovereign debt, debt relief, macroeconomic forecast, projection accuracy, projection bias, forecast error, growth-investment nexus, fiscal reaction function, balance of payments, IMF, World Bank, Low-Income Countries

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<sup>1</sup> Author E-mail addresses: [HMooney@imf.org](mailto:HMooney@imf.org) and [CdeSoyres@imf.org](mailto:CdeSoyres@imf.org)

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## I. EXECUTIVE SUMMARY

Debt sustainability analyses (DSAs) for low-income countries (LICs) inform IMF, World Bank, and other lenders' policy advice, the design and implementation of reform programs, and the appropriate size and mix of official and private financing. They were designed to help LICs and the donor community avoid a reemergence of imprudent policies resulting in debt overhangs that might necessitate another round of broad-based debt relief—e.g., the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiatives (MDRI). To be effective, debt sustainability analyses rest crucially upon macroeconomic forecasts that serve as the basis for DSA debt projections.

While acknowledging that our analyses were limited by the fact that only a fraction of DSAs' 20-year projection horizons could be tested against outturns, this assessment of LIC DSAs finds that: (i) debt projection errors are skewed towards optimism<sup>3</sup> for most groups of DSAs assessed; (ii) the magnitude of errors tends to increase as forecast horizons extend; (iii) that the degree of optimism has increased over successive vintages for most groups of LIC DSAs assessed; and, (iv) that there is evidence of a systematic bias towards optimism—that was most conclusive in the case of public DSAs—that remains even after we control for major economic and other shocks.

We also find that DSAs for certain sub-groupings of LICs display pronounced optimism when compared to other country groups. These include (but are not exclusive to) those in the two highest income quartiles, 'frontier' LICs with prospects for market access, and those assessed by DSAs as displaying 'moderate risks' of debt distress. Public debt projections for countries engaged in IMF-supported adjustment programs also display greater optimism than those not under an arrangement.

In terms of economic projections driving optimism in DSA debt forecasts, errors for what DSAs define as projected 'residuals' (e.g., for external DSAs, exceptional financing, valuation adjustments, and components of the balance of payments, etc.), fiscal deficits, and/or output growth were significant for many LIC sub-groups considered.

Finally, we considered the potential causes of economic projection errors driving DSA biases, and found: (i) optimism regarding the projected pace and depth of fiscal consolidation in response to rising debt levels—i.e., fiscal reaction functions—when compared to LICs' own historical experiences, as well as those of emerging and advanced economies; (ii) optimism with respect to the expected growth dividends of investment (both public and private) when compared to past LIC experiences and those of countries at higher levels of development; and, (iii) that external debt forecasts could be improved via the incorporation of information regarding the capital account of the balance of payments available when the projection was undertaken.

Taken together, our findings suggest the need to redouble efforts to ensure that LIC DSAs and their underpinning macroeconomic projections are methodologically sound, incorporate all available information, and are guided by realistic assumptions informed by countries' own experiences and that of peers. Results also suggest that greater transparency and more detailed presentations regarding projection assumptions for external financing flows (e.g., the capital account and other components of external residuals) could improve forecast accuracy and better align DSAs with IMF country frameworks. Moreover, there is a need for caution when using DSAs for policy advice regarding reforms and financing—particularly for countries at 'moderate risk' of distress and frontier LICs with increasing non-concessional and non-traditional borrowing options. Future research could usefully consider whether findings remain evident over longer periods (e.g., beyond 5 years).

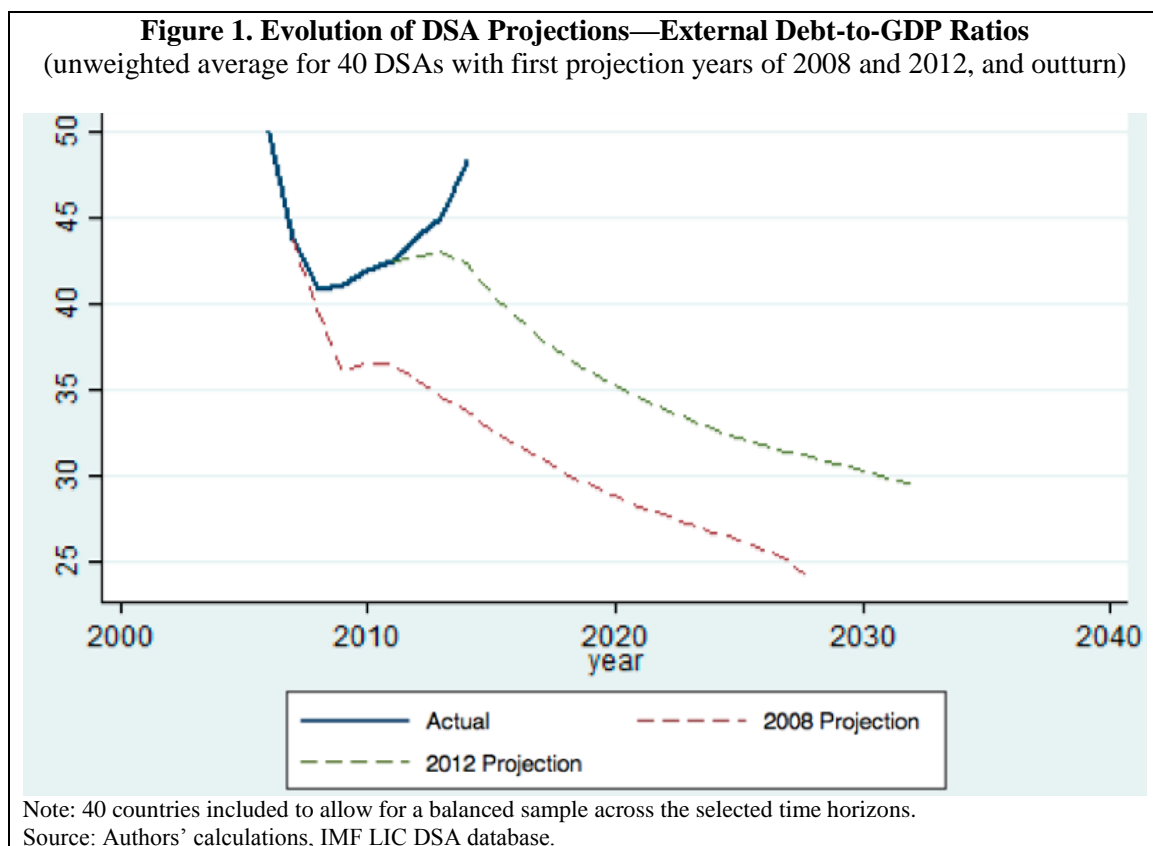
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<sup>3</sup> Note that we use the term 'optimism' in the literal sense, i.e.: "...an inclination to put the most favorable construction upon actions and events or to anticipate the best possible outcome." (Merriam-Webster Dictionary) The same is true for pessimism, which we define as the inverse. We define the concept of 'projection bias' more precisely in the paper.

## II. INTRODUCTION

### A. Motivation

1. The LIC Debt Sustainability Analysis framework (DSF) was introduced<sup>4</sup> with the objectives of, inter alia: (i) guiding LIC borrowing and creditor lending in a manner consistent with development goals and long-term debt sustainability; (ii) improving IMF and World Bank policy advice on debt; and, (iii) serving as an ‘early warning system’ for risks so that timely preventive financing and policy actions can be taken.<sup>5</sup> At the time the DSF was launched, the international community was in the midst of one of the most significant debt relief initiatives ever undertaken—the Heavily Indebted Poor Countries (HIPC) Initiative<sup>6</sup> (launched in 1996) and the Multilateral Debt Relief Initiative (MDRI, launched in 2005). By end-2016, 36 countries had received relief under these initiatives, amounting to \$76 billion in debt service.



2. While the LIC DSA was designed to improve policy advice and the accuracy of debt projections, evidence suggests that the gap between DSA-forecasts and actual debt accumulation has been widening in the decade or so since the DSF was introduced. Figure 1 shows the average projected external debt burden (in percent of GDP) for a balanced sample of 40 LICs for DSAs produced during two time periods—with first projection years 2008 and 2012—and compares those with actual outturns. For these countries in aggregate, actual external debt burdens increased

<sup>4</sup> While the formal LIC DSF was launched in support of the HIPC Initiative, debt projections and related sustainability analyses had been undertaken by the IMF, World Bank, and other institutions prior to its introduction. Our analysis is restricted to the post-2005 period owing to data comparability and availability.

<sup>5</sup> Public Information Notice No. 12/17; “[IMF Executive Board Reviews the Joint IMF-World Bank DSF for LICs](#)”; February 23, 2012, and IMF Web-Based Factsheet: “[The Debt Sustainability Framework for LICs](#)”.

<sup>6</sup> See “[Debt Relief under the HIPC Initiative](#)”; and “[The Multilateral Debt Relief Initiative](#)”.

much faster than projected by DSAs in 2008, and later DSAs (e.g., 2012) relied on more rapid projected improvements in economic performance to tilt medium- and long-term debt dynamics back towards previously-projected trajectories.

3. In this context, we attempt in this paper to answer the following questions: (i) How have LIC DSAs performed in terms of projection accuracy? (ii) Are there differences in performance across sub-groupings of LICs? (iii) If evident, do errors result from unanticipated shocks or could they possibly also result from systematic biases inherent to the DSA and underlying economic projections? (iv) What are the most significant drivers of errors?

## B. Overview of the Joint IMF-World Bank LIC-DSA Framework

4. The LIC DSF is tailored to the needs and unique economic and funding characteristics of LICs. While many LICs have traditionally depended on aid and concessional loans with long maturities and below-market interest rates, the last decade has seen several countries tap international capital markets in addition to traditional sources of funding. LIC policies and institutions tend to be weaker than for countries at more advanced stages of development—including for debt and public financial management—, complicating the implementation of sustainable policies. Financing sources also tend to be more limited, which can subject LICs to increased volatility, refinancing uncertainties, and risks.<sup>7</sup>

5. Against this background, the main features of DSAs relevant to this paper include:

- **Debt Projections:** Projections for external and public and publicly-guaranteed (PPG) debt trajectories over 20-year horizons, based on macroeconomic projections produced independently (generally by IMF and World Bank economists, with input from governments and development partners).
- **Risk Assessment:** An assessment of the risk of debt distress based on indicative external and public debt thresholds, calibrated to the assessed quality of policies and institutions.<sup>8</sup> There are four possible ratings of external debt distress:
  - **Low Risk:** when all debt burden indicators are well below thresholds.
  - **Moderate Risk:** when debt burden indicators are below thresholds under the baseline scenario, but stress tests indicate that the thresholds are breached by simulated external or policy shocks.
  - **High Risk:** when one or more debt burden indicators breach thresholds under the baseline scenario.
  - **In Debt Distress:** when the country is already facing repayment difficulties.
- **Policy Recommendations:** Advice regarding policies and borrowing to limit the risk of distress.

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<sup>7</sup> For a detailed discussion of DSAs and related thresholds, see: <https://www.imf.org/external/pubs/ft/dsa/lic.htm>

<sup>8</sup> The quality of policies and institutions is measured by the CPIA index, compiled annually by the World Bank. The DSF uses the CPIA scores to classify countries into one of three categories: ‘weak’, ‘medium’, or ‘strong’. The three-year moving average scores are used, including to avoid overly abrupt or unforeseen changes in assessments.

### C. Related Research

6. We are aware of only one published paper that has undertaken a detailed analysis of IMF-World Bank LIC DSAs over multiple vintages—i.e., Baduel and Price (2012): “Evolution of Debt Sustainability Analysis in Low-Income Countries: Some Aggregate Evidence”. The paper used LIC DSAs available through 2011 to analyze the evolution of debt projections, including before and after the global financial crisis beginning in 2008-09. Authors found that, prior to the financial crisis (i.e., from 2005 to 2008), DSAs’ projections for debt accumulation and debt burdens improved over time and successive iterations—or ‘vintages’. As DSAs incorporated crisis-driven decelerations in GDP and export growth, reductions in non-debt creating flows (e.g., FDI and remittances), as well as weaker fiscal positions and LIC exchange rate depreciations against hard currencies (particularly the US dollar), forecasts for short- to medium-term debt dynamics deteriorated markedly.

7. However, despite these short-term crisis-driven deteriorations, public debt dynamics in post-crisis DSAs were forecast to substantially improve over the longer term (e.g., the 6- to 20-year segment of the DSA’s 20-year projection horizon). This resulted in debt trajectories often converging back to, or in some cases improving compared to those projected before the crisis.

8. While Baduel and Price (2012) did not formally attempt to analyze the factors driving this increase in post-crisis optimism in DSA projections, they did put forward a few preliminary hypotheses, including:

- **Investment Dividends.** DSA projections may have shifted towards greater optimism regarding the assumed dividends from investment for growth and other debt-related variables.
- **Financing Sources.** That post-crisis DSAs may have assumed a shift to less-risky financing—i.e., faster domestic market development and shifts to domestic vs. external borrowing, thus slowing the pace of public external debt accumulation.
- **Improving Debt Management Capacity.** That post-crisis DSAs might have begun to reflect prospective improvements in fiscal and debt management policies and capacity, which could reduce overall financing needs.

9. Our paper formally considers whether increasing optimism observed in unrealized projections remains evident when these same forecasts are assessed against outturns. We also attempt to determine whether any such optimism may have been systematic, driven by observable biases, and what macroeconomic variables may have been most directly and commonly responsible for errors and/or biases. We also consider the degree to which errors may have been influenced by unanticipated shocks.

### III. DATA AND PROJECTION ERROR ASSESSMENT

#### A. Dataset

10. Data are drawn from actual DSAs produced for LICs since 2005<sup>9</sup>, as well as the IMF's World Economic Outlook (WEO) and World Bank's World Development Indicators databases. This paper focuses on aggregations of LICs into groups, and no individual-country DSAs are discussed.<sup>10</sup>

#### B. Country Sub-Categorizations

11. LICs are diverse, including with respect to size, economic structure, natural endowments, institutional capacity, and vulnerability to non-economic shocks. Also, many of those countries have benefited from debt relief (e.g., HIPC and MDRI). In this light, this paper disaggregates LICs into 8 categories and 24 sub-groups (Table 1)—see Annex I for further details:

**Table 1. LIC Sub-Categories**

LIC Categories	Sub-Group	Definition
<i>1. Financing &amp; Development Category</i>	<b>Frontier</b>	LICs that have or have the potential for private capital market access (see Annex I for methodology, based on IMF definitions).
	<b>Small States</b>	Based on IMF and World Bank definition.
	<b>Fragile</b>	Countries in fragile situations (following the World Bank and IMF categorizations).
	<b>Other Developing</b>	All countries not falling into other three categories.
<i>2. Risk of Debt Distress</i>	<b>Low Risk</b>	DSA classification. Risk rating at the time the projection is undertaken and the DSA under scrutiny is finalized.
	<b>Moderate Risk</b>	
	<b>High Risk</b>	
	<b>In Distress</b>	
<i>3. CPIA-Based Policy Strength</i>	<b>Strong</b>	DSA classification.
	<b>Medium</b>	
	<b>Weak</b>	
<i>4. Position in Income Distribution (Quartiles)</i>	<b>Highest</b>	Based on gross national income per capita (World Bank Atlas method).
	<b>Middle-High</b>	
	<b>Middle-Low</b>	
	<b>Lowest</b>	
<i>5. Commodity Exporters</i>	<b>Commodity Exporters</b>	>50 percent of export earnings from fuels and primary commodities.
	<b>Other Countries</b>	Other LICs.
<i>6. HIPC Status</i>	<b>Post-Completion Point HIPCs</b>	Countries that have reached the completion point under the Enhanced HIPC initiative.
	<b>Other Countries</b>	Other LICs.
<i>7. IMF Arrangement</i>	<b>W/O IMF Program</b>	Engaged in an IMF program.
	<b>With IMF Program</b>	Other LICs.
<i>8. Projection Years</i>	<b>2007/2008</b>	Grouped by DSA first projection year.
	<b>2009/2010</b>	
	<b>2010/2011</b>	

<sup>9</sup> Albania and Angola graduated from this list in 2009, so the only DSAs available were issued in 2008 for Albania, and in 2007 and 2009 for Angola. Somalia and South Sudan are not included in the analysis because no DSA had been produced through August 2015. Liberia and Timor-Leste are not included because of data availability and other issues.

<sup>10</sup> Note that unidentified data errors may have implications for results.

(continued...)

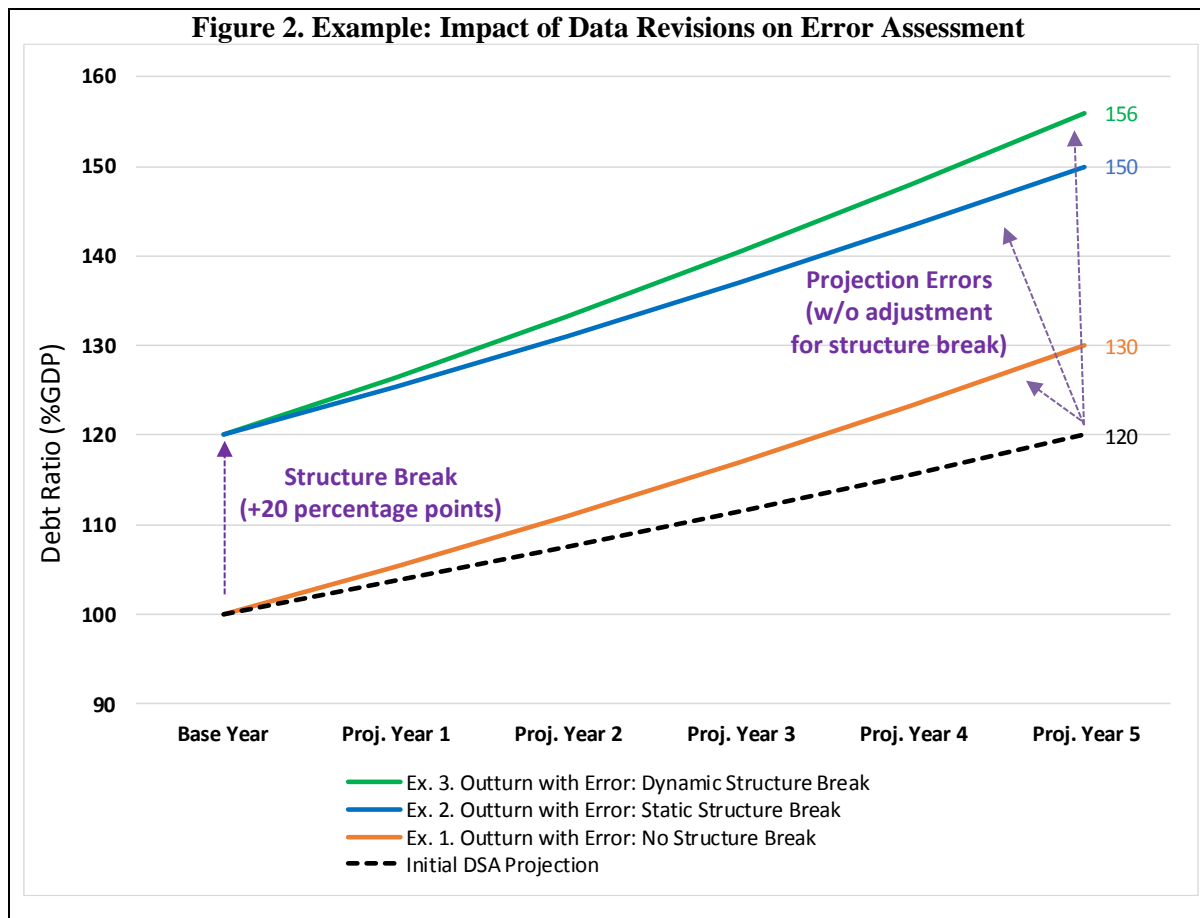


## D. Methods to Assess Projection Errors

12. LICs have been prone to revisions of economic statistics and related compilation methods<sup>11</sup>, such as updates of national accounts statistics (e.g., GDP), changes in the definition and coverage of the public sector (e.g., inclusion of state enterprises or sub-national governments), and the materialization of contingent liabilities that are then added to PPG debt stocks.

13. For this paper, the methodological challenge stems from the fact that time series for DSAs produced after such revisions are generally updated—often including updates of both historical series and projections—, rendering some data inconsistent and thus not comparable with that available from older DSA vintages. Similarly, given the hundreds of DSA vintages used for the analyses, it was not possible to determine when such revisions and resulting structure breaks may have taken place<sup>12</sup>, or the specific nature of such revisions (e.g., revisions to GDP, PPG debt stocks, the scope and definition of the public sector, etc.).

14. Figure 2 illustrates related challenges by comparing a DSA projection against three distinct outturns for the debt-to-GDP ratio—two with and one without data revisions. All three outturns illustrated involve an error at the 5-year horizon in the direction of optimism (a negative error) relative to the initial projection. Outturns reflecting data revisions (i.e., Examples 2 and 3) could involve a change in the stock of debt (numerator) and/or nominal GDP (denominator), or both.



<sup>11</sup> For example, an update of national accounts for Nicaragua in 2012 resulted in an upward revision of GDP by about 30 percent, implying a revaluation of public external debt from 61 to 35 percentage points of GDP.

<sup>12</sup> Doing so would have required a review of each of the hundreds of DSAs for which data was assessed, as well as their supporting IMF staff reports, to determine if and when structure breaks had occurred, as well as the nature of revisions.

- **Example 1: No Structural Break—True Error.** This represents an actual outturn that does not reflect any data revisions, but that does involve an error (i.e., -10 percentage points (pp) of the ratio) relative to the DSA projection scrutinized.
- **Example 2: Static Revision.** This example incorporates a ‘static’ revision resulting in a parallel shift across the entire projection horizon. It reflects the same error relative to the initial DSA projection as outlined in Example 1, but also incorporates a revision that increases the ratio by 20 percentage points from the base year onwards—from the orange to the blue line. An example of this type of revision might be the realization of a contingent liability affecting only the numerator.
- **Example 3. Dynamic Revision.** As in Example 2, the revision increases the ratio by 20 pp from the base year, but this change grows at the same annual rate as the unrevised outturn’s debt ratio over the entire projection horizon—from the orange to the green line. An example might be a revision to nominal GDP.

15. To overcome these challenges, alternative assessment methods were developed. The following illustrates and discusses the mechanics and rationale underpinning these new methods, and relative advantages and/or drawbacks vis-à-vis the standard method—i.e., the simple difference between projected and actual outturns.

**Figure 3. Comparison of Projection Error Calculation Methods**

Initial DSA Projection / Actual Outturns	Growth Rate	Debt-to-GDP Ratio		Error Calculation Methods (A-C)						
		Base Year	Proj. Year 5	A. Simple Difference		B. Adjusted Difference		C. Percentage Change		
		percent		percentage points		percentage points		percent		
Ex. 3. Dynamic Structure Break (initial base year + 20 pp)	5.4	120	156	120-156=	-36	(120-100) - (156-120)=	-16	(((120/100)-1)-((156/120)-1))*100=		-10
Ex. 2. Static Structure Break (initial base year + 20 pp)	4.5	120	150	120-150=	-30	(120-100) - (150-120)=	-10	(((120/100)-1)-((150/120)-1))*100=		-5
Ex. 1. No Structure Break (initial base year + 0 pp)	5.4	100	130	120-130=	-10	(120-100) - (130-100)=	-10	(((120/100)-1)-((130/100)-1))*100=		-10
Initial DSA Projection (basis for error assessment)	3.7	100	120	na		na		na		

**Sign of Errors:** Negative error means the ratio increased by more than projected by the DSA assessed, resulting in an underestimation—i.e., optimism. Positive errors indicate that projections overestimated the degree to which a variable increased—i.e., pessimism.

- **Method A: Standard Method—Simple Difference (projected value vs. outturn).** Subtracting the outturn from the originally-projected ratio when the outturn reflects a structural break leads to inaccurate results. Without any data revision (Ex. 1), forecast errors are -10 pp of the ratio—the simplest and most accurate measure. However, the forecast error would be significantly overstated if structural breaks are present—i.e., -36 pp if the revised ratio grew at the same rate as the initial ratio (Ex. 3), or -30 pp with a static increase that behaves like a parallel shift (Ex. 2).
- **Method B: Adjusted Difference.** A comparison of the adjusted difference from the base year to year 5 for the actual outturn versus to the corresponding projection is an accurate approach for static, but not for dynamic data revisions. For example, this method returns a forecast error of -10 pp for both the unrevised (Ex. 1) and static revision (Ex. 2). However, when the revised ratio grows at the same rate (in annualized percentage terms) as the unrevised series, this method overestimates forecast errors—e.g., -16 pp (Ex. 3) versus -10 pp (Ex. 1 and 2).
- **Method C. Percentage Change.** A comparison of the percentage changes from the base year to year 5 for the actual outturn versus the corresponding projection is accurate for dynamic data revisions, but not when revisions are static. This method returns an error of -10 percent for both the unrevised (Ex. 1) and dynamic revisions (Ex. 3). However, when revisions are static, this method underestimates the error—i.e., -5 percent (Ex. 2). Method C will also be influenced by

base effects—e.g., errors for series with lower base year ratios will be assessed as greater (in percentage terms) than those with higher base year ratios, all other things equal.

16. In summary, Method A is not an appropriate method for comparing realized debt ratios against projections when the data includes structural breaks, which are common within the DSA dataset. Methods B and C each have their own advantages and limitations, which as described above, depend on the type of revision and behavior of revised series following a structure break. In this context, we use both methods to ensure robustness, and have found results to be consistent across Methods B and C in terms of direction and the relative magnitude and ordering of overall errors across country sub-groupings. Results for both methods are generally reported throughout.

17. As further support, our aggregate error assessment findings are broadly similar to preliminary results of analyses undertaken for a forthcoming review of the LIC DSF. We take several steps beyond the assessment of errors, including by considering: (i) errors by time horizon (1-5 years); (ii) a disaggregation of error results by 24 country sub-groupings; (iii) a decomposition of external and public DSA errors by projection input component; (iv) an analysis of whether results represent testable ‘biases’ for external and public DSAs; (v) consideration of whether errors were influenced by exogenous shocks (e.g., commodity price movements or other macroeconomic shocks); and, (vi) various potential theoretical and/or other drivers of biases—e.g., assumptions regarding public and private investment dividends, government fiscal reaction functions, and whether all available information regarding the balance of payments was incorporated into projections. Where possible, we compare our results for LICs to the literature, including for developing and other more advanced economies, as well as LICs’ own historical experiences.

### **E. DSA Projection Errors: Multiple Horizons**

18. By focusing on errors calculated using Methods B and C, all results presented in subsequent sections compensate for the impact of any data revisions or structural breaks in underlying series. As a first step, this section identifies projection errors for external and public DSAs, using both methods for 24 country sub-groupings, over the 1- to 5-year horizons tested.

#### ***External Debt***

19. DSA projections underestimate the pace of external debt accumulation for most country groupings<sup>13</sup> (Figure 4). Errors generally increase in magnitude as forecast horizons are extended.

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<sup>13</sup> It is important to note that these groups are not mutually exclusive—e.g., many countries displaying ‘weak’ policy quality based on CPIA scores also fall in the ‘high’ or ‘in distress’ categories for DSA risk ratings.

Figure 4. Projection Errors—External DSA (2 Methods)

Adjusted difference between projected and outturn (percentage points; “Method B”)							
External Debt / Method B (pp)	Sub-Group	1-year	2-year	3-year	4-year	5-year	Year 5 Rank (ascending)
1.Financing and Development Category	Frontier	-1.99	-5.80	-8.62	-12.92	-29.26	1
	Small States	1.03	-0.03	-3.92	-11.89	-15.99	3
	Fragile	1.58	5.97	8.15	11.05	13.50	22
	Other Developing	-0.73	-1.35	-1.22	-2.53	-4.03	10
2.Risk of Debt Distress	Low Risk	-1.06	-2.54	-4.64	-6.32	-11.64	5
	Moderate Risk	-0.89	-3.71	-4.42	-7.64	-10.98	7
	High Risk	1.11	3.85	6.00	6.52	7.87	19
	In Distress	4.83	18.83	20.96	27.58	32.84	23
3.CPIA-Based Policy Strength	Strong	-0.34	-1.72	-2.48	-6.74	-11.26	6
	Medium	-0.93	-2.69	-4.06	-5.60	-9.27	8
	Weak	1.01	4.20	5.86	7.59	8.99	21
4.Position in Income Distribution (Quartiles)	Highest	0.73	-2.46	-5.51	-11.45	-19.14	2
	Middle-High	-2.11	-3.92	-6.06	-9.10	-13.08	4
	Middle-Low	0.68	2.48	3.33	5.62	6.32	18
	Lowest	0.91	3.97	6.13	7.96	7.88	20
5.Commodity Exporters	Com. Exporters	-0.41	-0.56	-0.64	1.07	-1.41	16
	Other Countries	0.13	0.60	0.62	-1.29	-2.54	12
6.HIPC Status	Other Countries	0.36	1.40	1.05	1.14	-1.84	14
	HIPC Post-CP	-0.54	-1.21	-0.85	-2.12	-2.40	13
7.IMF Arrangement	W/O IMF Program	0.03	-1.47	-2.67	-3.00	-6.32	9
	With IMF Program	-0.18	1.91	2.85	1.95	1.52	17
8.Projection Years	2007/2008	0.09	-2.14	-1.48	-0.65	-3.03	11
	2009/2010	0.99	4.21	3.54	1.71	-1.54	15
	2010/2011	-1.08	-1.27	-2.98	-4.23	na	na

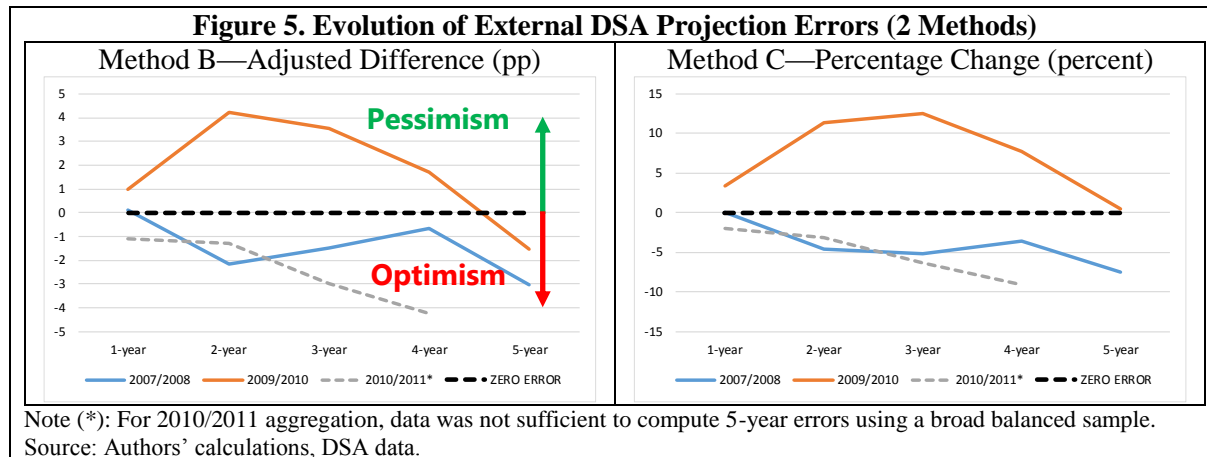
Percentage difference between projected and outturn (percent; “Method C”)							
External Debt / Method C (percent)	Sub-Group	1-year	2-year	3-year	4-year	5-year	Year 5 Rank (ascending)
1.Financing and Development Category	Frontier	-4.06	-11.17	-19.55	-37.30	-89.16	1
	Small States	2.93	2.38	-4.25	-13.94	-20.12	5
	Fragile	3.40	10.89	17.09	22.02	30.21	21
	Other Developing	-0.81	-1.02	0.70	-0.14	-1.73	13
2.Risk of Debt Distress	Low Risk	-2.22	-4.86	-9.96	-15.98	-30.58	3
	Moderate Risk	-0.74	-6.22	-6.20	-12.81	-18.33	6
	High Risk	4.21	13.17	20.84	27.46	33.40	22
	In Distress	3.93	22.51	24.57	30.19	34.47	23
3.CPIA-Based Policy Strength	Strong	-0.21	-2.47	-2.89	-10.50	-16.11	8
	Medium	-1.14	-2.77	-4.50	-7.38	-17.20	7
	Weak	1.98	6.66	10.24	12.25	15.83	19
4.Position in Income Distribution (Quartiles)	Highest	3.33	-1.57	-8.51	-19.94	-36.95	2
	Middle-High	-3.19	-3.44	-6.55	-12.90	-22.05	4
	Middle-Low	0.86	2.82	3.78	7.68	8.71	18
	Lowest	1.74	6.12	13.42	15.54	15.87	20
5.Commodity Exporters	Com. Exporters	-1.06	-1.91	-3.33	-3.30	-12.72	10
	Other Countries	1.04	2.81	5.02	3.03	3.85	16
6.HIPC Status	Other Countries	0.60	2.83	2.58	2.31	-4.86	12
	HIPC Post-CP	-0.09	-0.88	1.03	-1.36	-0.59	14
7.IMF Arrangement	W/O IMF Program	0.52	-2.53	-5.74	-7.63	-14.37	9
	With IMF Program	-0.02	4.70	8.79	7.35	6.34	17
8.Projection Years	2007/2008	0.01	-4.60	-5.16	-3.61	-7.44	11
	2009/2010	3.41	11.41	12.50	7.72	0.51	15
	2010/2011	-2.00	-3.09	-6.32	-9.05	na	na

Notes: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).

Source: Authors' calculations. Data: IMF DSA Database.

20. Country groups displaying the largest forecast errors in the direction of optimism (i.e., negative values) for projected external debt ratios include frontier LICs (ranked 1<sup>st</sup> out of 23 groupings by error calculation Methods B and C), those in the two highest income quartiles (ranked 2<sup>nd</sup> and 4<sup>th</sup>, respectively), countries rated ‘low’ and ‘moderate’ risk by DSAs (ranked between 3<sup>d</sup> and 7<sup>th</sup>), and small states (ranked 3<sup>d</sup> and 5<sup>th</sup>). In contrast, a few sub-groupings display appreciable projection errors in the direction of pessimism (i.e., positive values), including those with the two poorest DSA risk ratings of ‘in distress’ and ‘high risk’ (ranked between 19<sup>th</sup> and 23<sup>rd</sup> out of 23 groups assessed by Methods B and C), countries in fragile situations (ranked 22<sup>nd</sup> and 21<sup>st</sup>), and those with ‘weak’ policies (ranked 21<sup>st</sup> and 19<sup>th</sup>).

21. We also find evidence of faster projected improvements in debt dynamics for DSA vintages produced during 2010/2011 compared to those produced during 2007/2008 and 2009/2010 (Figure 5). This is in line with findings from Baduel and Price (2012), but based on a broader sample of DSAs that includes newer vintages.<sup>14</sup>



### **Public Debt**

22. Public debt projections displayed optimism by underestimating the pace of PPG debt accumulation for 19 out of 23 country groups in year 5 (Figure 6). As was the case for external DSAs, the magnitude of these errors tends to increase over time as projection horizons are extended. Most pronounced were errors for LICs at 'moderate risk' (ranked 4<sup>th</sup> and 3<sup>d</sup> out of 23 groupings by Methods B and C), and those in the two highest income quartiles (ranked between 1<sup>st</sup> and 6<sup>th</sup>). Conversely, DSA projections for a few groups displayed pessimism, particularly those classified as being 'in debt distress' and at 'high risk' of distress (ranked between 18<sup>th</sup> and 23<sup>d</sup>), and those defined as fragile states (ranked 20<sup>th</sup> and 19<sup>th</sup>).

<sup>14</sup> Baduel and Price (2012) found increasing optimism ex ante for unrealized projections, while we find optimism ex post via an assessment of errors. Note that sample sizes and compositions upon which results are based differ across the two papers.

Figure 6. Projection Errors—Public DSA (2 Methods)

Adjusted difference between projected and outturn (percentage points; “Method B”)							
Public Debt / Method B (pp)	Sub-Group	1-year	2-year	3-year	4-year	5-year	Year 5 Rank (ascending)
1.Financing and Development Category	Frontier	-0.14	-1.54	-2.24	-5.36	-10.19	5
	Small States	0.41	-1.47	-6.01	-12.73	-18.57	2
	Fragile	0.20	3.06	2.85	3.15	2.32	20
	Other Developing	-0.65	-1.83	-1.90	-3.55	-5.69	11
2.Risk of Debt Distress	Low Risk	0.04	-1.49	-3.24	-5.52	-9.57	7
	Moderate Risk	-1.31	-4.29	-4.94	-8.59	-12.19	4
	High Risk	0.40	1.91	1.91	0.50	-0.91	18
	In Distress	2.79	15.92	15.15	20.70	24.77	23
3.CPIA-Based Policy Strength	Strong	-0.09	-2.02	-3.76	-8.07	-13.24	3
	Medium	-0.20	-1.52	-2.39	-3.92	-6.50	10
	Weak	-0.19	1.85	1.83	1.37	0.12	19
4.Position in Income Distribution (Quartiles)	Highest	0.07	-3.29	-9.23	-19.08	-29.87	1
	Middle-High	-1.31	-3.23	-3.94	-7.32	-9.94	6
	Middle-Low	0.86	2.04	2.02	3.59	3.68	22
	Lowest	-0.42	1.91	2.60	3.25	2.95	21
5.Commodity Exporters	Com. Exporters	-0.68	-0.71	-1.48	-1.90	-4.44	14
	Other Countries	0.12	-0.10	-0.70	-2.82	-5.11	13
6.HIPC Status	Other Countries	0.72	1.98	1.49	1.06	-1.91	17
	HIPC Post-CP	-1.12	-2.82	-3.59	-6.36	-7.99	8
7.IMF Arrangement	W/O IMF Program	0.30	-0.30	-1.01	-0.78	-2.49	16
	With IMF Program	-0.70	-0.35	-0.97	-3.89	-6.73	9
8.Projection Years	2007/2008	-1.18	-3.81	-3.85	-2.77	-4.34	15
	2009/2010	0.80	3.13	1.73	-1.37	-5.55	12
	2010/2011	-0.39	-0.47	-2.30	-5.15	na	na

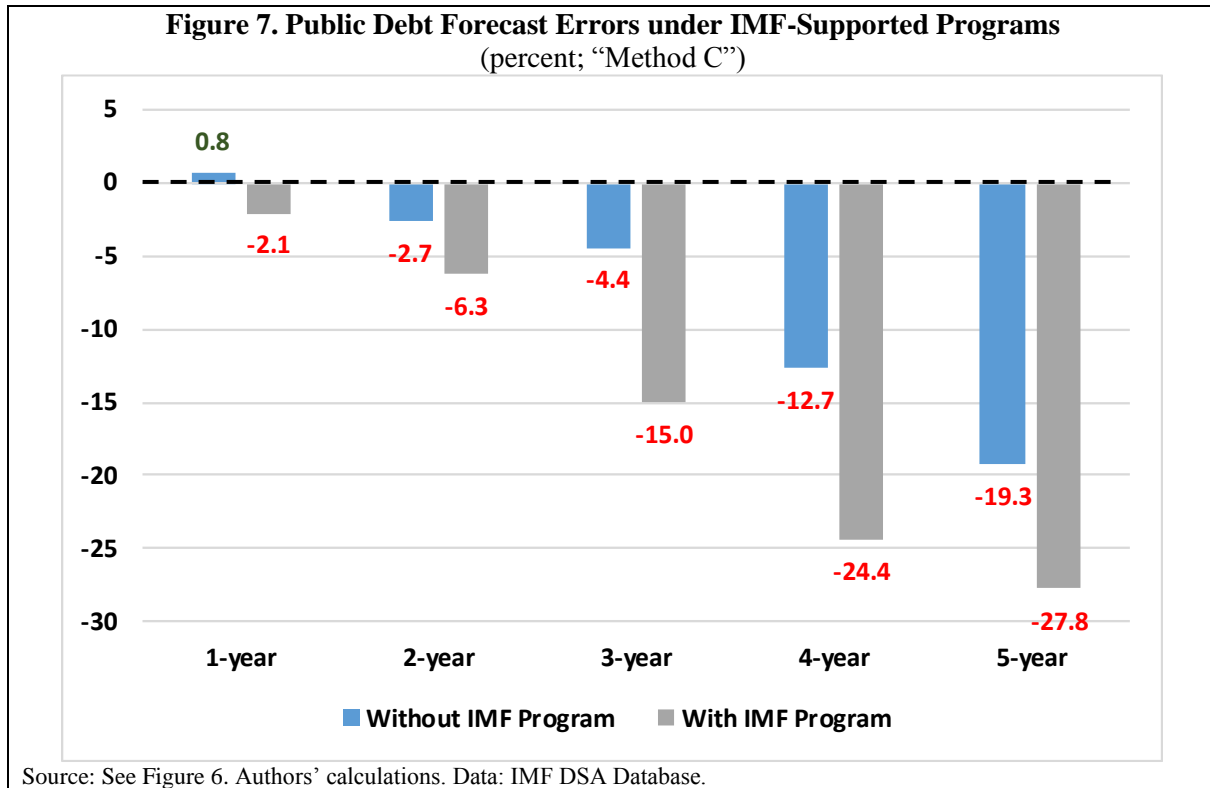
Percentage difference between projected and outturn (percent; “Method C”)							
Public Debt / Method C (percent)	Sub-Group	1-year	2-year	3-year	4-year	5-year	Year 5 Rank (ascending)
1.Financing and Development Category	Frontier	-1.46	-6.59	-9.15	-14.48	-30.40	8
	Small States	1.40	0.07	-7.06	-17.48	-26.49	11
	Fragile	-0.78	1.55	3.01	1.98	1.18	19
	Other Developing	-0.60	-9.02	-20.32	-36.76	-40.60	5
2.Risk of Debt Distress	Low Risk	0.23	-3.98	-8.93	-15.32	-26.14	12
	Moderate Risk	-3.14	-16.68	-31.68	-55.71	-61.93	3
	High Risk	1.36	5.78	9.47	8.44	6.20	22
	In Distress	2.54	18.45	16.94	21.58	22.92	23
3.CPIA-Based Policy Strength	Strong	0.70	-3.47	-5.48	-14.86	-23.61	13
	Medium	-0.80	-9.80	-22.83	-38.27	-41.65	4
	Weak	-1.07	0.58	1.61	-1.58	-5.77	18
4.Position in Income Distribution (Quartiles)	Highest	0.15	-7.00	-19.98	-40.32	-62.23	2
	Middle-High	-1.85	-13.71	-30.95	-54.70	-63.87	1
	Middle-Low	1.34	2.25	1.80	2.60	1.77	20
	Lowest	-1.93	0.25	2.87	4.12	2.61	21
5.Commodity Exporters	Com. Exporters	-2.11	-4.53	-5.79	-6.99	-13.86	16
	Other Countries	0.31	-4.41	-12.52	-26.72	-30.60	7
6.HIPC Status	Other Countries	0.85	-3.29	-12.35	-23.57	-29.13	9
	HIPC Post-CP	-2.07	-5.69	-7.55	-14.27	-18.86	15
7.IMF Arrangement	W/O IMF Program	0.78	-2.67	-4.45	-12.70	-19.29	14
	With IMF Program	-2.07	-6.28	-15.04	-24.35	-27.79	10
8.Projection Years	2007/2008	-2.90	-9.73	-8.35	-8.22	-9.94	17
	2009/2010	2.21	6.00	-5.44	-21.24	-35.40	6
	2010/2011	-1.63	-10.50	-17.38	-32.20	na	na

Notes: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).

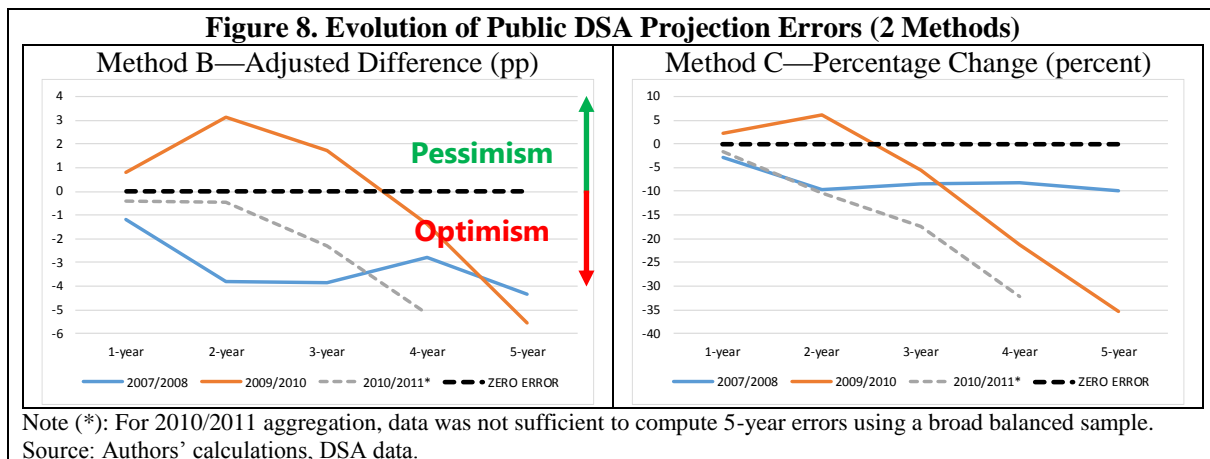
Source: Authors' calculations. Data: IMF DSA Database.

23. One noteworthy finding relates to implications of IMF-supported adjustment programs for projection accuracy (Figure 6, rows numbered 7—labeled “IMF Arrangements”). For external (public and private) debt projections, the presence of an IMF-supported program reduced optimism relative to countries without a program (Figure 4). However, this tendency inverts when we assess errors for public debt projections, with IMF arrangements (in aggregate) driving increased optimism at nearly all horizons tested under both methods (see Figure 7). While

identifying causation is beyond the scope of this paper, these findings are generally supported by previous studies.<sup>15</sup>



24. As was the case for external DSAs, we find evidence of increasing optimism in terms of ex post errors for the most recent aggregation of public DSA vintages produced during 2010/2011, compared to those produced during 2007/2008 and 2009/2010 (Figure 8).



<sup>15</sup> See: [Beddies, Doemeland, Le Manchec, and Mooney \(2009\)](#), which surveys several studies finding optimism with respect to IMF economic projections for countries under a Fund-supported adjustment program—e.g., a 2003 IMF Independent Evaluation Office study found that actual GDP growth fell short of the IMF’s projections by an average 1.5 percentage points over various two-year periods studied for 159 IMF-supported adjustment programs.

### Comparison of Results: Country Groups Ranked by Errors

25. When errors are compared, and ranked in terms of relative magnitude, several groups display common tendencies across both external and public DSAs (Figure 9). DSA debt projections for countries in the two highest income quartiles, frontier LICs, and those at ‘moderate risk’ display significant optimism for both external and public sector forecasts, while countries assessed as ‘in distress’ and at ‘high risk’, those in the lowest income quartile, and fragile states display some degree of pessimism across both types of DSA. The policy implications may be significant—groups found to display the most persistent optimism tend to be those with the greatest potential to access financing among the LICs, including non-concessional and non-traditional flows.

**Figure 9. Public and External DSA Projection Errors: Composite Raking of Country Groups**  
(based on Methods B and C)

Group	Sub-Group	External DSAs		Public DSAs		Composite Ranking
		Method B	Method C	Method B	Method C	
		Year 5 Rank (ascending)	Year 5 Rank (ascending)	Year 5 Rank (ascending)	Year 5 Rank (ascending)	
4. Position in Income Distribution (Quartiles)	Highest	2	2	1	2	1.8
1. Financing and Development Category	Frontier	1	1	5	8	3.8
4. Position in Income Distribution (Quartiles)	Middle-High	4	4	6	1	3.8
2. Risk of Debt Distress	Moderate Risk	7	6	4	3	5.0
1. Financing and Development Category	Small States	3	5	2	11	5.3
2. Risk of Debt Distress	Low Risk	5	3	7	12	6.8
3. CPIA-Based Policy Strength	Medium	8	7	10	4	7.3
3. CPIA-Based Policy Strength	Strong	6	8	3	13	7.5
1. Financing and Development Category	Other Developing	10	13	11	5	9.8
5. Commodity Exporters	Other Countries	12	16	13	7	12.0
7. IMF Arrangement	W/O IMF Program	9	9	16	14	12.0
8. Projection Years	2009/2010	15	15	12	6	12.0
6. HIPC Status	HIPC Post-CP	13	14	8	15	12.5
6. HIPC Status	Other Countries	14	12	17	9	13.0
7. IMF Arrangement	With IMF Program	17	17	9	10	13.3
8. Projection Years	2007/2008	11	11	15	17	13.5
5. Commodity Exporters	Com. Exporters	16	10	14	16	14.0
3. CPIA-Based Policy Strength	Weak	21	19	19	18	19.3
4. Position in Income Distribution (Quartiles)	Middle-Low	18	18	22	20	19.5
2. Risk of Debt Distress	High Risk	19	22	18	22	20.3
1. Financing and Development Category	Fragile	22	21	20	19	20.5
4. Position in Income Distribution (Quartiles)	Lowest	20	20	21	21	20.5
2. Risk of Debt Distress	In Distress	23	23	23	23	23.0

Notes: Composite rank is the average of four individual rankings, based on results of each method—see Figures 4 and 6.

### F. DSA Projection Errors: Decomposition by Component

26. This section decomposes DSA forecast errors calculated using Methods B and C discussed in previous sections, by main economic and financial projection component at the 5-year horizon.

27. Table 2 lists all economic and financial variables used as inputs for nominal external and public DSA debt-to-GDP ratio projections. These variables are not calculated autonomously by the DSA itself, but rather projected via separate processes and/or methodologies<sup>16</sup>, and then used as inputs to the DSA. The sum of these externally-calculated input variables is equal to the DSA’s

<sup>16</sup> Medium-term projections (e.g., 1 to 5 years) are based on the IMF’s standard financial programming methods and tools.

(continued...)



projected stock of debt in any given year, expressed in terms of nominal GDP—i.e., a debt-to-GDP ratio.<sup>17</sup>

**Table 2. DSA Debt Forecast Input Components**  
(as a percent of nominal GDP)

External DSA	Public DSA
<ul style="list-style-type: none"> <li>• Current Account Deficit</li> <li>• Net Foreign Direct Investment</li> <li>• Nominal Interest Rate</li> <li>• Real GDP Growth</li> <li>• Price and Exchange Rate</li> <li>• Exceptional Financing</li> <li>• External Residual (/1)</li> </ul>	<ul style="list-style-type: none"> <li>• Primary Budget Deficit</li> <li>• Real Interest Rate</li> <li>• Real GDP Growth</li> <li>• Real Exchange Rate</li> <li>• Other Debt-Creating Flows (/2)</li> <li>• Public Residual (/3)</li> </ul>

/1) External DSA residuals include exceptional financing (i.e., changes in arrears and debt relief), changes in gross foreign assets, errors and omissions, and valuation adjustments.

/2) Other debt-creating flows include privatization receipts, recognition of contingent liabilities, debt relief, etc.

/3) Public DSA residuals refer to any changes in the stock of public debt not explained by all other input components—e.g., changes in the valuation of assets held within the debt portfolio, etc.

28. We focus the analysis on a 5-year horizon, which allows for a sufficiently broad set of 148 observations for external DSAs, and 145 observations for public DSAs. Opting for longer forecast horizons considerably reduces observations—e.g., at the 7-year horizon, the number of observations falls to 53 and 50 for external and public DSA projections, respectively. As the choice of horizon does not affect the direction of errors for most groups, results for shorter horizons were tested and found to be broadly similar.

29. It is important to note that for some groups, the sum of projection input components presented in the results tables is not equal to overall error for the debt-to-GDP ratio, owing to missing data for 14 DSAs, out of several hundred observations in total. This does not affect or undermine overall error findings or relative rankings (see Annex III for results adjusted to remove observations where some input data is missing—results and overall rankings remain broadly similar).

### ***External DSA Projections***

30. The following figures illustrate the contribution of errors for projected macroeconomic inputs to the overall error in the DSA's projection for the debt-to-GDP ratio at the 5-year horizon. While the most significant components vary by country grouping, Figure 10 shows that external DSAs for most groups of LICs assessed displayed errors in the direction of optimism, most often driven by overestimations (i.e., negative values in the tables) for 'external residuals' (e.g., frontier LICs, those in the highest income quartiles, and with 'low' or 'moderate' DSA risk ratings) and foreign direct investment (e.g., small states). It is worth noting that external residuals defined by the DSA include several projected values such as exceptional financing and components of the

<sup>17</sup> For a detailed discussion of DSAs and underpinning projection methods, see: [IMF \(2013\): "Staff Guidance Note on the Application of the Joint Bank-Fund Debt Sustainability Framework for Low-Income Countries"](#)

(continued...)

capital account of the balance of payments (BOP)—e.g., capital transfers and the acquisition/disposal of non-produced nonfinancial assets between residents and nonresidents.<sup>18</sup>

**Figure 10. Decomposition of External DSA Forecast Errors (5-year horizon)**

<b>Adjusted difference between projected and outturn (percentage points; “Method B”)</b>										
External Debt / Method B (pp)	Projection Component	Current Account Deficit	Foreign Direct Investment	Interest Rate	Growth	Exchange Rate	Except. Financing	Residual	Overall Error	Overall Error Rank (ascending)
1. Financing and Development Category	Frontier	-16.75	13.95	1.21	0.76	2.72	2.83	-33.98	-29.26	1
	Small States	29.44	-20.18	2.20	-4.41	-1.77	-6.94	-16.42	-15.99	3
	Fragile	3.68	-1.38	2.13	-3.48	-0.32	1.73	11.12	13.50	22
	Other Developing	-1.12	5.52	1.42	0.26	1.12	-1.93	-8.15	-4.03	10
2. Risk of Debt Distress	Low Risk	-4.59	8.38	0.81	0.06	0.41	0.24	-15.66	-11.64	5
	Moderate Risk	-6.02	3.28	0.90	0.02	1.67	-3.70	-5.85	-10.98	7
	High Risk	22.19	-9.42	1.56	-2.25	1.22	-2.62	-3.99	7.87	19
	In Distress	-1.99	5.72	6.62	-8.88	-5.53	10.57	26.34	32.84	23
3. CPIA-Based Policy Strength	Strong	7.35	-8.88	0.56	-1.96	1.03	1.36	-7.07	-11.26	6
	Medium	-1.13	7.79	1.30	-0.07	0.48	-1.44	-16.29	-9.27	8
	Weak	3.35	-1.32	2.54	-2.70	0.34	-0.04	6.81	8.99	21
4. Position in Income Distribution (Quartiles)	Highest	14.47	-8.95	1.78	-3.55	-1.59	-6.12	-16.43	-19.14	2
	Middle-High	8.79	2.23	1.36	-0.61	1.67	-3.53	-22.41	-13.08	4
	Middle-Low	-3.21	1.65	1.63	-1.27	0.93	6.82	0.30	6.32	18
	Lowest	-6.66	6.83	2.30	-1.48	-0.61	-3.83	11.33	7.88	20
5. Commodity Exporters	Com. Exporters	-9.12	10.21	2.54	-1.15	0.04	0.48	-4.41	-1.41	16
	Other Countries	9.14	-4.21	1.16	-1.64	0.82	-1.05	-5.29	-2.54	12
6. HIPC Status	Other Countries	4.10	-3.78	2.76	-2.36	0.41	3.00	-3.41	-1.84	14
	HIPC Post-CP	-0.31	7.19	0.62	-0.42	0.62	-4.03	-6.53	-2.40	13
7. IMF Arrangement	W/O IMF Program	-0.35	-0.18	1.85	-1.66	0.60	3.07	-7.31	-6.32	9
	With IMF Program	4.08	2.64	1.62	-1.27	0.44	-3.16	-3.06	1.52	17
8. Projection Years	2007/2008	0.64	-1.03	0.47	-2.00	1.09	-1.67	-0.12	-3.03	11
	2009/2010	3.96	4.95	2.29	-1.00	-0.46	0.50	-10.42	-1.54	15

<b>Percentage difference between projected and outturn (percent; “Method C”)</b>										
External Debt / Method C (percent)	Projection Component	Current Account Deficit	Foreign Direct Investment	Interest Rate	Growth	Exchange Rate	Except. Financing	Residual	Overall Error	Overall Error Rank (ascending)
1. Financing and Development Category	Frontier	-62.74	48.54	2.30	8.06	9.90	4.39	-99.61	-89.16	1
	Small States	52.56	-22.96	2.82	-6.10	3.23	-21.50	-32.31	-20.12	5
	Fragile	49.12	-5.48	2.51	-3.60	2.53	7.59	-22.46	30.21	21
	Other Developing	34.11	-0.17	2.20	-1.25	2.61	0.78	-39.60	-1.73	13
2. Risk of Debt Distress	Low Risk	10.29	21.84	1.51	-0.80	3.81	4.12	-71.34	-30.58	3
	Moderate Risk	-17.19	4.84	1.75	2.09	4.88	-3.04	-10.82	-18.33	6
	High Risk	122.33	-22.30	3.12	-5.14	2.22	-0.38	-66.46	33.40	22
	In Distress	-8.37	9.85	3.70	-3.08	0.22	11.38	20.76	34.47	23
3. CPIA-Based Policy Strength	Strong	-3.20	-6.56	-1.29	-1.85	5.43	3.38	-12.02	-16.11	8
	Medium	21.72	12.76	3.06	-0.60	2.74	0.46	-58.15	-17.20	7
	Weak	47.64	-5.75	2.97	-1.95	3.62	2.56	-33.28	15.83	19
4. Position in Income Distribution (Quartiles)	Highest	15.91	2.49	2.55	-4.81	2.63	-16.84	-41.98	-36.95	2
	Middle-High	87.96	9.89	1.96	1.75	6.62	-0.60	-129.64	-22.05	4
	Middle-Low	4.52	1.31	2.04	-1.12	1.39	13.27	-11.27	8.71	18
	Lowest	10.55	-3.51	3.31	-2.77	2.61	-2.07	7.75	15.87	20
5. Commodity Exporters	Com. Exporters	12.26	15.94	3.39	1.42	5.43	1.53	-52.68	-12.72	10
	Other Countries	40.48	-7.43	1.70	-3.22	2.26	2.02	-31.89	3.85	16
6. HIPC Status	Other Countries	35.10	-7.70	3.41	-0.89	4.71	3.34	-42.48	-4.86	12
	HIPC Post-CP	23.19	11.73	1.31	-1.87	2.30	0.26	-38.04	-0.59	14
7. IMF Arrangement	W/O IMF Program	30.50	0.96	1.60	0.03	6.83	2.86	-57.84	-14.37	9
	With IMF Program	28.23	2.61	2.98	-2.47	0.93	1.03	-26.98	6.34	17
8. Projection Years	2007/2008	14.74	-0.35	1.17	-1.67	5.15	-0.96	-25.98	-7.44	11
	2009/2010	43.80	7.00	3.16	-1.08	1.44	3.72	-57.38	0.51	15

Legend: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).

Note: For some groups, the sum of components is not equal to overall error for the debt-to-GDP ratio, owing to missing data for 14 DSAs for 8 countries. This does not affect or undermine overall error findings or relative rankings.

Source: Authors' calculations. Data: IMF DSA Database.

31. LIC groups displaying significant positive errors in the direction of pessimism (e.g., those with the poorest DSA risk ratings and countries in the lowest income quartile) displayed the inverse tendency, with errors driven largely by underestimations of projected external residuals.

<sup>18</sup> Such transfers can involve natural resources, contracts, leases, licenses, marketing assets, and goodwill. For a detailed discussion, see: [IMF Balance of Payments and International Investment Position Manual](#)

## Public DSA Projections

32. Figure 11 illustrates that DSAs for most groups of LICs displayed negative errors in the direction of optimism, driven most commonly by errors for projected ‘public residuals’—defined as the change in public debt that is not explained by all other input components identified in Table 2 (e.g., changes in the valuation of assets affecting the stock of debt)—, primary budget deficits, and growth. Few groups displayed appreciable positive errors in the direction of pessimism, which when evident were generally driven by pessimism regarding projections for ‘other debt-creating flows’—including privatization receipts, recognition of contingent liabilities, debt relief, etc.—such as countries rated by DSAs as ‘in debt distress’ and fragile LICs.

**Figure 11. Decomposition of Public DSA Forecast Errors (5-year horizon)**

<b>Adjusted difference between projected and outturn (percentage points; “Method B”)</b>									
Public Debt / Method B (pp)	Projection Component	Primary Balance Deficit	Interest Rate	Growth	Exchange Rate	Other Debt Flows	Residual	Overall Error	Overall Error Rank (ascending)
<b>1. Financing and Development Category</b>	Frontier	-4.93	2.73	-2.30	0.14	4.27	-10.11	-10.19	5
	Small States	-6.38	1.52	-4.80	-1.57	0.59	-0.29	-18.57	2
	Fragile	1.58	3.72	-3.37	-2.32	11.89	-9.19	2.32	20
	Other Developing	-0.24	1.03	-0.82	-0.84	0.97	-4.39	-5.69	11
<b>2. Risk of Debt Distress</b>	Low Risk	-2.56	1.15	-1.11	-0.52	-0.10	-3.54	-9.57	7
	Moderate Risk	-1.92	1.23	-1.53	-0.36	-0.48	-7.33	-12.19	4
	High Risk	-0.28	2.01	-1.58	-0.49	6.40	-7.72	-0.91	18
	In Distress	9.44	8.21	-8.26	-8.04	30.18	-6.76	24.77	23
<b>3. CPIA-Based Policy Strength</b>	Strong	-2.47	1.10	-3.05	-1.34	-0.94	-1.15	-13.24	3
	Medium	-0.74	1.25	-1.27	-0.69	1.03	-4.97	-6.50	10
	Weak	-0.31	3.60	-2.96	-1.89	11.32	-9.73	0.12	19
<b>4. Position in Income Distribution (Quartiles)</b>	Highest	-14.31	1.64	-2.81	-0.60	-0.98	-7.47	-29.87	1
	Middle-High	1.21	0.92	-2.70	-0.56	0.63	-7.45	-9.94	6
	Middle-Low	2.06	1.05	-2.01	-1.36	6.67	-2.72	3.68	22
	Lowest	1.96	5.76	-2.13	-3.19	10.74	-10.30	2.95	21
<b>5. Commodity Exporters</b>	Com. Exporters	0.46	3.31	-2.93	-2.45	7.32	-10.15	-4.44	14
	Other Countries	-1.64	1.49	-1.81	-0.52	3.43	-3.87	-5.11	13
<b>6. HIPC Status</b>	Other Countries	0.83	2.70	-3.18	-1.60	9.17	-7.58	-1.91	17
	HIPC Post-CP	-2.65	1.73	-1.23	-0.98	0.31	-5.20	-7.99	8
<b>7. IMF Arrangement</b>	W/O IMF Program	2.31	1.40	-3.10	-0.71	8.66	-8.81	-2.49	16
	With IMF Program	-3.33	2.85	-1.57	-1.74	1.96	-4.58	-6.73	9
<b>8. Projection Years</b>	2007/2008	-2.70	2.42	-2.35	-1.33	5.07	-5.84	-4.34	15
	2009/2010	0.30	2.12	-2.11	-1.38	4.23	-6.21	-5.55	12

Percentage difference between projected and outturn (percent; “Method C”)									
Public Debt / Method C (percent)	Projection Component	Primary Balance Deficit	Interest Rate	Growth	Exchange Rate	Other Debt Flows	Residual	Overall Error	Overall Error Rank (ascending)
1. Financing and Development Category	Frontier	-17.67	6.16	2.71	-0.01	5.16	-26.76	-30.40	8
	Small States	-20.50	1.49	-4.47	-0.65	0.36	-2.72	-26.49	11
	Fragile	2.42	3.81	-2.47	-0.58	19.09	-21.09	1.18	19
	Other Developing	-8.57	3.22	1.40	-2.35	6.73	-15.94	-40.60	5
2. Risk of Debt Distress	Low Risk	-13.86	3.60	-1.35	-1.09	-1.78	-10.80	-26.14	12
	Moderate Risk	-16.95	2.36	4.15	-0.37	8.08	-24.88	-61.93	3
	High Risk	9.07	3.51	-3.39	-1.24	18.67	-20.42	6.20	22
	In Distress	7.35	7.64	-1.58	-4.99	25.83	-11.34	22.92	23
3. CPIA-Based Policy Strength	Strong	-12.56	2.13	0.09	-2.44	-0.59	-10.23	-23.61	13
	Medium	-7.40	3.65	1.15	-2.06	8.08	-19.87	-41.65	4
	Weak	-4.82	4.15	-1.92	-0.11	15.94	-18.54	-5.77	18
4. Position in Income Distribution (Quartiles)	Highest	-43.98	2.70	-1.62	1.22	-3.36	-17.19	-62.23	2
	Middle-High	-11.23	3.37	2.19	-0.90	5.09	-21.11	-63.87	1
	Middle-Low	0.78	3.89	-1.20	-3.59	11.05	-9.17	1.77	20
	Lowest	6.54	5.14	-1.01	-1.57	20.97	-27.85	2.61	21
5. Commodity Exporters	Com. Exporters	-2.39	4.80	-0.62	-1.19	6.17	-20.63	-13.86	16
	Other Countries	-10.06	2.85	-0.05	-1.36	12.65	-16.04	-30.60	7
6. HIPC Status	Other Countries	-4.73	3.80	-0.09	-0.57	13.48	-19.02	-29.13	9
	HIPC Post-CP	-9.46	3.46	-0.46	-2.03	6.66	-16.71	-18.86	15
7. IMF Arrangement	W/O IMF Program	-1.86	1.97	-0.57	0.89	10.81	-20.71	-19.29	14
	With IMF Program	-11.13	4.93	-0.05	-2.98	9.58	-15.69	-27.79	10
8. Projection Years	2007/2008	-6.12	4.00	-0.79	-0.86	11.31	-17.58	-9.94	17
	2009/2010	-8.95	3.52	0.44	-1.37	8.91	-17.72	-35.40	6

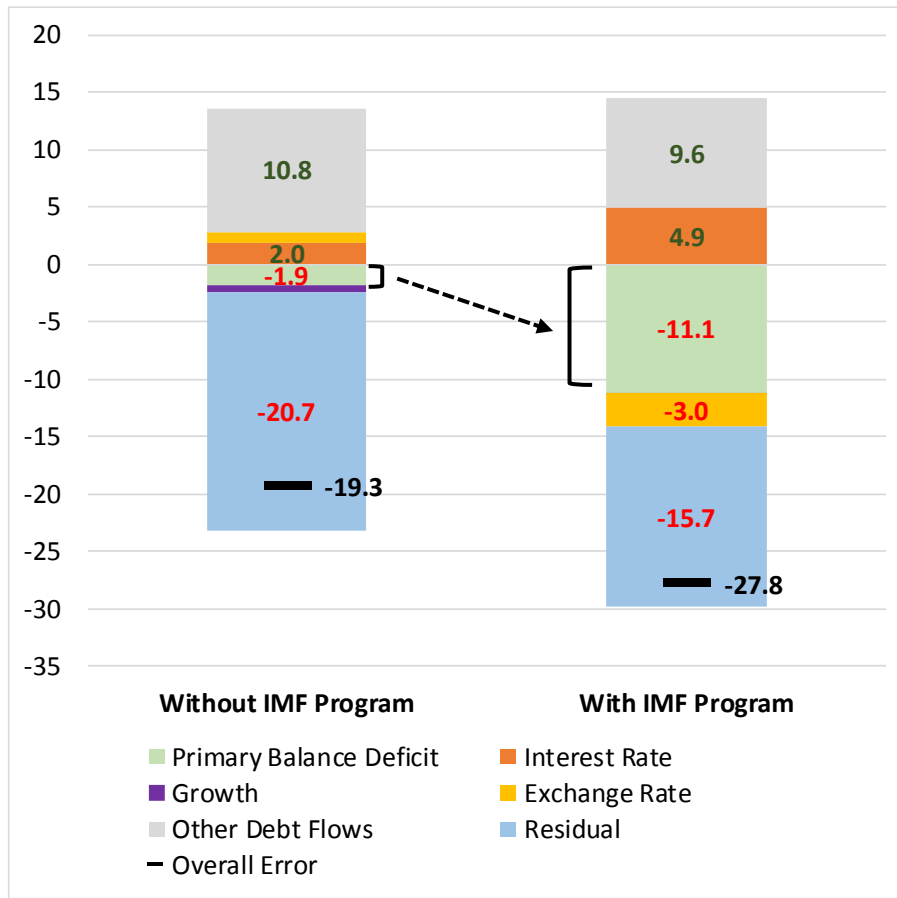
Legend: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).

Note: For some groups, the sum of components is not equal to overall error for the debt-to-GDP ratio, owing to missing data for 14 DSAs for 8 countries. This does not affect or undermine overall error findings or relative rankings.

Source: Authors' calculations. Data: IMF DSA Database.

33. As discussed in Section III.E, we find that DSA public debt projection optimism is greater (in aggregate) for countries with IMF-supported programs than when there is no Fund arrangement in place. Figures 11 and 12 highlight our finding that this is partly driven by greater optimism with respect to the pace and/or magnitude of expected fiscal consolidation—i.e., projected improvements in primary balances. Conversely, projected residuals were less optimistic under IMF-supported programs than in the absence of Fund support.

**Figure 12. Public Debt Forecast Errors under IMF-Supported Programs:  
Decomposition by Projection Component**  
(percent; “Method C”)



Source: See Figure 11. Authors' calculations. Data: IMF DSA Database.

### Summary

34. Errors for projected external and public debt burdens tended to display a negative sign and lean in the direction of optimism. For external DSAs, these were most often driven by optimism with respect to projected residuals, foreign investment, and/or GDP growth. Errors for public DSAs were most often driven by optimism regarding projected residuals, fiscal performance, and growth.

## G. Testing for Biases

### Methods

35. To test more formally whether the errors described above are statistically significant and reflect biases, our analysis builds on Timmermann (2006), who evaluated the performance of IMF World Economic Outlook (WEO) forecasts and provided a set of testable properties for an optimal forecast. In addition, we also use statistical tests of economic forecast performance as in Schuh (2001). We define ‘bias’ as in Timmerman (2006)—i.e., a common and persistent tendency towards errors in the direction of either optimism or pessimism. In this context, two complementary methods were identified.

36. **Method 1: Regression Analysis.** This involves regressing the outturns on the previous year's projections. According to the literature, if projections are biased, the joint test requiring the regression constant to be zero and the coefficient of the projection to be one would be rejected (Timmerman (2006)).

37. Formally, if projections are unbiased, actual outturns should be explained one-for-one by projections, and the intercept for the regression  $\beta_0$  should be equal to zero, while the slope  $\beta_1$  should be equal to one.

$$D_{i,t} = \beta_0 + \beta_1 D_{i,t}^p + \epsilon_{i,t}$$

Where  $D_{i,t}$  is the actual debt ratio in growth terms,  $D_{i,t}^p$  the debt ratio projected one year earlier in growth terms, and  $\epsilon_{i,t}$  the error term.

38. **Method 2: Statistical Test.** This involves computing average cumulative projection errors using 1-year to 7-year projection horizons. The next step is to assess a 90 percent confidence interval around the mean. If projections are biased, cumulative errors will fall away from zero as the horizon increases and average errors will not be zero (Schuh (2001)).

### Results: Regression Analysis

39. We find that external and public debt ratio projections are not unbiased (Table 3)—both Methods B and C illustrated.

**Table 3. External and Public Debt Regression Tests (All LICs)**

(Method B illustrated—percentage points)					
Regression Tests of Bias					
Variable	Horizon	$\beta_0$	$\beta_1$	$\bar{R}^2$	p-value
External Debt (%GDP)	1-year	-0.05 (-0.11)	0.70*** (15.33)	0.41	<b>0.00</b>
Public Debt (%GDP)	1-year	-0.05 (0.44)	0.74*** (18.36)	0.50	<b>0.00</b>

(Method C illustrated—percent)					
Regression Tests of Bias					
Variable	Horizon	$\beta_0$	$\beta_1$	$\bar{R}^2$	p-value
External Debt (%GDP)	1-year	0.43 (0.43)	0.62*** (11.06)	0.27	<b>0.00</b>
Public Debt (%GDP)	1-year	1.12 (1.26)	0.69*** (12.53)	0.32	<b>0.00</b>

*t* statistics in parentheses. The p-value is from the F-test.

Bold indicates rejection of unbiasedness at the 10 percent level or better.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Note: Under the null hypothesis of unbiased projections, these parameters should be close to zero and one, respectively. Any significant deviations of one or both parameters would lead to a rejection of the null hypothesis. The p-value from the joint test of this hypothesis is shown in the table, and it indicates the level of confidence with which the hypothesis can be rejected.

40. For both regressions, the joint test on the intercept and the slope rejects the null hypothesis of unbiasedness for both external and public debt ratio projections in aggregate.<sup>19</sup>

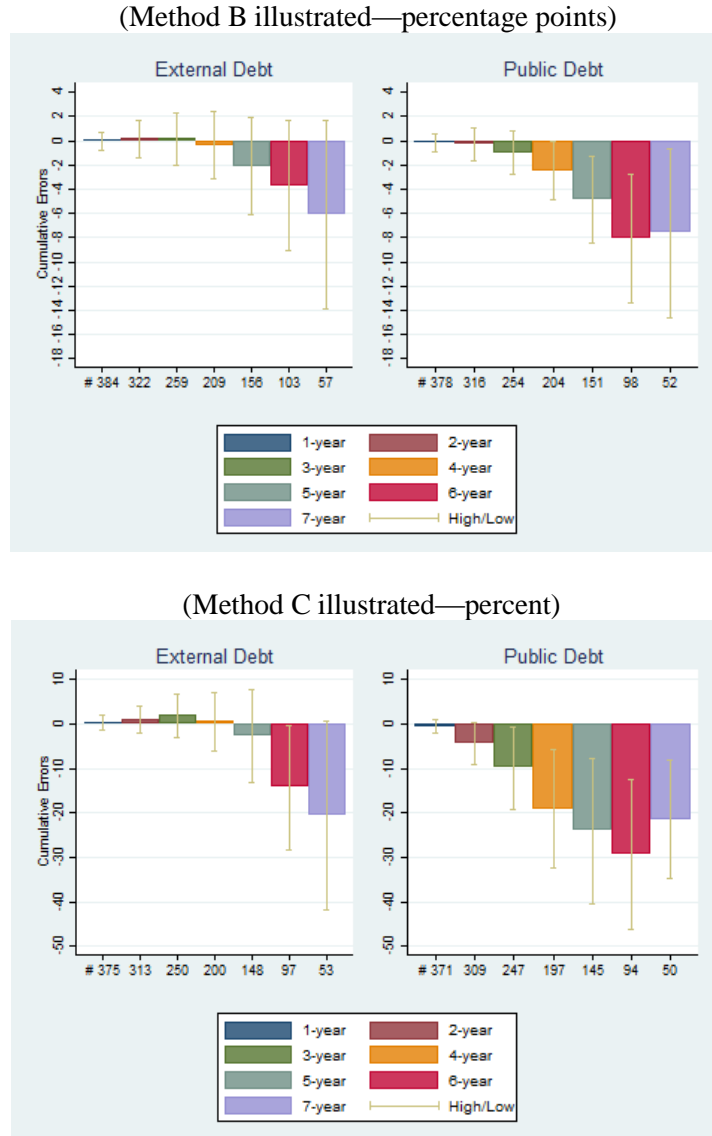
41. We take this analysis several steps further by also applying this test for biasness and significance to the 23 country sub-groupings for which results were available at the 5-year horizon. Annex II details these results, which further support for our findings, as errors assessed for all country sub-groupings display evidence of bias and statistical significance for at least one of the two assessment methods (B or C) for both public and external DSA debt projections.

### ***Results: Statistical Tests***

42. Figure 13 depicts the average of cumulative errors across all LICs for both external and public debt ratios using both Methods B and C, within a 90 percent confidence interval. We find that external debt projections display positive cumulative errors, on average, in the direction of pessimism from the 1-year to the 3- or 4-year horizon, depending on the assessment method. However, beyond this forecast horizon, average errors inflect towards optimism. In aggregate, these cumulative errors are not significantly different from zero, as zero falls within the 90 percent confidence interval at almost all horizons. Thus, using this method, we do not find convincing evidence of bias for external debt projections.

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<sup>19</sup> The four regressions presented in Table 3 display an intercept that is close to zero, with a slope of less than 1. This suggests that projections tended to underestimate increases in the debt ratio (optimism) for negative values, while overestimating the increase (pessimism) for positive values. However, any interpretation requires caution given the relatively limited explanatory power of the regressions—i.e., the adjusted R square value is less than 0.5 in all four cases.

**Figure 13. Aggregated External and Public DSA Projection Errors (1 - 7 year horizons)**

Note: “#” refers to the number of observations on the x-axis. Observations differ slightly across analyses owing to data availability (e.g., missing data for some vintages in either external or public DSAs).  
Source: Authors’ calculations. Data: IMF DSA database.

43. In contrast, we find that public debt ratio projections exhibit significantly negative cumulative errors in the direction of optimism over most horizons. As errors are significantly different from zero from the 3- or 4-year to the 7-year horizons (depending on the assessment method), they appear to display a systematic bias towards optimism.

### Summary

44. In sum, at the aggregate level, regression analyses found a bias towards optimism for both public and external DSA debt projections, while statistical tests identified such a bias only for public DSA projections.



#### IV. SHOCKS AND UNANTICIPATED EVENTS

45. This section considers the degree to which observed errors and evidence suggesting biases towards optimism in DSA debt projections may have been influenced by unanticipated shocks. Specifically, (i) the sharp commodity price decline that began in 2012, and (ii) shocks to macroeconomic and financial variables.<sup>20</sup>

##### A. Commodity/Oil Price Shock

46. The commodity and oil price declines that began in 2012 could be a source of DSA projection optimism. Countries relying on commodity exports for external financing and growth saw revenues fall after 2012, causing debt ratios to increase more than could have been expected. Moreover, these price declines have been more prolonged than anticipated when many of the DSAs assessed were produced.

47. In order to determine whether the observed optimism in debt projections remains evident once commodity/oil price declines since 2012 are accounted for, we carry out a counterfactual experiment to determine what debt ratio would have been projected if commodity prices had been correctly anticipated. If there remains evidence of an underestimation of debt projections, the optimism in public debt ratios cannot be explained solely by this factor.<sup>21</sup> The econometric analysis uses fixed-effects panel regression analysis.<sup>22</sup>

48. The fixed-effects regressions, where countries are indexed by  $i$  and time by  $t$ , can be formulated as:

$$PD_{i,t}^p = \alpha_i + \beta P_t^p + \gamma X_{i,t}^p + \epsilon_{i,t}$$

where  $PD_{i,t}^p$  is the projected public debt ratio,  $P_t^p$  the projected commodity/oil price,  $X_{i,t}^p$  a set of control variables (filtered projected nominal GDP, filtered projected government primary expenditures and inflation), and  $\epsilon_{i,t}$  is the random error term.

#### Results

49. We run the two regressions—i.e., of the projected public debt ratio on projected commodity and oil prices—for all countries and on the subset of commodity exporters. The four regressions show a negative and significant relationship between the two variables. As expected, an increase in the commodity/oil price is associated with a significant reduction in the public debt ratio in the projections, whether we look at the entire set of LICs or only at the subset of commodity exporters. The regression table can be found in Annex IV, Table A.

<sup>20</sup> We do not consider indicators of external stresses such as advanced economy interest rates or market volatility, given that many LICs were not fully exposed to capital and financial account shocks owing to their level of market development.

<sup>21</sup> For commodities, we use the Commodity Industrial Inputs Price Index—a combination of agricultural raw materials and metals price indices. For oil, we use the average of three spot prices of crude oil—Dated Brent, West Texas Intermediate, and the Dubai Fateh. These are published in the IMF WEO twice per year. We used the April WEO publications, except in 2006, where we used the September publication because the prices were not available in the April version.

<sup>22</sup> With this strategy, we can either control for heterogeneity across countries keeping a time series of one-year projections, or control for heterogeneity across countries and vintages keeping a time series of projections made over all horizons. As projections of commodity/oil prices are available over a 2-year horizon only, the second option would reduce the horizon for our regressions drastically. Thus, we chose the first option and focused on 1-year ahead projections only.

50. Using these relationships, we perform four counterfactual experiments where we infer what the projected public debt ratio would have been if the commodity/oil price had been correctly projected, such that:

$$\widehat{PD}_{i,t}^p = \widehat{\alpha}_i + \widehat{\beta}P_t + \widehat{\gamma}X_{i,t}^p$$

where  $\widehat{PD}_{i,t}^p$  is the counterfactual projected public debt ratio,  $P_t$  is the actual commodity/oil price,  $\widehat{\alpha}_i$  denotes the fixed effects estimated in the previous regression, while  $\widehat{\beta}$  and  $\widehat{\gamma}$  denote the coefficients associated with the commodity/oil price and the controls.

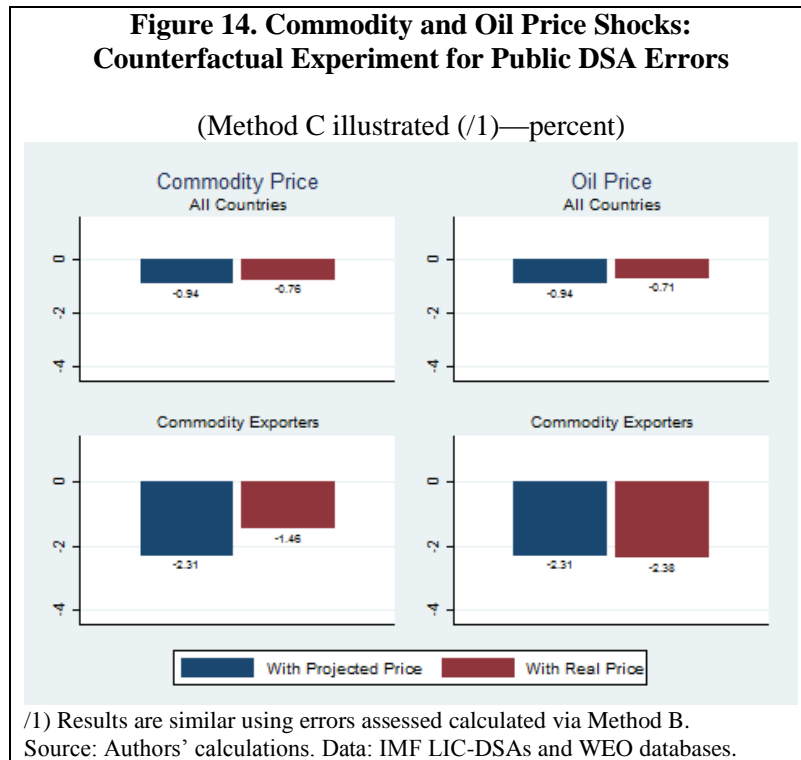
51. To simplify the derivation of the counterfactual public debt ratio, we take the difference between the two equations so that it becomes a function of the projected public debt level, the projected and actual prices, and the errors only:

$$\widehat{PD}_{i,t}^p = PD_{i,t}^p + \widehat{\beta}(P_t^p - P_t) - \widehat{\epsilon}_{i,t}$$

where  $\widehat{\epsilon}_{i,t}$  are the errors from the previous regressions.

52. With the counterfactual time series of projected public debt ratios, we are able to infer counterfactual projection errors. Figure 14 shows the projection errors resulting from the counterfactual analyses (in red) to be compared with the actual projection errors (in blue). On the left are the results of the analysis relative to the commodity price experiment—both for the entire set of countries and the subset of commodity exporters—, while results on the right are relative to the oil price experiment.

- **Commodity Price Experiment.** When the experiment is run to adjust for commodity price projections, the magnitude of errors is reduced, while remaining negative in the direction of optimism. This result suggests that optimism would have been reduced by about 20 percent for the entire set of countries, and by almost 40 percent for the subset of commodity exporters if prices had been accurately projected.
- **Oil Price Experiment.** When the same experiment is run for oil prices alone, projection errors are again dampened by 25 percent for the entire set of countries. However, errors are found to increase in magnitude by 3 percent for the subset of commodity exporters.



53. In summary, the decline in oil and commodity prices that began in 2012 did contribute to projection errors in the direction of optimism, but this factor is not sufficient to explain the full magnitude of projection errors and biases identified in previous sections.

## B. Economic and Financial Shocks

54. This sub-section shifts to a broader definition of shocks across several variables that are conceptually similar to those used for bound stress tests by external DSAs.<sup>23</sup> These comprise shocks to real GDP growth, export growth, US dollar GDP deflators, and FDI as a share of GDP, and the nominal exchange rate (depreciation).<sup>24</sup> Two approaches are used to identify and remove from the sample periods that were subject to such shocks.

### *Methods*

55. **Method 1:** Defines a shock event as a 5-year period during which at least one of the five variables described above had an extreme realization in cumulative terms.<sup>25</sup> The bottom 10 percent of the distribution of outcomes for these variables (the top 10 percent for nominal depreciation) are then identified as major shocks. The corresponding 5-year period is then excluded from an assessment of errors. This method excludes approximately one third of the dataset.

<sup>23</sup> For details see: [The Debt Sustainability Framework for Low-Income Countries: An Introduction](#)

<sup>24</sup> Note that public DSAs include a bound test simulating a one standard deviation shock to the primary fiscal balance, in addition to shocks to GDP growth, the ER, and other flows.

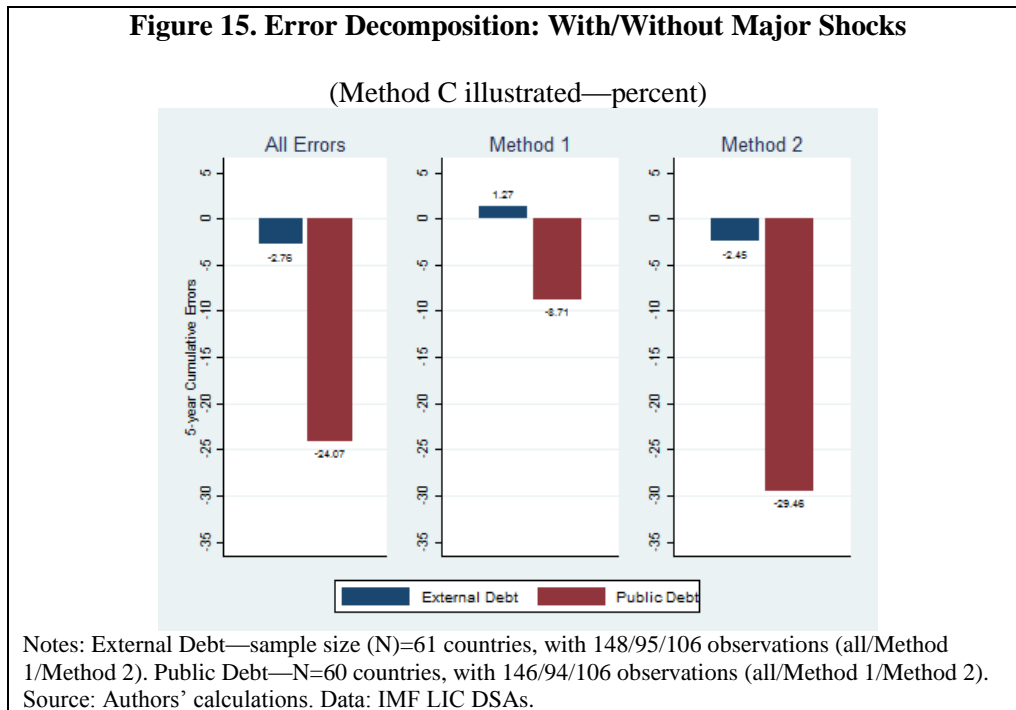
<sup>25</sup> The 5-year horizon is chosen to capture one or more consecutive shocks that together would be similar to one major shock, rather than focusing on deviations that would only have materialized over shorter horizons.

(continued...)

56. **Method 2:** Approximates more closely the notion of shocks used in external DSA bound stress tests. The definition of the nominal exchange rate depreciation shock is as defined in DSAs at 30 percent. For real GDP growth, export growth, the GDP deflator, and non-debt creating flows, shocks are defined in terms of standard deviations (SDs) below the historical mean. After several simulations, a shock magnitude of two SDs was chosen.<sup>26</sup>

### Results

57. **Method 1.** Results of this test suggest that major shocks seem to represent an important driver of the observed optimism for both public and external DSAs, although there remains evidence of optimism for public debt projections even after these events are removed from the sample of DSAs assessed (Figure 15). When errors associated with shocks identified under Method 1 are excluded, errors remain negative for public debt projections, though they diminish considerably—by about 64 percent. For external DSA projections, this exercise leads the direction of errors to invert from negative to positive (in the direction of pessimism).



58. **Method 2.** Using this method, forecast errors for external and public debt remain negative after excluding major shocks, indicating that the bias towards optimism is still present (Figure 15). For external debt, forecast errors are smaller once observations involving major shocks are removed, suggesting that forecasts produced during relatively normal periods display less optimism. However, for public DSAs, forecast errors in the direction of optimism become even more pronounced. This counterintuitive result may be driven in part by the fact that many shocks identified using this method affected fragile countries, which as described above, display positive DSA projection errors in the direction of pessimism. Thus, as fragile countries were removed, the weight of negative errors increased in the remaining sample, amplifying projection optimism.

<sup>26</sup> It was necessary to test several shock magnitudes defined in terms of SDs from the 20-year historical mean. At 2 SDs, 28 percent of the dataset would be defined as being subject to a shock, which was chosen to allow for reasonable sampling.

## V. ROLE OF OPTIMISM IN FORECAST ASSUMPTIONS

60. Fiscal performance, output growth, and external residuals were (among other variables) found to be important drivers of errors and bias for many DSA debt projections. This section assesses whether forecast assumptions for those variables are consistent with historical experience for LICs and countries at different stages of development, as well as whether all available information was incorporated when forecasts were initially produced.

### A. Government's Fiscal Reaction Function

61. An important result discussed in previous sections was optimism regarding projected fiscal deficits. In this context, we investigate the extent to which this finding could be explained by assumptions underpinning DSAs' projected fiscal reaction functions—in particular, to what extent are projections consistent with history and the experiences of other countries. Here we build on Bohn (1998), who investigated changes in fiscal policies and deficits following increases in public debt in the United States. We also reference D'Erasmus, Mendoza and Zhang (2015), which is a more recent update of Bohn's findings, as well as Mendoza and Ostry (2007), which extended this analysis to a broad group of industrialized and emerging economies.

### *Methods*

62. We use a fixed-effects panel estimation to regress the primary budget deficit on the public debt ratio, lagged by one year (i) in the outturn and (ii) in the projections, respectively, along with a set of control variables. These regressions test the degree to which the primary budget deficit is likely to react following a change in the public debt ratio. We use data on the primary budget deficit as a share of GDP, and on the public debt ratio as a share of GDP from DSAs. Both regressions use as controls filtered nominal GDP and filtered primary expenditures as a share of GDP, replicating the method most commonly employed in the literature. This also allows for a comparison of our results for LICs with other groups of countries.<sup>27</sup>

63. The regression equation can be written as follows, with  $i$  indexing the country/vintage and  $t$  time:

$$PBD_{i,t} = \alpha_i + \beta PD_{i,t-1} + \gamma X_{i,t} + \epsilon_{i,t}$$

where  $PBD_{i,t}$  is the primary budget deficit ratio,  $PD_{i,t}$  the public debt ratio,  $X_{i,t}$  the set of controls and  $\epsilon_{i,t}$  the error term.

### *Results*

64. Table 4 presents results of the analysis. Historical data, presented in column (1) yield a negative and significant coefficient of -0.02.<sup>28</sup> By contrast, for projection data, presented in column (2), the coefficient is 3 times larger and also statistically significant. Hence, DSAs and their underlying projections assume a stronger fiscal reaction than has been observed in the past

<sup>27</sup> We follow Mendoza and Ostry (2008), including the same set of controls and filtering techniques—i.e., for temporary fluctuations in government outlays and GDP, as well as the business cycle. Cyclical components are extracted by de-trending data using the Hodrick-Prescott filter with a smoothing parameter of 100.

<sup>28</sup> Thus, an increase by 1 percentage point (pp) of the public debt to GDP ratio is associated with a reduction of the primary budget deficit to GDP ratio of 0.02 points in the next period.

(continued...)

for LICs. Allowing for first-order autocorrelation, the government’s fiscal reaction is stronger in both the data and in the projections, but projections are still more optimistic.<sup>29</sup>

	Dependent Variable: Primary Budget Deficit (%GDP)			
	Fixed Effect Regressions			
	(1)	(2)	(3)	(4)
	Data	Projections	Data	Projections
Lagged Public Debt (%GDP)	<b>-0.02***</b> (-2.99)	<b>-0.06***</b> (-8.11)	<b>-0.06***</b> (-4.97)	<b>-0.09***</b> (-8.14)
Controls	Yes	Yes	Yes	Yes
AR(1)	No	No	Yes	Yes
#Countries	75	75	75	75
#Observations	724	2300	650	1840
R <sup>2</sup> within	0.08	0.30	0.11	0.24
Country(#Vintage) FE	Yes	Yes	Yes	Yes

*t* statistics in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$   
Source: Authors’ calculations. Data: IMF LIC DSAs.

65. Our coefficient on the government’s fiscal reaction for LICs is smaller in magnitude than found in the literature for other types of countries. Mendoza and Ostry (2008) found a coefficient of -0.023 for industrial countries, and of -0.035 for emerging markets using corresponding specifications. D’Erasmus, Mendoza and Zhang (2015) found a larger coefficient of -0.08 for the United States and of -0.01 for developed countries in general. Thus, the assumed fiscal reaction in DSA projections for LICs is larger in magnitude than the observed reaction function for both industrial and emerging markets, and very close in magnitude to that estimated for the United States. A robustness test repeating this analysis using the initial public debt ratio as the independent variable can be found in Annex IV, Table B, which produces similar results.

66. In sum, although historical performance regarding fiscal reactions to increasing debt levels in LICs appears in line with that of other groups of countries, LIC DSA projections show considerable optimism, not only when compared to their own historical experience, but also in contrast to more advanced economies with greater fiscal flexibility, as well as stronger institutions and capacity.

## B. The Investment-Growth Nexus

67. Another important result outlined above is that real GDP growth was often overestimated, and that the magnitude of this error is significant for some groups of LICs—e.g., those with the highest incomes. One potential explanation may lie in the projected relationship between investment and growth.

68. Similar to the analysis in the previous section, we consider whether the investment-growth nexus assumed in DSA projections is in line with relationships evident from the historical data. We follow methods used by Carkovic and Levine (2002), who assessed the relationship between

<sup>29</sup> Since first-order autocorrelation of the error term is probable given the annual time series used in the regressions, columns (3) and (4) show results adding within-group serial autocorrelation in the error terms. In this case, the AR(1) error term becomes  $\epsilon_{i,t} = \delta_i \epsilon_{i,t-1} + \mu_{i,t}$ .

GDP growth and FDI. We also draw on work that considered the impact of public investment (Warner (2014)) and private investment (Khan and Reinhart (1989)) on growth.

### **Methods**

69. Using a fixed-effects regression analysis, we regress real GDP growth on three types of investment each lagged by one year: (i) private investment, (ii) public investment, and (iii) foreign direct investment (FDI). As before, we perform this regression using data on outturns and projections, respectively, as this will allow us to compare the observed and the underlying transmission mechanism (the latter being implicit from the projections).

70. Data on private and public capital formation as a share of GDP are used as proxies for private and public investment, and sourced from WEO databases. Data on FDI as a share of GDP are taken from DSAs. Similarly, we use data on real GDP growth published in the WEO whenever the investment variable comes from this database, and from the DSA database otherwise.<sup>30</sup>

71. The regression equation can be written as follows, with  $i$  indexing the country/vintage and  $t$  time:

$$\mathbf{Growth}_{i,t} = \alpha_i + \beta \mathbf{I}_{i,t-1} + \gamma \mathbf{X}_{i,t} + \epsilon_{i,t}$$

where  $\mathbf{Growth}_{i,t}$  is real GDP growth,  $\mathbf{I}_{i,t-1}$  the investment ratio,  $\mathbf{X}_{i,t}$  the set of controls and  $\epsilon_{i,t}$  the error term.

72. Regressions for private and public investment use as other independent variables inflation and government expenditures to control for macroeconomic stability and government size, respectively. Regressions for FDI also use the sum of imports and exports as a share of GDP to control for openness, following the literature on the investment-growth relationship.<sup>31</sup>

### **Results**

73. We find evidence of optimism with respect to the growth-investment nexus in the projections that is not supported by observed relationships between these variables based on actual data. For each of the three investment variables, the impact on future growth is assumed to be positive and significant in DSA projections, whereas it is found not to be significant in the historical data (Table 5).

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<sup>30</sup> For real GDP growth, data from the latest WEO and latest DSAs are very similar. Small differences arise because the latest DSA was published before the April 2016 revisions for most countries in the dataset.

<sup>31</sup> See for example Carkovic and Levine (2002) for the impact of FDI on growth.

**Table 5. Growth – Investment Relationship**

	Dependent Variable: Real GDP Growth					
	Fixed Effect Regressions					
	(1)		(2)		(3)	
	Private		Public		Foreign Direct	
	Data	Projections	Data	Projections	Data	Projections
Lagged Investment (%GDP)	0.04 (1.47)	<b>0.20***</b> (8.75)	0.00 (0.05)	<b>0.15**</b> (2.13)	-0.04 (-1.25)	<b>0.05***</b> (2.86)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
#Countries	75	75	75	75	75	75
#Observations	1204	315	1204	315	735	2310
$R^2$ within	0.01	0.30	0.00	0.10	0.05	0.07
Country(#Vintage) FE	Yes	Yes	Yes	Yes	Yes	Yes

*t* statistics in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

74. To put these findings in perspective, overall, the evidence from the literature of the impact on growth for the three types of investment is not clear. Carkovic and Levine (2002) find that FDI does not exert a robust positive influence on growth. Firm-level studies do not find any significant impact on economic growth, while other studies find a positive impact in specific cases (e.g., in countries with a highly-educated workforce, or with developed financial markets). As for public investment, Warner (2014) finds no evidence of a positive impact on next-year growth. Kahn and Reinhart (1989) find that private investment has a larger impact on growth than public investment.

75. In summary, this analysis finds evidence of optimism in DSA projections regarding the positive implications of private and public investment on growth and other debt-related economic variables. This is evident when compared with historical performance, as well as when compared with the performance of other groups of countries assessed using comparable methods from the literature.

### C. Projected External Residuals

76. In this section, we explore the relationship between subcomponents of the balance of payments and the large external residuals identified in earlier sections as among the most important drivers of DSA projection errors and biases. As discussed above, these residuals include exceptional financing (e.g., debt relief, reserves depletion, arrears), and some financing flows not otherwise identified as an input to the DSA framework (e.g., that must be projected outside of the DSA). As a test of robustness, Annex IV illustrates similar exercises adjusting for autocorrelation (Table C), and using 5-year averages (Table D).

77. In this context, while the current account and most sub-components of the financial account (e.g., FDI, short- and long-term loans, portfolio flows, etc.) are separately projected inputs to the DSA, flows that would fall within the capital account (e.g., private transfers) are embedded with other inputs in the DSA residual.

#### *Methods*

78. To assess whether projections incorporate all available information, one can regress projection errors on the data available at the time the forecasts were developed. If the projection error is found to be significantly related to the independent variables, this would suggest that the



projection did not fully incorporate all available information and its accuracy could have been improved.

79. We use a fixed effects analysis to regress one-year errors for external residuals on subcomponents of the balance of payments, all lagged by one year (variables are expressed as a share of GDP).<sup>32</sup> Errors were computed using data from DSAs, whereas data for different BOP components were sourced from the IMF WEO (April 2016 edition).

### Results

80. Table 6 illustrates that errors are significantly related to the size of the capital account balance<sup>33</sup> from the previous period, indicating that projections did not fully incorporate related information that would have been available.

	Dep. Variable: Errors on External Residual Fixed Effect Regression (1)
Lagged Current Account (%GDP)	-0.30 (-0.75)
Lagged Capital Account (%GDP)	<b>-1.49**</b> (-2.39)
Lagged Financial Account (%GDP)	0.16 (0.65)
#Countries	60
#Observations	181
$R^2$ within	0.05
Country(#Vintage) FE	Yes

*t* statistics in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$   
Source: Authors' calculations. Data: IMF LIC DSAs.

81. This might suggest that some issues driving errors in projected residuals could be addressed via a clearer distinction in DSA templates of sources of BOP financing that would fall within the residual category, particularly for the capital account—e.g., capital transfers and the acquisition/disposal of non-produced non-financial assets. This could help to make all related assumptions more transparent, as well as support consistency between DSAs and country macroeconomic frameworks.

## D. Summary

82. We find that projected fiscal outturns, growth, and residuals are important drivers of errors. An analysis of these variables, relationships between them, and DSA debt projections following commonly-cited empirical approaches suggests: (i) optimism relative to historical and cross-country experiences with respect to the government's fiscal reaction; (ii) similar optimism with respect to the potential impact of investment (both public and private) on economic performance; and, (iii) that errors in projected external residuals are at least partly driven by a

<sup>32</sup> The errors in residuals are 1-year errors made at different horizons—in particular, the 1-year errors from year 1, year 2, year 3, etc., are included, if BOP data are available for the regression.

<sup>33</sup> See Sixth Edition of the [IMF's Balance of Payments and International Investment Position Manual \(BPM6\)](#).

failure to incorporate all available information regarding some components of the balance of payments.

## VI. CONCLUSIONS

83. This assessment of LIC DSA performance with respect to debt projections and their underlying macroeconomic assumptions finds that: (i) errors are evident, and skewed towards optimism for most DSAs assessed; (ii) the magnitude of errors tends to increase as forecast horizons extend; (iii) that the degree of optimism has increased over successive vintages for most LIC DSAs assessed; and, (iv) that there is evidence of a systematic bias towards optimism—that is most conclusive for public DSAs—that remains even after we control for major economic and other shocks. We note, however, that our analyses were limited by the fact that only a fraction of DSAs' 20-year projection horizons could be tested against outturns.

84. We also find that DSAs for certain sub-groupings of LICs display pronounced optimism when compared to other country groups. These include (but are not exclusive to) those in the two highest income quartiles, 'frontier' LICs with prospects for market access, and those at 'moderate risk' of debt distress. Countries engaged in IMF-supported adjustment programs also display greater optimism in public debt forecasts than those not under an active Fund program.

85. In terms of economic factors driving biases in DSA debt forecasts, errors for what DSAs define as projected 'residuals' (e.g., for external DSAs, exceptional financing, valuation adjustments, and components of the balance of payments, etc.), fiscal deficits, and/or output growth were significant for most LIC sub-groups considered.

86. Finally, we considered the potential causes of economic projection errors driving DSA biases, and found: (i) optimism regarding the projected pace and depth of fiscal consolidation in response to rising debt levels—i.e., fiscal reaction functions—when compared to LICs' own historical experiences, as well as those of emerging and advanced economies; (ii) optimism with respect to the expected growth dividends of investment (both public and private) when compared to past LIC experiences and those of countries at higher levels of development; and, (iii) that external debt forecasts could be improved via the incorporation of additional information that was available when the projection was undertaken.

87. Taken together, our findings suggest the need to redouble efforts to ensure that LIC DSAs and their underpinning economic projections are methodologically sound, incorporate all available information, and are guided by realistic assumptions informed by past performance and that of peer countries. Results also suggest that greater transparency and detailed presentations regarding assumptions for external financing flows (e.g., the capital account and other components of external residuals) could improve forecasts and better align DSAs with IMF country frameworks. Our research also points to the importance of caution when interpreting and leveraging the results of DSAs for policy advice regarding reforms, the design of adjustment programs, as well as decisions regarding lending—particularly for countries at 'moderate risk' of distress and frontier LICs with increasing non-concessional and non-traditional borrowing options. Future research could usefully consider whether findings remain evident over longer periods (e.g., beyond 5 years).

## Annex I. Country Sub-Categories

### A. Financing and Development Categories

Frontier LICs (14)*	Fragile States (27)	Small States (14)	Other Developing (24)
Bangladesh	Afghanistan	Cape Verde	Albania
Bolivia	Burundi	Dominica	Angola
Cote d'Ivoire	Central African Rep.	Grenada	Armenia
Ghana	Chad	Guyana	Benin
Kenya	Comoros	Maldives	Bhutan
Mongolia	Congo Democratic Rep.	Marshall Islands	Burkina Faso
Mozambique	Congo Rep.	Micronesia	Cambodia
Nigeria	Djibouti	Samoa	Cameroon
Papua New Guinea	Eritrea	St Lucia	Ethiopia
Senegal	Guinea	St Vincent	Gambia
Tanzania	Guinea-Bissau	Timor Leste***	Georgia
Uganda	Haiti	Tonga	Honduras
Vietnam	Kiribati	Tuvalu	Kyrgyz Rep.
Zambia	Liberia***	Vanuatu	Lao PDR
	Madagascar		Lesotho
	Malawi		Mauritania
	Mali		Moldova
	Myanmar		Nepal
	Sao Tome and Principe		Nicaragua
	Sierra Leone		Niger
	Solomon Islands		Rwanda
	Somalia**		Sri Lanka
	South Sudan**		Tajikistan
	Sudan		Uzbekistan
	Togo		
	Yemen Rep.		
	Zimbabwe		

**Notes:** \*\* Not in the DSA dataset; \*\*\*Outliers (excluded from the analysis)

#### Definitions:

- **\*Frontier LICs:** List reflects countries identified as Frontier LICs by IMF (2014); “Macroeconomic Developments in Low-Income Developing Countries: 2014 Report”; Washington, D.C.
- **Fragile States:** countries where (i) institutional capacity is weak, measured by a three-year average Country Policy and Institutional Assessment (CPIA) score below 3.2, and/or (ii) there has been/is significant internal conflict.
- **Small States:** countries eligible for PRGT resources because of vulnerabilities associated with their small size despite having per capita incomes above the more generally applied thresholds for PRGT eligibility. Specifically, these are countries with a population of less than 1.5 million and a per capita income above the IDA cutoff of \$2,390 in 2013.
- **Developing Markets:** are all LIDCs that are neither fragile nor frontier economies.

**B. Export Composition**

<b>Commodity Exporters (27)</b>	<b>Diversified Exporters (33)</b>	<b>Other (19)</b>
Afghanistan	Bangladesh	Albania
Bolivia	Benin	Angola
Burkina Faso	Bhutan	Armenia
Burundi	Cambodia	Cape Verde
Central African Rep.	Cameroon	Dominica
Chad	Comoros	Georgia
Congo Democratic Rep.	Cote d'Ivoire	Grenada
Congo Republic	Djibouti	Guyana
Eritrea	Ethiopia	Maldives
Guinea	Gambia	Marshall Islands
Guinea-Bissau	Ghana	Micronesia
Malawi	Haiti	Samoa
Mali	Honduras	Sri Lanka
Mauritania	Kenya	St Lucia
Mongolia	Kiribati	St Vincent
Mozambique	Kyrgyz Rep.	Timor Leste**
Niger	Lao PDR	Tonga
Nigeria	Lesotho	Tuvalu
Papua New Guinea	Liberia**	Vanuatu
Sierra Leone	Madagascar	
Solomon Islands	Moldova	
South Sudan*	Myanmar	
Sudan	Nepal	
Uzbekistan	Nicaragua	
Yemen Rep.	Rwanda	
Zambia	Sao Tome and Principe	
Zimbabwe	Senegal	
	Somalia*	
	Tajikistan	
	Tanzania	
	Togo	
	Uganda	
	Vietnam	

**Notes:** \* Not in the DSA dataset; \*\*Outliers (excluded from the analysis)

**Definitions:**

- **Commodity Exporters:** countries where at least 50 percent of export earnings come from fuels and primary commodities.
- **Diversified Exporters:** are LIDCs that do not belong to the commodity exporter group.
- **Other:** Small States and graduated LICs are excluded from the two categories.

## Annex II. Significance Tests for Country Sub-Grouping Error Results

Tables A and B (below) present tests for biasness and the significance of results for 23 of the country sub-groupings presented above, for both Methods B and C. This replicates the assessment undertaken in Section III.G for overall errors at the aggregate level. As above, this involves regressing outturns on the previous year's projections. According to the literature, if projections are biased, the joint test requiring the regression constant to be zero and the coefficient of the projection to be one would be rejected (Timmerman (2006)).

Formally, if projections are unbiased, actual outturns should be explained one-for-one by projections, and the intercept for the regression  $\beta_0$  should be equal to zero, while the slope  $\beta_1$  should be equal to one.

$$D_{i,t} = \beta_0 + \beta_1 D_{i,t}^p + \epsilon_{i,t}$$

Where  $D_{i,t}$  is the actual debt ratio in growth terms,  $D_{i,t}^p$  the debt ratio projected one year earlier in growth terms, and  $\epsilon_{i,t}$  the error term.

In terms of results, errors can be considered significant if the joint test rejects the hypothesis. In particular, the p-value of the test indicates the probability with which one might be incorrect when rejecting the hypothesis. Hence, a smaller p-value implies that errors are significant. For subgroupings composed of relatively limited observations (i.e., because there are very few qualifying countries), test results are more difficult to interpret. In this context, a larger p-value can either mean that: (i) the null hypothesis cannot be rejected with confidence, or (ii) that the sample size is not large enough to accurately test the hypothesis.

When results for both Methods B and C are taken together, they support our findings. Error results for all country sub-groupings display evidence of significance for at least one of the two error assessment methods (B or C) for both public and external DSA debt projections. As expected, sub-groups composed of fewer qualifying countries and observations displayed greater ambiguity in terms of results—e.g., frontier LICs, small states, and those with ‘strong’ CPIA scores with between 39 and 68 observations. Note that other country sub-groupings displayed as many as 200+ observations. Specifically:

- **Method B:** The null hypothesis can be rejected across all 23 sub-groupings with a p-value of up to 12 percent (0.12). P-values are at or below this threshold for 21/23 sub-groupings, with the exception of frontier LICs and small states in the ‘Financing and Development’ category—where the number of observations are relatively small (61 and 39, respectively).
- **Method C:** The null hypothesis can be rejected across all sub-groupings with a p-value of up to 10 percent (0.10). P-values are at or below this threshold for 22/23 sub-groupings, with the exception of countries classified as displaying ‘strong’ CPIA scores—where the number of observations is relatively small (68).

Table A. Significance Tests across Subgroupings – Method B

Category	Variable	Regression Tests of Bias			N	$R^2$	p-value
		Horizon	$\beta_0$	$\beta_1$			
Financing and Development Category							
Frontier	External Debt (%GDP)	1-year	2.55* (1.76)	0.94*** (4.54)	61	0.25	0.22
	Public Debt (%GDP)	1-year	0.44 (0.65)	0.86*** (7.91)	61	0.51	0.43
Small States	External Debt (%GDP)	1-year	0.84 (0.65)	0.50*** (2.75)	40	0.14	<b>0.03</b>
	Public Debt (%GDP)	1-year	0.93 (0.52)	0.77*** (3.42)	39	0.22	0.59
Fragile	External Debt (%GDP)	1-year	-2.78*** (-2.73)	0.71*** (11.07)	100	0.55	<b>0.00</b>
	Public Debt (%GDP)	1-year	-1.51 (-1.32)	0.78*** (11.67)	97	0.58	<b>0.01</b>
Other Developing	External Debt (%GDP)	1-year	0.68 (1.34)	0.40*** (5.48)	137	0.18	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.48 (1.02)	0.39*** (6.06)	136	0.21	<b>0.00</b>
Risk of Debt Distress							
Low Risk	External Debt (%GDP)	1-year	1.56** (2.21)	0.67*** (6.08)	110	0.25	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.66 (0.87)	0.69*** (4.71)	107	0.17	0.11
Moderate Risk	External Debt (%GDP)	1-year	0.50 (0.62)	0.67*** (8.23)	124	0.35	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.64 (1.04)	0.64*** (11.29)	124	0.51	<b>0.00</b>
High Risk	External Debt (%GDP)	1-year	-1.35 (-1.14)	0.74*** (8.79)	74	0.51	<b>0.01</b>
	Public Debt (%GDP)	1-year	-0.64 (-0.50)	0.80*** (9.80)	73	0.57	<b>0.06</b>
In Distress	External Debt (%GDP)	1-year	-5.92*** (-3.81)	0.57*** (5.58)	26	0.55	<b>0.00</b>
	Public Debt (%GDP)	1-year	-4.44*** (-2.84)	0.70*** (6.53)	26	0.62	<b>0.01</b>
CPIA-Based Policy Strength							
Strong	External Debt (%GDP)	1-year	0.88 (1.16)	0.60*** (5.11)	72	0.26	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.78 (0.78)	0.70*** (5.68)	71	0.31	<b>0.05</b>
Medium	External Debt (%GDP)	1-year	1.36* (1.85)	0.45*** (4.38)	138	0.12	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.68 (1.45)	0.36*** (5.22)	136	0.16	<b>0.00</b>
Weak	External Debt (%GDP)	1-year	-1.74** (-1.98)	0.74*** (12.25)	128	0.54	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.71 (-0.79)	0.80*** (13.66)	126	0.60	<b>0.00</b>

Category	Variable	Horizon	$\beta_0$	$\beta_1$	$N$	$\bar{R}^2$	p-value
Position in Income Distribution (Quartiles)							
Highest	External Debt (%GDP)	1-year	1.30 (0.80)	0.56*** (3.11)	50	0.15	<b>0.06</b>
	Public Debt (%GDP)	1-year	1.56 (1.04)	0.63*** (4.15)	49	0.25	<b>0.06</b>
Middle-High	External Debt (%GDP)	1-year	1.70 (1.62)	0.59*** (5.89)	87	0.28	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.69 (0.87)	0.56*** (8.20)	87	0.44	<b>0.00</b>
Middle-Low	External Debt (%GDP)	1-year	-0.71 (-1.18)	0.37*** (3.86)	93	0.13	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.72 (-1.33)	0.63*** (6.10)	91	0.29	<b>0.00</b>
Lowest	External Debt (%GDP)	1-year	-1.77* (-1.74)	0.81*** (11.93)	86	0.62	<b>0.01</b>
	Public Debt (%GDP)	1-year	-0.68 (-0.60)	0.85*** (11.90)	85	0.63	0.12
Commodity Exporters							
Comm. Exp.	External Debt (%GDP)	1-year	0.03 (0.03)	0.72*** (9.45)	128	0.41	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.07 (-0.08)	0.77*** (13.01)	126	0.57	<b>0.00</b>
Other Countries	External Debt (%GDP)	1-year	-0.10 (-0.23)	0.66*** (11.90)	210	0.40	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.02 (-0.03)	0.68*** (11.46)	207	0.39	<b>0.00</b>
HIPC Status							
Other Countries	External Debt (%GDP)	1-year	-0.06 (-0.10)	0.67*** (8.45)	177	0.29	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.54 (-1.03)	0.73*** (12.32)	172	0.47	<b>0.00</b>
HIPC Post-CP	External Debt (%GDP)	1-year	-0.00 (-0.00)	0.71*** (12.74)	161	0.50	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.50 (0.69)	0.75*** (13.28)	161	0.52	<b>0.00</b>
IMF Arrangement							
W/O IMF Program	External Debt (%GDP)	1-year	0.58 (0.90)	0.57*** (6.40)	186	0.18	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.15 (0.28)	0.65*** (8.87)	181	0.30	<b>0.00</b>
With IMF Program	External Debt (%GDP)	1-year	-0.56 (-0.76)	0.73*** (13.32)	152	0.54	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.13 (-0.17)	0.76*** (14.32)	152	0.57	<b>0.00</b>
Projection Years							
2007/2008	External Debt (%GDP)	1-year	-1.92* (-1.83)	0.63*** (6.95)	65	0.43	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.99 (-0.86)	0.65*** (7.95)	63	0.50	<b>0.00</b>
2009/2010	External Debt (%GDP)	1-year	-0.81 (-0.73)	0.68*** (8.51)	95	0.43	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.70 (-0.61)	0.73*** (9.23)	95	0.47	<b>0.00</b>

*t* statistics in parentheses. The p-value is from the F-test.

Bold indicates rejection of unbiasedness at the 10 percent level or better.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

**Table B. Significance Tests across Subgroupings – Method C**

Category	Variable	Regression Tests of Bias			$N$	$\bar{R}^2$	p-value
		Horizon	$\beta_0$	$\beta_1$			
Financing and Development Category							
Frontier	External Debt (%GDP)	1-year	5.74** (2.11)	0.60*** (3.23)	61	0.14	<b>0.03</b>
	Public Debt (%GDP)	1-year	2.78 (1.54)	0.75*** (5.80)	61	0.35	<b>0.09</b>
Small States	External Debt (%GDP)	1-year	0.69 (0.48)	0.45*** (4.47)	37	0.34	<b>0.00</b>
	Public Debt (%GDP)	1-year	1.12 (1.09)	0.62*** (7.18)	37	0.58	<b>0.00</b>
Fragile	External Debt (%GDP)	1-year	-4.77** (-2.59)	0.59*** (7.66)	99	0.37	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.82 (-0.39)	0.65*** (6.57)	96	0.31	<b>0.00</b>
Other Developing	External Debt (%GDP)	1-year	2.55 (1.62)	0.53*** (5.21)	133	0.17	<b>0.00</b>
	Public Debt (%GDP)	1-year	2.07 (1.44)	0.62*** (6.42)	134	0.23	<b>0.00</b>
Risk of Debt Distress							
Low Risk	External Debt (%GDP)	1-year	4.31** (2.55)	0.49*** (4.40)	106	0.15	<b>0.00</b>
	Public Debt (%GDP)	1-year	3.00** (2.01)	0.46*** (4.52)	105	0.16	<b>0.00</b>
Moderate Risk	External Debt (%GDP)	1-year	0.78 (0.43)	0.71*** (7.43)	120	0.31	<b>0.01</b>
	Public Debt (%GDP)	1-year	3.18** (2.06)	0.86*** (9.14)	121	0.41	<b>0.04</b>
High Risk	External Debt (%GDP)	1-year	-3.19 (-1.54)	0.50*** (5.30)	74	0.27	<b>0.00</b>
	Public Debt (%GDP)	1-year	-1.11 (-0.53)	0.57*** (5.38)	73	0.28	<b>0.00</b>
In Distress	External Debt (%GDP)	1-year	-5.08*** (-3.51)	0.62*** (7.35)	26	0.68	<b>0.00</b>
	Public Debt (%GDP)	1-year	-4.01** (-2.60)	0.67*** (6.51)	26	0.62	<b>0.00</b>
CPIA-Based Policy Strength							
Strong	External Debt (%GDP)	1-year	1.38 (1.09)	0.60*** (6.57)	69	0.38	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.44 (0.38)	0.86*** (8.96)	68	0.54	0.33
Medium	External Debt (%GDP)	1-year	2.85* (1.66)	0.52*** (4.70)	133	0.14	<b>0.00</b>
	Public Debt (%GDP)	1-year	2.41 (1.61)	0.60*** (5.72)	135	0.19	<b>0.00</b>
Weak	External Debt (%GDP)	1-year	-1.99 (-1.16)	0.62*** (8.12)	128	0.34	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.20 (0.12)	0.67*** (8.36)	125	0.36	<b>0.00</b>



Category	Variable	Horizon	$\beta_0$	$\beta_1$	$N$	$\bar{R}^2$	p-value
<b>Position in Income Distribution (Quartiles)</b>							
Highest	External Debt (%GDP)	1-year	2.87 (1.18)	0.24* (1.92)	47	0.06	<b>0.00</b>
	Public Debt (%GDP)	1-year	3.90* (1.79)	0.33** (2.50)	47	0.10	<b>0.00</b>
Middle-High	External Debt (%GDP)	1-year	3.79* (1.72)	0.60*** (4.57)	82	0.20	<b>0.00</b>
	Public Debt (%GDP)	1-year	2.26 (1.49)	0.71*** (8.27)	85	0.45	<b>0.00</b>
Middle-Low	External Debt (%GDP)	1-year	0.49 (0.32)	0.49*** (4.49)	93	0.17	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.35 (0.19)	0.68*** (4.80)	90	0.20	<b>0.09</b>
Lowest	External Debt (%GDP)	1-year	-2.35 (-1.06)	0.75*** (7.92)	86	0.42	<b>0.02</b>
	Public Debt (%GDP)	1-year	0.71 (0.36)	0.76*** (7.42)	85	0.39	<b>0.06</b>
<b>Commodity Exporters</b>							
Commodity Exporters	External Debt (%GDP)	1-year	1.20 (0.59)	0.65*** (6.58)	127	0.25	<b>0.00</b>
	Public Debt (%GDP)	1-year	1.94 (1.21)	0.67*** (8.06)	125	0.34	<b>0.00</b>
Other Countries	External Debt (%GDP)	1-year	0.20 (0.21)	0.57*** (9.64)	203	0.31	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.81 (0.79)	0.69*** (9.74)	203	0.32	<b>0.00</b>
<b>HIPC Status</b>							
Other Countries	External Debt (%GDP)	1-year	0.27 (0.24)	0.59*** (7.70)	169	0.26	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.01 (-0.01)	0.71*** (12.65)	168	0.49	<b>0.00</b>
HIPC Post-CP	External Debt (%GDP)	1-year	0.84 (0.51)	0.61*** (7.98)	161	0.28	<b>0.00</b>
	Public Debt (%GDP)	1-year	2.56 (1.62)	0.66*** (7.55)	160	0.26	<b>0.00</b>
<b>IMF Arrangement</b>							
W/O IMF Program	External Debt (%GDP)	1-year	1.75 (1.38)	0.52*** (6.03)	180	0.17	<b>0.00</b>
	Public Debt (%GDP)	1-year	0.83 (0.89)	0.62*** (9.37)	178	0.33	<b>0.00</b>
With IMF Program	External Debt (%GDP)	1-year	-0.43 (-0.27)	0.64*** (8.78)	150	0.34	<b>0.00</b>
	Public Debt (%GDP)	1-year	2.08 (1.29)	0.72*** (8.57)	150	0.33	<b>0.00</b>
<b>Projection Years</b>							
2007/2008	External Debt (%GDP)	1-year	-3.83* (-1.87)	0.35*** (3.11)	62	0.12	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.22 (-0.07)	0.54*** (3.15)	61	0.13	<b>0.01</b>
2009/2010	External Debt (%GDP)	1-year	-0.61 (-0.26)	0.57*** (5.58)	91	0.25	<b>0.00</b>
	Public Debt (%GDP)	1-year	-0.12 (-0.07)	0.66*** (8.25)	93	0.42	<b>0.00</b>

$t$  statistics in parentheses. The p-value is from the F-test.

Bold indicates rejection of unbiasedness at the 10 percent level or better.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

### Annex III. Projection Error Decomposition by Component Adjusted for Missing Input Data

Figures below provide revised error decompositions and overall results for both Methods B and C at the 5-year horizon, with the sample adjusted to remove the 14 observations where data for one or more input component was missing from the dataset. As noted above, these missing data for input components did not affect results for overall debt-to-GDP ratio projection errors presented in Section III. Similarly, results netting out such observations do not appreciably alter relative rankings or broader findings presented above.

#### A. Decomposition of External DSA Forecast Errors (5-year horizon)

<b>Adjusted difference between projected and outturn (percentage points; "Method B")</b>									
External Debt / Method B (pp)	Projection Component	Current Account Deficit	Foreign Direct Investment	Interest Rate	Growth	Exchange Rate	Except. Financing	Residual	Overall Error
<i>1. Financing and Development Category</i>	Frontier	-16.75	13.95	1.21	0.76	2.72	2.83	-33.98	-29.26
	Small States	30.08	-15.76	2.15	-4.22	-2.08	-6.94	-16.42	-13.20
	Fragile	3.68	-1.38	2.13	-3.48	-0.32	1.73	11.12	13.50
	Other Developing	-2.13	6.46	1.49	0.76	1.62	-2.19	-8.40	-2.39
<i>2. Risk of Debt Distress</i>	Low Risk	-7.45	11.58	0.82	0.59	0.74	0.06	-16.77	-10.43
	Moderate Risk	-8.30	4.16	0.88	0.63	2.16	-3.70	-5.85	-10.02
	High Risk	21.83	-7.88	1.56	-2.25	1.22	-2.62	-3.99	7.87
	In Distress	-1.99	5.72	6.62	-8.88	-5.53	10.57	26.34	32.84
<i>3. CPIA-Based Policy Strength</i>	Strong	4.49	-6.62	0.56	-1.73	1.51	1.36	-7.07	-7.51
	Medium	-2.94	10.08	1.26	0.52	0.80	-1.47	-16.72	-8.47
	Weak	3.45	-1.54	2.67	-2.83	0.37	-0.18	7.59	9.56
<i>4. Position in Income Distribution (Quartiles)</i>	Highest	10.73	-2.89	1.73	-3.23	-1.76	-6.12	-16.43	-17.97
	Middle-High	8.42	3.38	1.48	-0.20	2.41	-4.03	-23.49	-12.02
	Middle-Low	-3.05	1.18	1.67	-1.32	0.98	6.82	0.30	6.58
	Lowest	-6.74	7.10	2.28	-1.26	-0.56	-3.93	11.36	8.26
<i>5. Commodity Exporters</i>	Com. Exporters	-9.12	10.21	2.54	-1.15	0.04	0.48	-4.41	-1.41
	Other Countries	8.27	-2.98	1.17	-1.31	1.23	-1.20	-5.34	-0.16
<i>6. HIPC Status</i>	Other Countries	2.25	-2.17	2.80	-2.21	0.78	3.00	-3.41	1.05
	HIPC Post-CP	-0.60	7.94	0.58	-0.17	0.66	-4.39	-6.66	-2.63
<i>7. IMF Arrangement</i>	W/O IMF Program	-2.47	1.03	1.92	-1.41	0.87	3.10	-7.20	-4.15
	With IMF Program	3.53	3.83	1.62	-1.11	0.61	-3.28	-3.19	2.00
<i>8. Projection Years</i>	2007/2008	-0.29	0.38	0.39	-1.60	1.18	-1.79	-0.20	-1.92
	2009/2010	2.60	6.31	2.38	-0.91	-0.19	0.46	-10.42	0.23

Legend: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).

Source: Authors' calculations. Data: IMF DSA Database.

**Percentage difference between projected and outturn (percent; “Method C”)**

External Debt / Method C (percent)	Projection Component	Current Account Deficit	Foreign Direct Investment	Interest Rate	Growth	Exchange Rate	Except. Financing	Residual	Overall Error
1. Financing and Development Category	Frontier	-62.74	48.54	2.30	8.06	9.90	4.39	-99.61	-89.16
	Small States	59.02	-27.63	2.90	-6.10	1.98	-21.50	-32.31	-23.64
	Fragile	49.12	-5.48	2.51	-3.60	2.53	7.59	-22.46	30.21
	Other Developing	36.29	-3.92	2.25	-0.55	3.35	-1.60	-34.72	1.10
2. Risk of Debt Distress	Low Risk	9.36	20.46	1.46	0.46	4.91	0.79	-67.09	-29.64
	Moderate Risk	-16.55	2.41	1.78	2.23	4.78	-3.04	-10.82	-19.22
	High Risk	122.33	-22.30	3.12	-5.14	2.22	-0.38	-66.46	33.40
	In Distress	-8.37	9.85	3.70	-3.08	0.22	11.38	20.76	34.47
3. CPIA-Based Policy Strength	Strong	-3.20	-6.56	-1.29	-1.85	5.43	3.38	-12.02	-16.11
	Medium	24.03	11.79	2.94	0.14	2.85	0.47	-59.85	-17.63
	Weak	48.58	-8.68	3.23	-1.91	4.06	0.29	-26.83	18.74
4. Position in Income Distribution (Quartiles)	Highest	18.18	0.79	2.59	-4.74	1.77	-16.84	-41.98	-40.23
	Middle-High	93.05	6.12	2.31	2.15	7.64	-4.83	-126.65	-20.21
	Middle-Low	5.44	-0.47	2.08	-1.23	1.51	13.27	-11.27	9.32
	Lowest	11.04	-3.07	3.03	-1.72	2.98	-2.12	6.86	17.01
5. Commodity Exporters	Com. Exporters	12.26	15.94	3.39	1.42	5.43	1.53	-52.68	-12.72
	Other Countries	43.22	-11.07	1.71	-2.80	2.59	0.35	-28.00	6.01
6. HIPC Status	Other Countries	36.08	-8.93	3.46	-0.95	4.83	3.34	-42.48	-4.66
	HIPC Post-CP	24.13	10.03	1.27	-1.15	2.61	-1.88	-33.65	1.38
7. IMF Arrangement	W/O IMF Program	32.38	-2.45	1.80	0.03	7.00	1.58	-53.25	-12.90
	With IMF Program	28.84	2.11	2.86	-1.86	1.33	0.29	-26.96	6.61
8. Projection Years	2007/2008	15.83	-1.75	0.93	-0.70	5.64	-2.08	-25.92	-8.05
	2009/2010	45.08	4.96	3.39	-1.21	1.51	2.73	-53.73	2.73

Legend: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).  
Source: Authors' calculations. Data: IMF DSA Database.

**B. Decomposition of Public DSA Forecast Errors (5-year horizon)**

**Adjusted difference between projected and outturn (percentage points; “Method B”)**

Public Debt / Method B (pp)	Projection Component	Primary Balance Deficit	Interest Rate	Growth	Exchange Rate	Other Debt Flows	Residual	Overall Error
1. Financing and Development Category	Frontier	-4.93	2.73	-2.30	0.14	4.27	-10.11	-10.19
	Small States	-8.21	1.54	-4.91	-2.41	0.77	-0.94	-14.17
	Fragile	1.58	3.72	-3.37	-2.32	11.89	-9.19	2.32
	Other Developing	-0.23	1.04	-0.47	-0.83	1.22	-4.89	-4.17
2. Risk of Debt Distress	Low Risk	-2.83	1.19	-0.95	-0.54	0.04	-4.25	-7.35
	Moderate Risk	-2.61	1.21	-1.07	-0.49	-0.53	-7.75	-11.25
	High Risk	0.29	2.01	-1.58	-0.49	6.58	-7.72	-0.91
	In Distress	9.44	8.21	-8.26	-8.04	30.18	-6.76	24.77
3. CPIA-Based Policy Strength	Strong	-3.36	1.10	-3.21	-1.34	-1.07	-1.15	-9.04
	Medium	-0.94	1.24	-0.78	-0.80	1.13	-5.21	-5.35
	Weak	0.12	3.70	-3.05	-1.95	12.04	-10.39	0.47
4. Position in Income Distribution (Quartiles)	Highest	-17.29	1.66	-2.55	-1.11	-1.22	-8.30	-28.82
	Middle-High	1.59	0.95	-2.53	-0.59	0.97	-8.42	-8.03
	Middle-Low	2.16	1.03	-2.09	-1.32	6.82	-2.71	3.88
	Lowest	1.83	5.76	-1.96	-3.19	10.98	-10.30	3.11
5. Commodity Exporters	Com. Exporters	0.46	3.31	-2.93	-2.45	7.32	-10.15	-4.44
	Other Countries	-1.81	1.51	-1.54	-0.61	4.01	-4.36	-2.80
6. HIPC Status	Other Countries	0.77	2.71	-3.16	-1.58	10.06	-7.64	1.16
	HIPC Post-CP	-2.61	1.78	-1.02	-1.15	0.43	-5.83	-8.40
7. IMF Arrangement	W/O IMF Program	2.93	1.40	-3.06	-0.85	9.93	-9.53	0.82
	With IMF Program	-3.64	2.88	-1.43	-1.75	2.07	-4.74	-6.61
8. Projection Years	2007/2008	-2.06	2.48	-2.05	-1.51	5.52	-6.31	-3.92
	2009/2010	-0.26	2.14	-2.11	-1.39	4.68	-6.49	-3.41

Legend: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).  
Source: Authors' calculations. Data: IMF DSA Database.

**Percentage difference between projected and outturn (percent; “Method C”)**

Public Debt / Method C (percent)	Projection Component	Primary Balance Deficit	Interest Rate	Growth	Exchange Rate	Other Debt Flows	Residual	Overall Error
<b>1. Financing and Development Category</b>	Frontier	-17.67	6.16	2.71	-0.01	5.16	-26.76	-30.40
	Small States	-21.78	1.38	-4.56	-1.95	0.39	-2.86	-29.38
	Fragile	2.42	3.81	-2.47	-0.58	19.09	-21.09	1.18
	Other Developing	-0.22	3.11	0.11	-2.29	8.83	-19.69	-10.15
<b>2. Risk of Debt Distress</b>	Low Risk	-9.14	3.54	-0.66	-1.17	0.07	-16.21	-23.57
	Moderate Risk	-11.01	2.26	1.96	-0.47	8.83	-25.76	-24.19
	High Risk	9.07	3.51	-3.39	-1.24	18.67	-20.42	6.20
	In Distress	7.35	7.64	-1.58	-4.99	25.83	-11.34	22.92
<b>3. CPIA-Based Policy Strength</b>	Strong	-12.56	2.13	0.09	-2.44	-0.59	-10.23	-23.61
	Medium	-2.91	3.62	-0.19	-2.18	8.68	-20.34	-13.33
	Weak	-0.66	4.13	-1.92	-0.12	18.19	-22.35	-2.74
<b>4. Position in Income Distribution (Quartiles)</b>	Highest	-46.14	2.70	-1.52	0.46	-3.55	-18.09	-66.14
	Middle-High	3.34	3.30	-0.60	-0.97	8.17	-27.57	-14.34
	Middle-Low	0.98	3.83	-1.34	-3.41	11.31	-9.13	2.24
	Lowest	6.16	5.14	-0.33	-1.57	21.39	-27.85	2.93
<b>5. Commodity Exporters</b>	Com. Exporters	-2.39	4.80	-0.62	-1.19	6.17	-20.63	-13.86
	Other Countries	-4.17	2.76	-1.05	-1.48	14.85	-18.95	-8.04
<b>6. HIPC Status</b>	Other Countries	-0.46	3.77	-1.71	-0.41	14.05	-19.13	-3.90
	HIPC Post-CP	-6.59	3.44	0.01	-2.36	8.31	-20.19	-17.37
<b>7. IMF Arrangement</b>	W/O IMF Program	4.83	1.79	-1.23	0.73	12.85	-23.59	-4.62
	With IMF Program	-9.60	4.96	-0.61	-2.91	10.08	-16.70	-14.78
<b>8. Projection Years</b>	2007/2008	-5.75	4.05	-0.21	-1.01	12.10	-19.31	-10.13
	2009/2010	-2.79	3.44	-1.06	-1.37	10.35	-19.60	-11.03

Legend: Green font = (+) / Red font = (-). Color coded for relative intensity (Red = lowest / Green = highest).

Source: Authors' calculations. Data: IMF DSA Database.

## Annex IV. Regressions and Robustness Checks

### A. Commodity/Oil Price Regressions

Table A shows the regression analyses used in the counterfactual experiments for the commodity/oil price shocks, both for the set of all countries and the subset of commodity exporters. Using fixed effects regressions, the projected public debt ratio and the projected commodity/oil price exhibit a negative and significant relationship in all four cases.

Dependent Variable: Public Debt (%GDP)				
Fixed Effect Regressions				
	Commodity Price		Oil Price	
	(1)	(2)	(3)	(4)
	All Countries	Comm. Exp.	All Countries	Comm. Exp.
Price (%GDP)	<b>-0.08**</b>	<b>-0.18*</b>	<b>-0.17***</b>	<b>-0.36***</b>
	(-2.26)	(-1.81)	(-3.03)	(-2.72)
Controls	Yes	Yes	Yes	Yes
#Countries	50	50	404	151
#Observations	404	151	404	151
$R^2$ within	0.06	0.09	0.07	0.14
Country(#Vintage) FE	Yes	Yes	Yes	Yes

*t* statistics in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

Controls used are: (i) inflation, (ii) filtered primary expenditures, and (iii) filtered nominal GDP. We used the Hodrick-Prescott filter with a smoothing parameter of 100, following the literature on debt sustainability.

### B. Deficit – Debt Stock Relationship

Table B shows the analysis of the government's fiscal reaction function, but using an alternative independent variable—the initial public debt ratio, following Bohn (2008) and D'Erasmus, Mendoza and Zhang (2015).

This ratio is computed as the ratio of last year's debt stock (reported as the debt stock at the end of the year) over current nominal GDP. Controls used are the same as in the main analysis. Results are similar: without the autocorrelation coefficient, projections are more optimistic for the government's fiscal reaction (i.e., consolidation) compared to the data, while being less optimistic than in the benchmark case. With the autocorrelation coefficient, projections are more optimistic compared to the data as well, while displaying more optimism than in the benchmark case.

**Table B. Deficit vs. Initial Debt Stock Relationship**

	Dependent Variable: Primary Budget Deficit (%GDP)			
	Fixed Effect Regressions			
	(1)	(2)	(3)	(4)
	Data	Projections	Data	Projections
Initial Public Debt (%GDP)	<b>-0.02**</b> (-2.20)	<b>-0.05***</b> (-7.12)	<b>-0.07***</b> (-4.49)	<b>-0.1***</b> (-8.75)
Controls	Yes	Yes	Yes	Yes
AR(1)	No	No	Yes	Yes
<i>N</i>	724	2300	650	1840
<i>R</i> <sup>2</sup> within	0.07	0.29	0.10	0.25
<i>R</i> <sup>2</sup> between	0.02	0.00	0.01	0.01
<i>R</i> <sup>2</sup> overall	0.05	0.03	0.05	0.00
Country(#Vintage) FE	Yes	Yes	Yes	Yes

*t* statistics in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

### C. Investment-Growth Relationship

Table C shows the analysis of the investment-growth relationship using alternative autocorrelation coefficients. The controls used are the same as in the main analysis.

Results are similar for private investment, with projections displaying greater optimism than the historical experience. However, the relationship between investment and growth is not significant for public investment and FDI, both in the data and in the projections.

**Table C. Investment – Growth with Alternative Autocorrelation Coefficients**

	Dependent Variable: Real GDP Growth					
	Fixed Effect Regressions					
	(1)	(2)	(3)	(4)	(5)	(6)
	Private		Public		Foreign Direct	
	Data	Projections	Data	Projections	Data	Projections
Lagged Investment (%GDP)	0.01 (0.40)	<b>0.47***</b> (7.84)	-0.02 (-0.44)	0.19 (1.34)	-0.02 (-0.64)	0.02 (0.80)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)	Yes	Yes	Yes	Yes	Yes	Yes
#Countries	75	75	75	75	75	75
#Observations	1141	252	1141	252	660	1848
<i>R</i> <sup>2</sup> within	0.01	0.41	0.01	0.24	0.03	0.09
Country(#Vintage) FE	Yes	Yes	Yes	Yes	Yes	Yes

*t* statistics in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

Table D shows the analysis of investment-growth relationship using a different method, following Carkovic and Levine (2002). Both the dependent and independent variables are averaged over 5-year

periods. The periods considered are 2006-2010, 2011-2015, 2016-2020, 2021-2025, 2025-2030 (when available) for the data and the projections. The controls used are the same as in the main analysis.

Results are similar for private investment and FDI, where projections are more optimistic than the historical experience. However, the relationship between investment and growth is not significant for public investment, both in the data and in the projections.

**Table D. Investment – Growth Relationship with 5-year Buckets**

Dependent Variable: Real GDP Growth						
Fixed Effect Regressions over 5-year buckets						
	(1)	(2)	(3)	(4)	(5)	(6)
	Private		Public		Foreign Direct	
	Data	Projections	Data	Projections	Data	Projections
Investment (%GDP)	<b>0.19***</b> (2.95)	<b>0.35***</b> (9.39)	0.12 (1.27)	0.16 (0.70)	0.20 (0.94)	<b>0.09***</b> (5.04)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
#Countries	75	75	75	75	75	75
#Observations	250	126	250	126	211	1695
$R^2$ within	0.06	0.61	0.02	0.05	0.08	0.08
Country(#Bucket) FE	Yes	Yes	Yes	Yes	Yes	Yes

*t* statistics in parentheses, \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Source: Authors' calculations. Data: IMF LIC DSAs.

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