

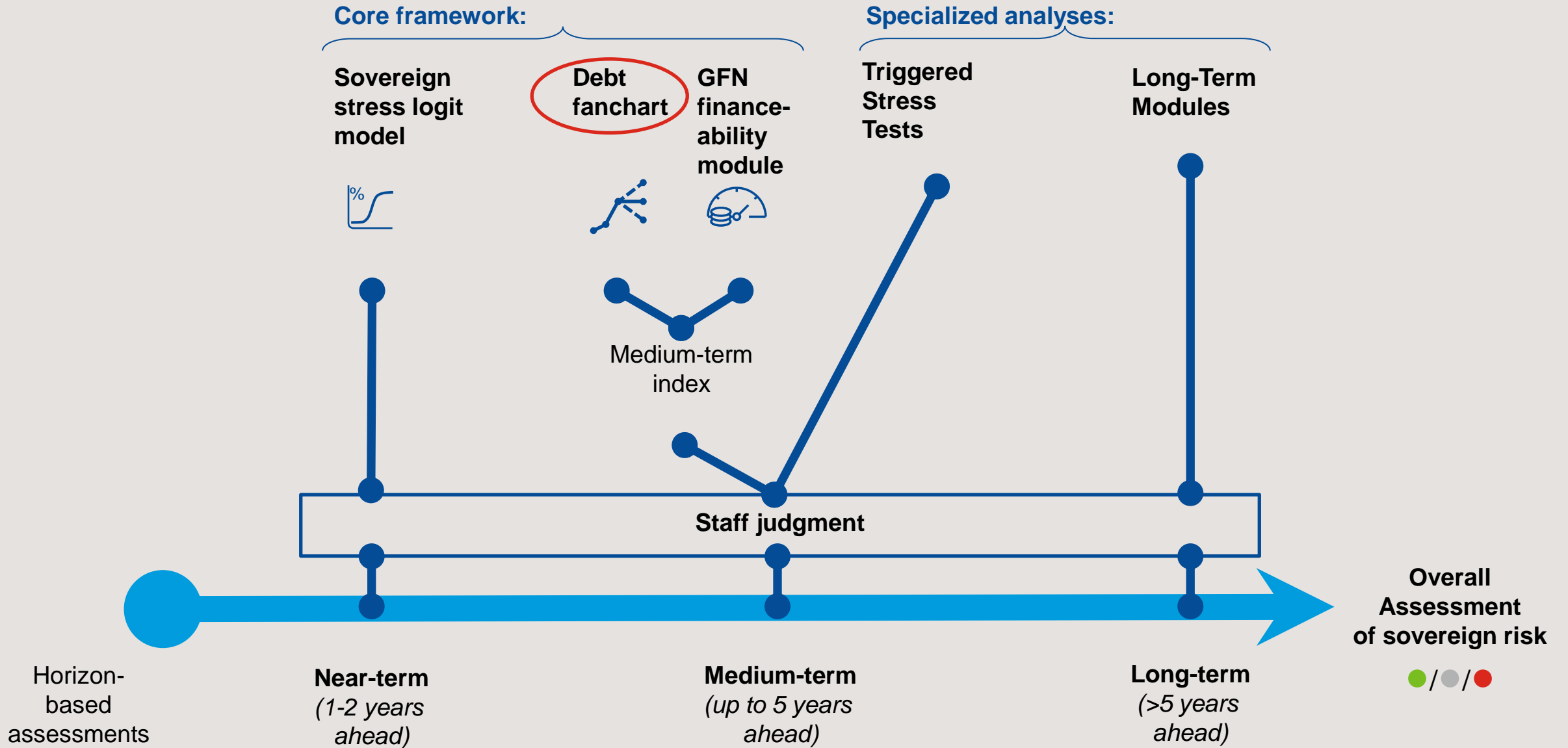
The Stochastic Debt Fanchart in the IMF's Sovereign Risk and Debt Sustainability Framework for MACs

November 30, 2023

ESM



Framework for sovereign risks (stress framework)



Constructing the fanchart

1. **Key debt drivers: real interest rate (r), growth (g), real ER depreciation (z), and primary balance (pb)**

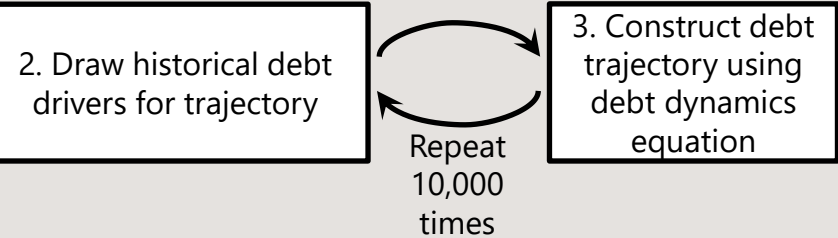
2. **Shocks:**

- Pool of past shock generated as deviations from the mean. Shocks are then drawn randomly and assigned to drivers in projection years
- Random draws of vectors of shocks as way of maintaining past correlation between drivers
- Draws in year pairs maintains some of the auto correlation in drivers

1. Input data and projections

2000	2001	2002	2003	...	T-3	T-2	T-1	Proj
r	r	r	r	...	r	r	r	...
g	g	g	g	...	g	g	g	...
z	z	z	z	...	z	z	z	...
pb	pb	pb	pb	...	pb	pb	pb	...
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

#1 #3 #2

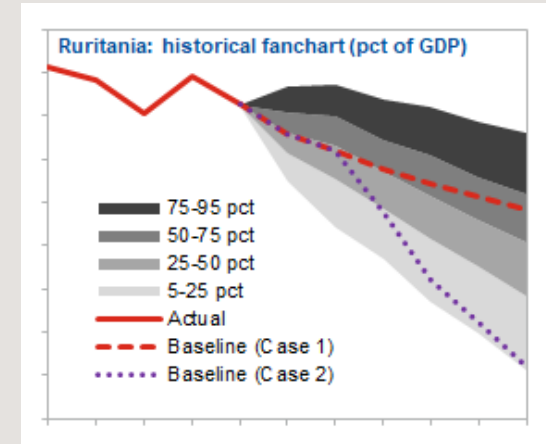


Positioning the fancart

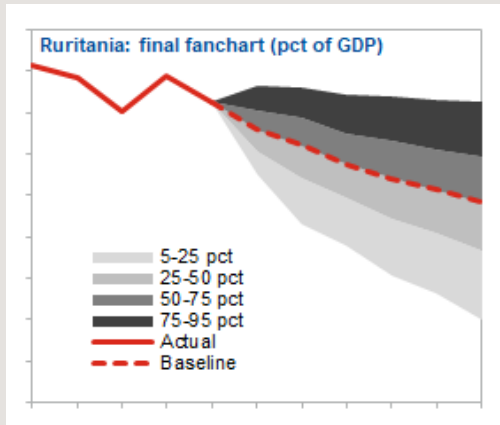
Two possible cases depending on position of baseline projection in the historical fancart

The central projection in the fancart is determined as follows:

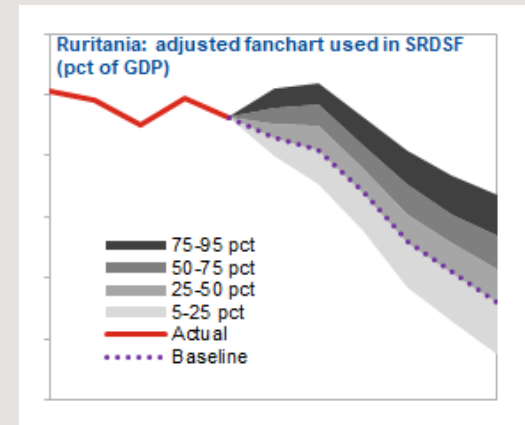
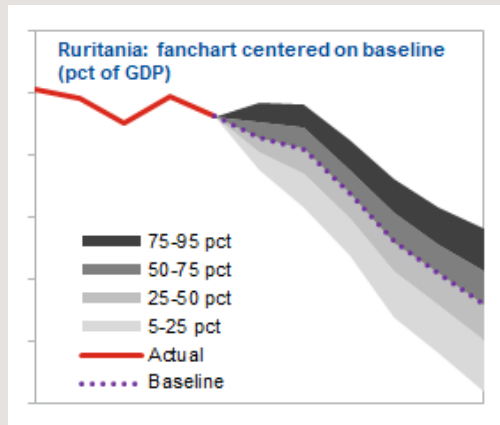
- A historical fancart based by drawing past outturns for debt drivers
- Overlays the baseline on the historical fancart as a realism diagnostic:
- If the diagnostic is normal (baseline above lower fancart region), a baseline-centered fancart is produced
- Otherwise, an adjusted (non-centered) fancart is produced



Case 1: No realism issue:
Final (baseline-centered)
fancart



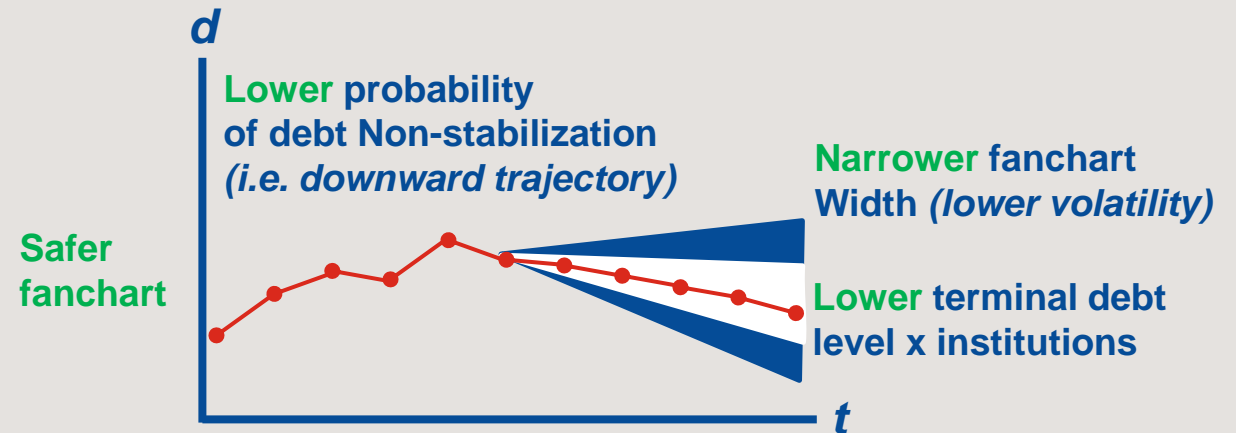
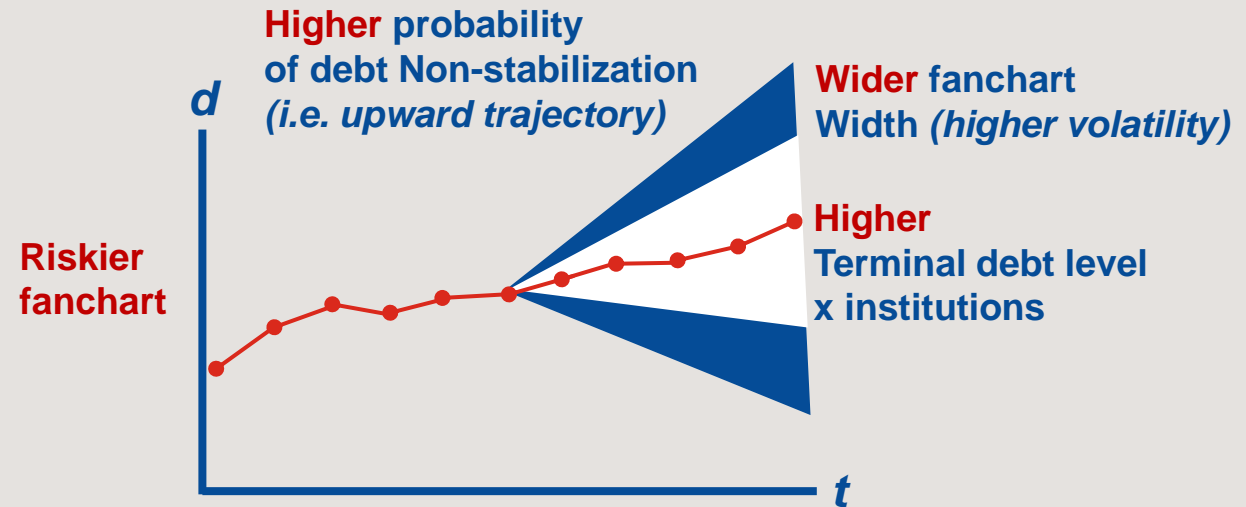
Case 2: Realism problem
Requires centering the fancart
above the baseline



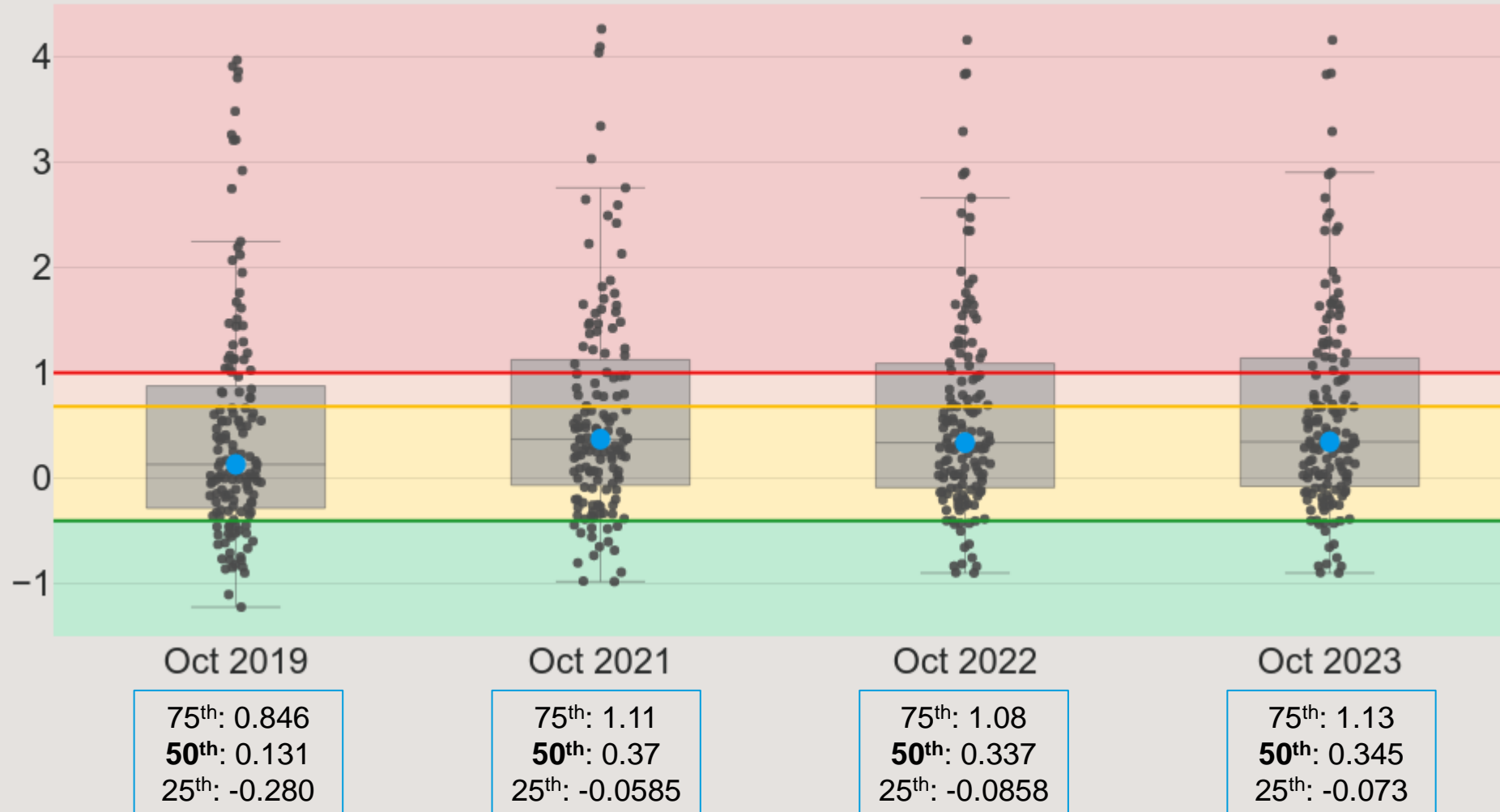
Measuring risks

The debt fanchart index has three component metrics obtained from the fanchart:

- Probability of debt non-stabilization
- Width of fanchart
- Terminal (t+5) debt level x institutions index
- Higher values imply higher risk



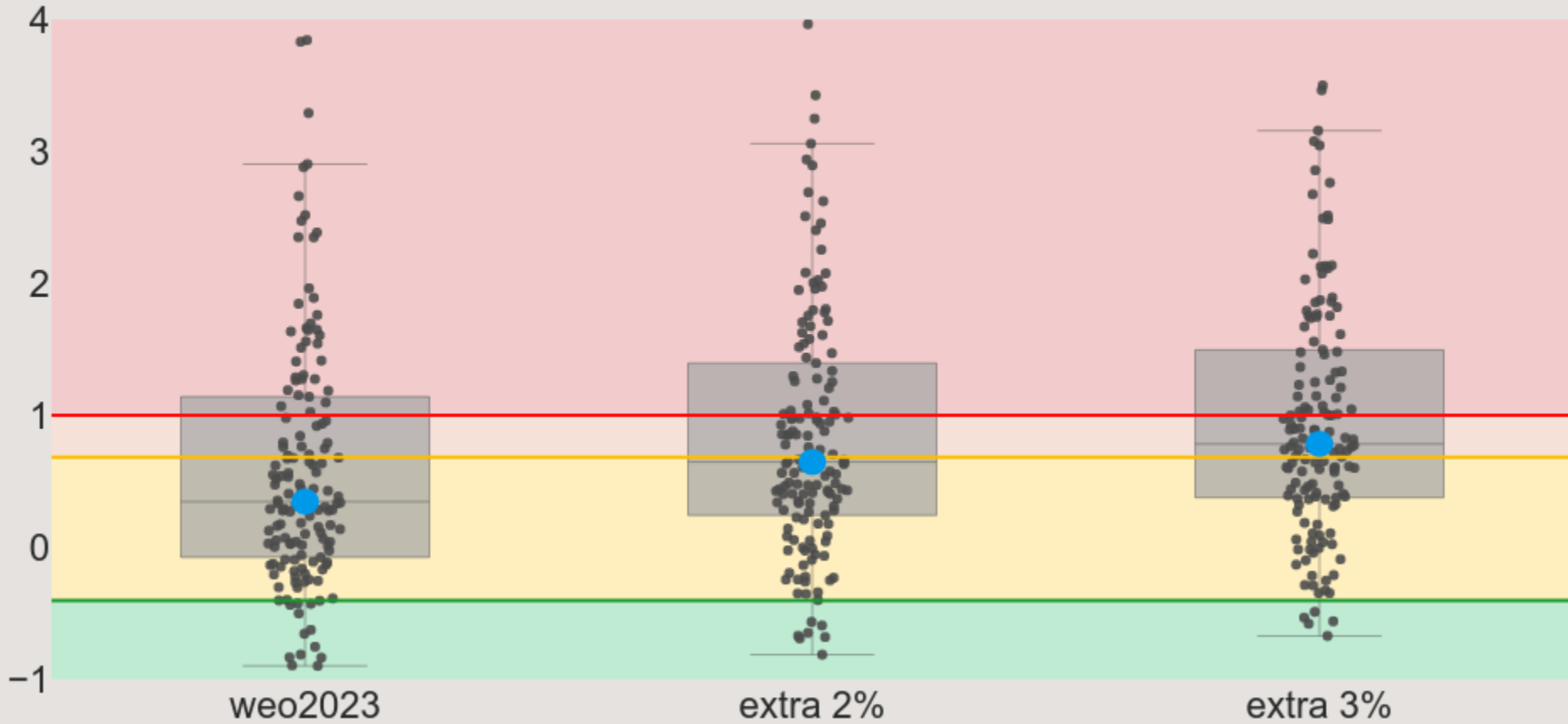
Debt fanchart risk scores increased significantly with Covid and have not decreased since



Source: IMF, World Economic Outlook (2023); and IMF staff calculations.

Note: Chart excludes (Bangladesh, Bolivia, Cabo Verde, Cambodia, Congo, Rep., Iran, Islamic Rep., Kiribati, Lao PDR, Micronesia, Fed. Sts., Myanmar, Nigeria, Papua New Guinea, Samoa, São Tomé and Príncipe, Solomon Islands, Tajikistan, Timor-Leste, Uzbekistan) due to data unavailability.

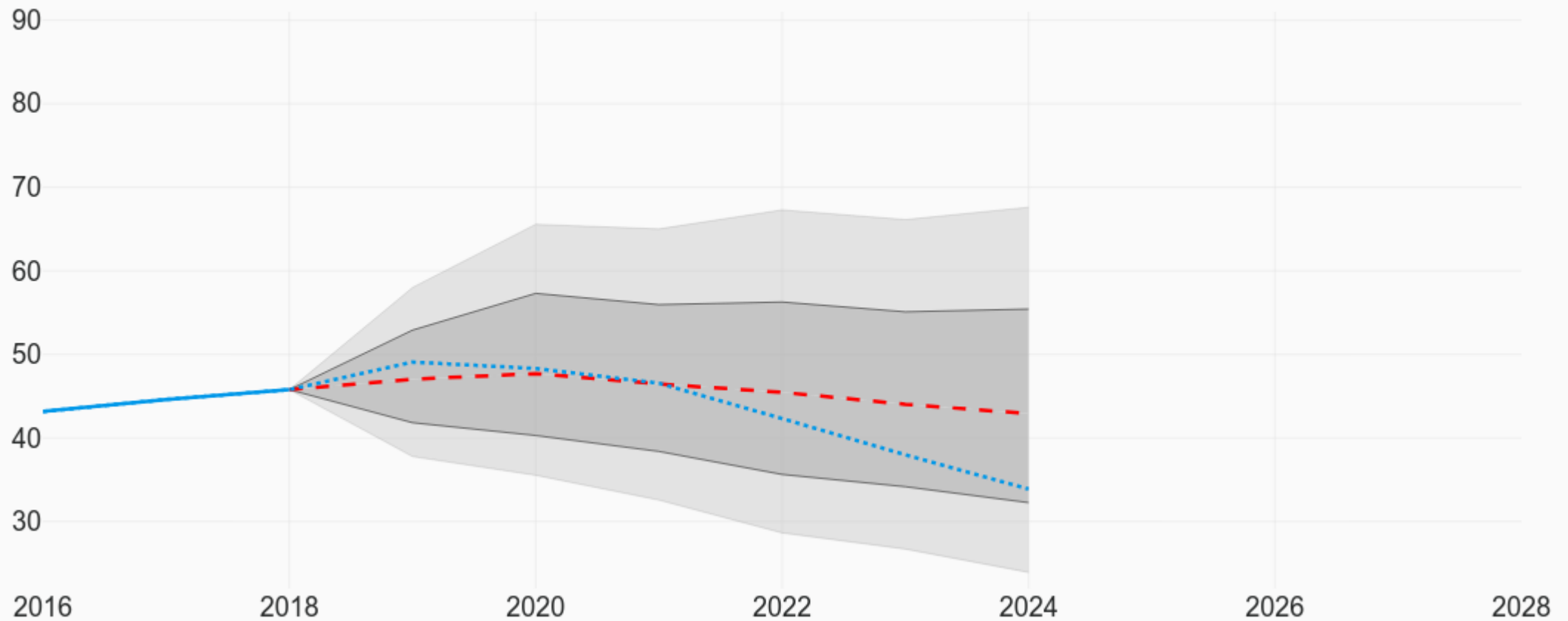
Getting r-g wrong in our baseline projections can have important implications for the assessment



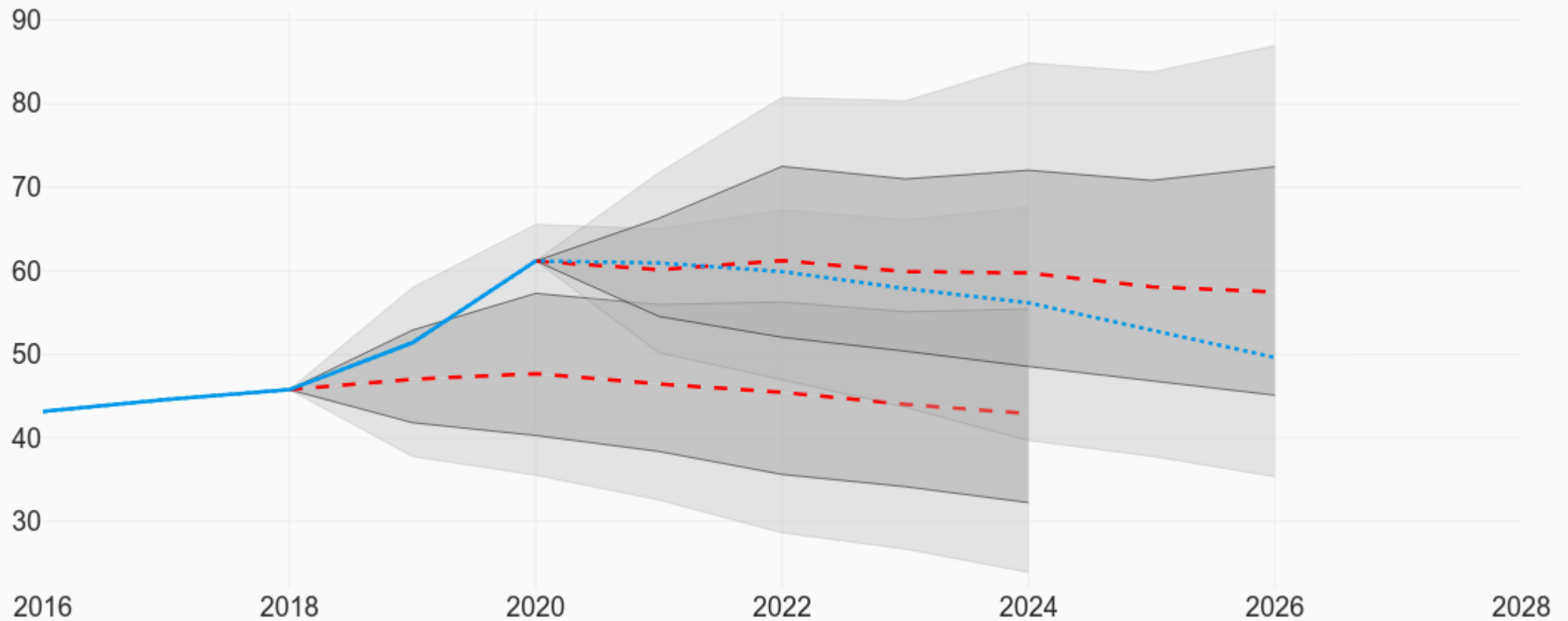
Dealing with large shocks

- Large shocks that are not typically well captured by fanchart:
 - Uncommon in the past
 - After a large shock, the distribution of shocks going forward may not remain invariant: for example, mean reversion towards the previous path/mean is likely.
- Example: Years of Covid pandemic

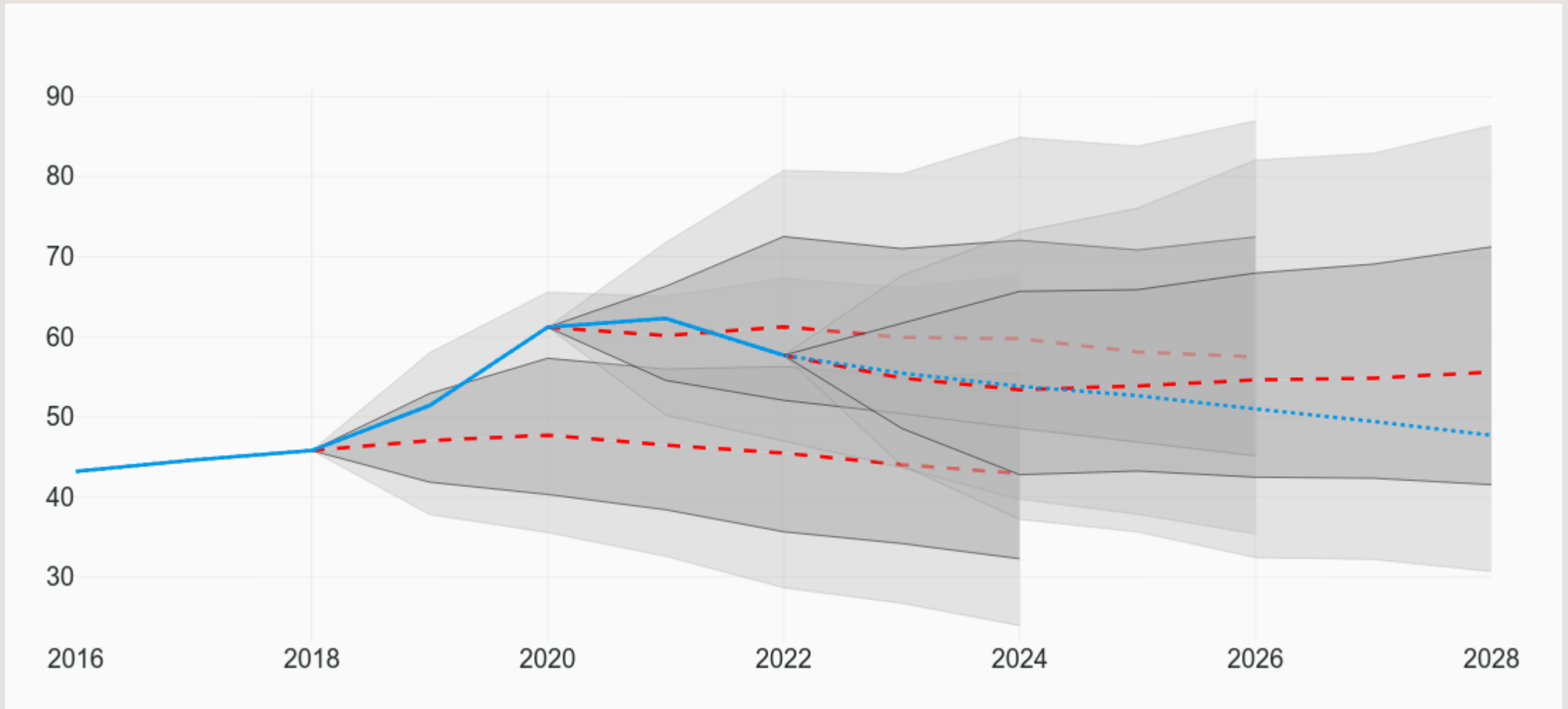
Pre-pandemic historical fanchart for Ecuador (WEO 2019)



Unexpected upward shift in debt due to Covid (from WEO 2019 to WEO 2021)



Partial mean reversion post-Covid, broadly captured by baseline from team (from WEO 2019 to WEO 2021, to WEO 2022)



Challenge: Is the history used to generate the fan chart good enough?

- Some likely events may not be in the history (e.g. a country with weak financial sector indicators that has never experienced a financial sector crisis before)
- We have stress tests for these events, but we have not yet adopted a methodology for using these to alter the fan chart.

Stress tests for medium-term risks not fully captured by the core tools:



Banking Crisis

Financial sector bailout if signs of overheating



ER Shock

Devaluation if misalignment not eliminated in MT



Commodity Prices

Extra scrutiny for exporters (revenue) & importers (subsidy)



Natural Disasters

Rebuilding costs when frequent events occur



Contingent Liabilities

Risks from narrow (less than GG) coverage

Conclusions

- Debt fancharts provide useful information in debt sustainability assessments. The width, probability of stabilization, and medium-term debt level are useful indicators of risk.
- The fanchart risk index moves relatively slowly over time, but does clearly reflect the impact of large shocks like Covid, with a significant mass of countries moving to high risk
- Baseline assumptions for debt drivers are a key determinant of the fanchart risk index under current IMF methodology. Underestimating $r-g$ under the baseline can have a very large impact.
- Alternative approaches are typically needed to capture the impact of large shocks and potential mean reversion after they occur

Some issues for future research

- Generating a fanchart projection for gross financing needs
- Changes in the distribution of shocks and mean reversion after a large shock
- Review of the realism adjustment in the fanchart: Is it triggered frequently enough? Is the resulting correction adequate?
- Incorporating feedback from the debt to interest rates in debt fancharts
- Incorporating stress tests in the fancharts

Q&A

Thank you



Assessing the impact of state contingent instruments on sustainability

- The debt fanchart could potentially be used to assess the impact of state-contingent debt instruments (SCDIs) on debt sustainability.
- See how the three metrics of the fanchart and the fanchart risk score increases with the SCDI. While the SCDI may reduce the width of the fanchart, it can increase the probability of debt non-stabilization even if calibrated to not produce additional payments under the baseline.

The SRDSF introduces several key reforms



Horizon-based approach & long-horizon analysis

Greater focus on the timing of risks and more attention to longer-term issues provides for a richer and more nuanced assessment



Emphasis on debt transparency

Improved debt disclosures and reporting aims to avoid debt surprises and support more evenhandedness in DSAs



Improved techniques and predictive power

Strengthened methodologies support better overall capacity of the framework to detect sovereign debt risks



Clearer bottom-line results

Clear communication supported by mechanical signals, three-way assessments at each horizon, and an overall judgment-based sovereign risk assessment

One framework, two aims

To provide a framework that can be used to assess the **risk of sovereign stress**
AND **debt sustainability** in market-access countries



Sovereign Risk Assessment

Critical for IMF's **surveillance** function: ("Early Warning System" for alerting sovereigns to the risk of falling into debt-related **stress**").

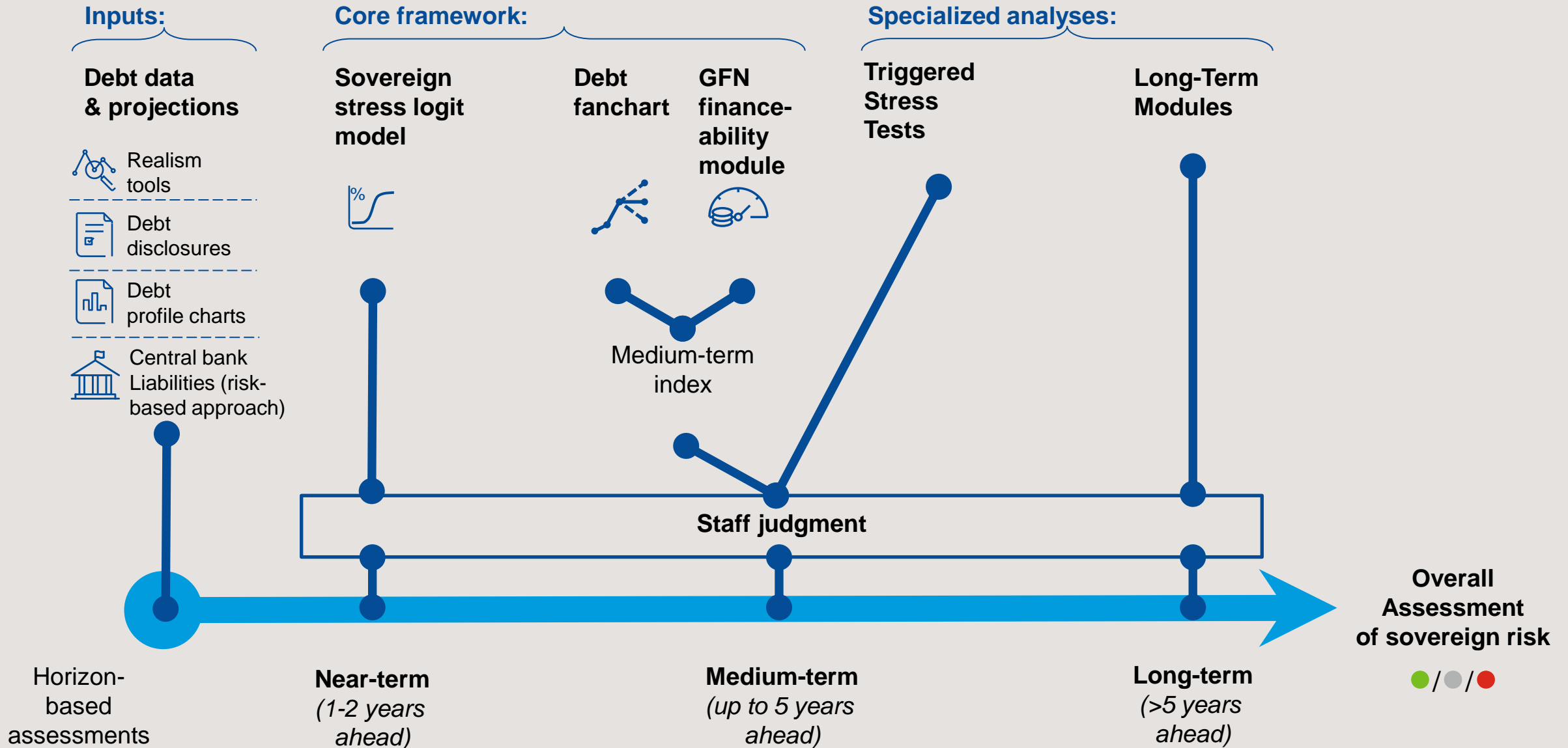


Debt Sustainability Assessment

Critical to support IMF **lending** decisions: Underpin the Fund's judgments on whether debt is sustainable (or sustainable with high probability, in exceptional access cases)

Hence, new title: "Sovereign Risk and Debt Sustainability Framework for Market Access Countries"(MAC-SRDSF)

Framework for sovereign risks (stress framework)



The roles of signals, assessments, and judgement

Mechanical Signals



- Core tools produce risk indexes, and each tool has upper and lower thresholds
- The mechanical signal can be high risk if above upper threshold, low risk if below lower threshold, or moderate risk if between the two thresholds

Final Assessments



- Are determinations of risk at each of the 3 horizons (near, medium, and long-term). There is also an overall risk assessment that synthesizes all horizons
- Like signals, assessments can take values of high, moderate, or low

Using Judgment

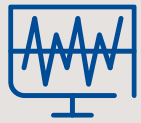


- Refers to when an assessment is not given by a mechanical signal.
- It can occur if there is a disagreement with the mechanical result (in either direction) and can be warranted in various situations. Some examples include:
 - Widely conflicting results between various tools
 - Results distorted by well-understood anomalies in the data
 - Factors outside the tools
 - Historical performance
- It can also occur if the underlying analytical tool does not produce a mechanical signal
- All judgment is confirmed through the Fund's internal review process


Comprehensive realism tools



Forecast track record
For all debt drivers




Output gap revisions
Detect biases in output gap projections




Debt drivers
Contributions to debt dynamics



Financing terms
Realism in issuance assumptions




3-yr debt reductions
Overall check for overoptimism




3yr fiscal adjustment
Cross-country & own history comparisons



Fiscal multipliers
Analyze fiscal & growth projections

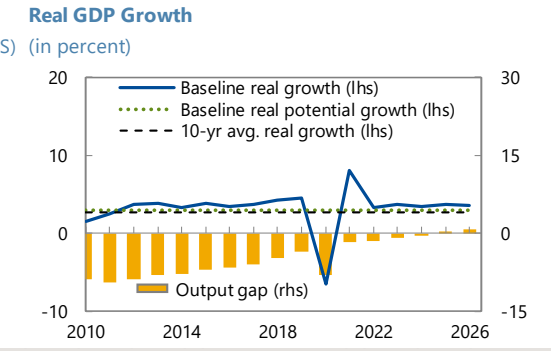
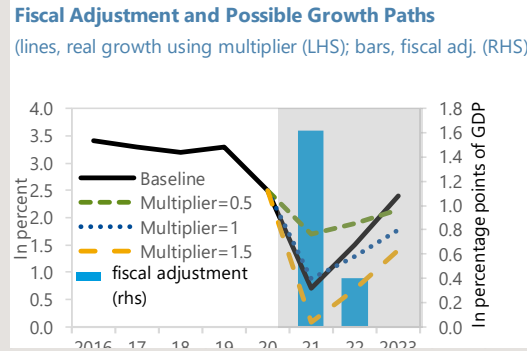
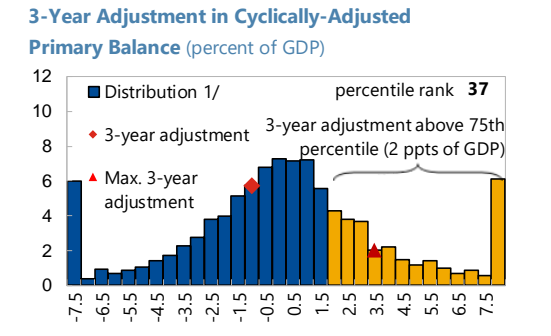
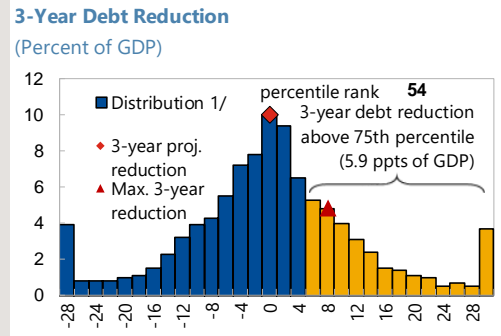
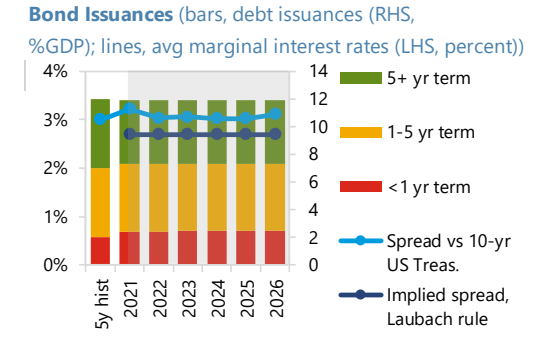
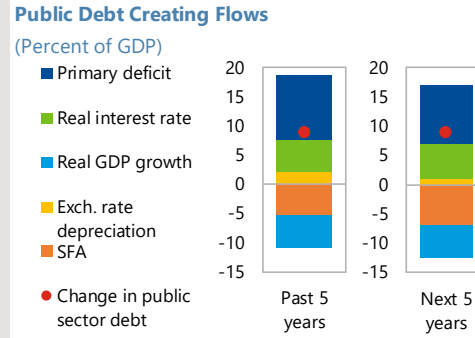
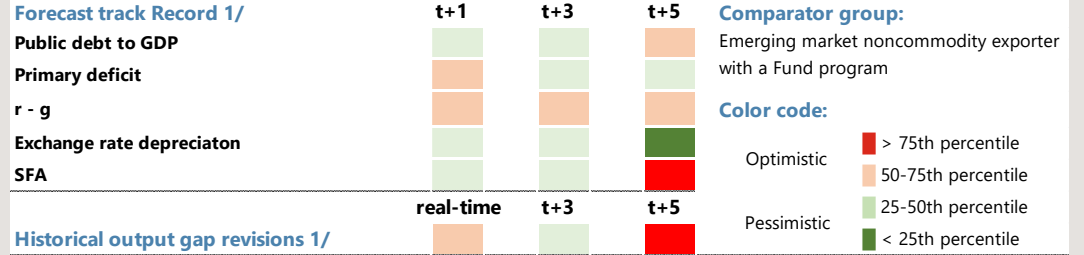


Growth comparisons
Actual vs. potential growth, & output gaps



REER gap
Scrutiny of misalignment risks

Ruritania: Realism of Baseline Assumptions



The near-term assessment is based on a logit model

- A multivariate logit model to act as an Early Warning System featuring key stress drivers across a variety of categories:
- This module is applicable only to countries not currently in stress (it is not run for non-precautionary program countries)
- All inputs to the model are historical observations, eliminating optimism as a risk in this module
- The key metric is the fitted probability from the logit model, which indicates probability of sovereign stress in the next 1-2 years

Structural characteristics

- Institutional quality index
- Stress History

Cyclical position

- Current account balance
- Change in REER (3-yr)
- Credit gap (if > 0)

Debt burden and buffers

- Δ public debt-to-GDP
- Public debt-to-revenue
- FX public debt-to-GDP
- Intl. reserves-to-GDP

Global conditions

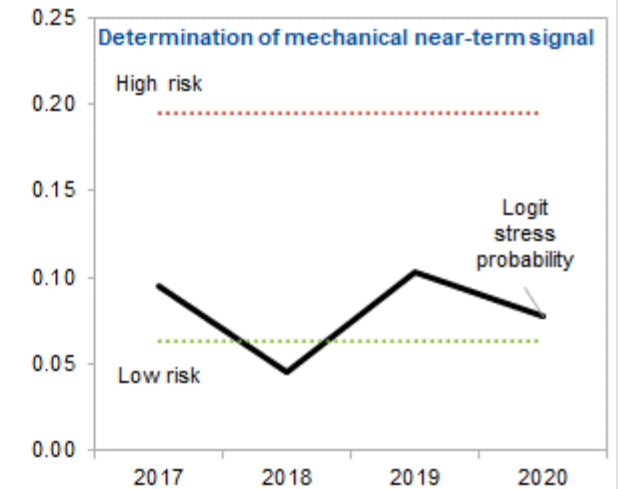
- Change in VIX
- Option: share of currency union MACs in stress

Application of the stress logit

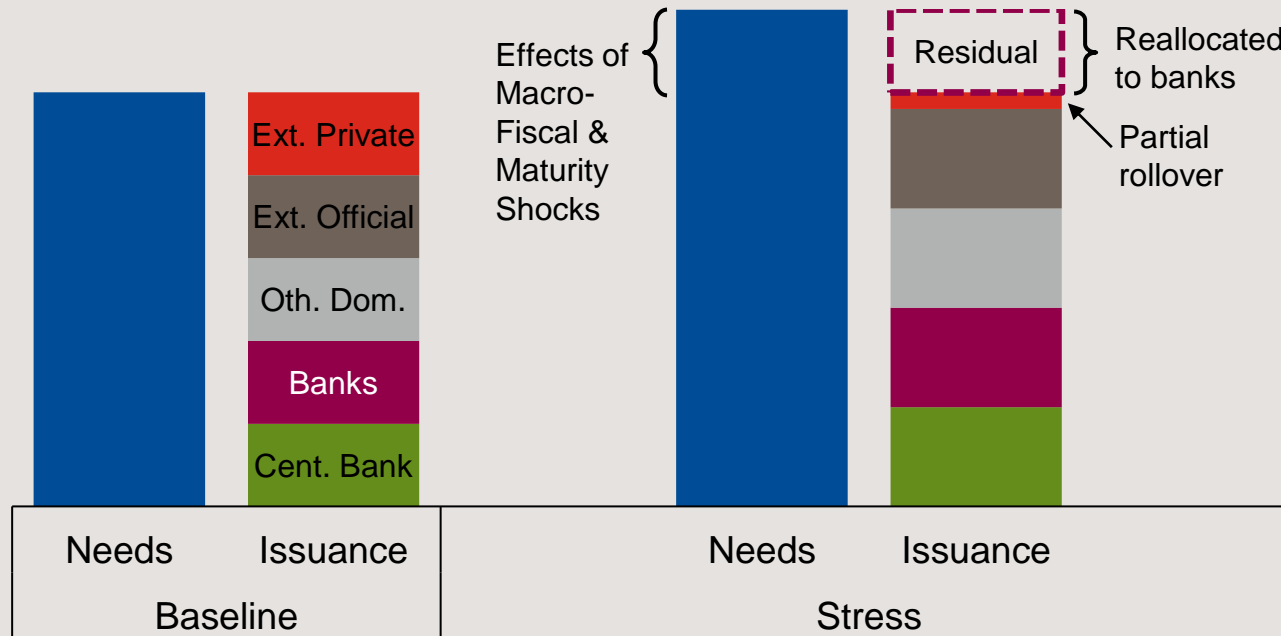
- Users enter the most recently reported data in the template.
- Once all variables are entered, the template gives the logit stress probability (LSP).
- To help analyze this probability, additional calculations show estimated contributions to the change in the LSP.
- In this hypothetical case, the logit probability decreased in 2020, mainly because more favorable levels of debt burden and global conditions variables offset a weakening in cyclical position indicators
- The mechanical signal is moderate. IMF country teams would form a final assessment at the time of the Article IV consultation.
- **Important:** This output is included in the staff report that is discussed by the Executive Board, but it is deleted in the published version of the staff report.

Ruritania: Near-term risk analysis

Year of data	2017	2018	2019	2020
<i>To predict stress in [t+1, t+2]</i>	2018-19	2019-20	2020-21	2021-22
Logit stress probability (LSP)	0.095	0.045	0.103	0.078
Change in LSP	0.050	-0.049	0.058	-0.025
due to:				
Institutional quality	0.001	0.000	0.000	0.000
Stress history	0.000	0.000	0.000	0.000
Cyclical position	0.001	0.001	0.001	0.006
Debt burden & buffers	0.058	-0.080	0.077	-0.009
Global conditions	-0.012	0.031	-0.021	-0.022
Missed crisis probability in 2021-22 if stress not predicted				15%
False alarm probability in 2021-22 if stress predicted				72%



GFN module methodology



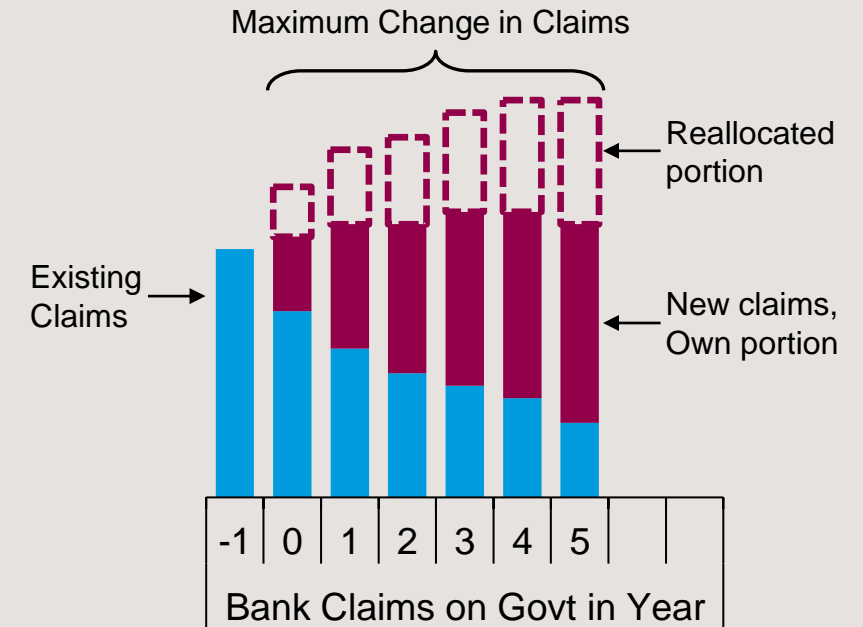
Users continue to enter macroeconomic, fiscal, and financing assumptions which generate GFN projections

The SRDSF's innovation is to ask users to allocate debt issuance among 5 broad creditor groups

Macro-fiscal and maturity shortening shocks cause higher GFNs relative to the baseline

Debt holders are also critical to the analysis: the Central Bank, Domestic Banks, Other Domestic Creditors, and Official Creditors raise financing proportionately to the baseline

External private investors only roll over a portion of existing claims; the residual is reallocated to the banks



The module calculates the implications of the implied demand on the banks from the higher GFNs and exit of foreign private investors

This is summarized as the maximum change in bank claims on the government in any year over the medium-term horizon

The GFN module analyzes liquidity risks

The GFN Financeability Index is the key output from the module

Average GFN-to-GDP ratio in the baseline

This continues to be a critical indicator of potential vulnerability

Higher financing needs imply higher liquidity risks

Users are now asked to enter assumptions on financing by creditor group:

- Central bank
- Domestic commercial banks
- Other domestic creditors
- External official creditors
- External private creditors

Initial bank claims on the government

This metric is an indicator of the banking system's capacity to absorb public debt

Banks tend to be a stable source of financing when conditions become stressed

If bank claims are already high, it implies higher risk because it suggests that the banks do not much space to provide further financing

Change in bank claims on the government in stress

Higher financing needs (for the banking system especially) result from:

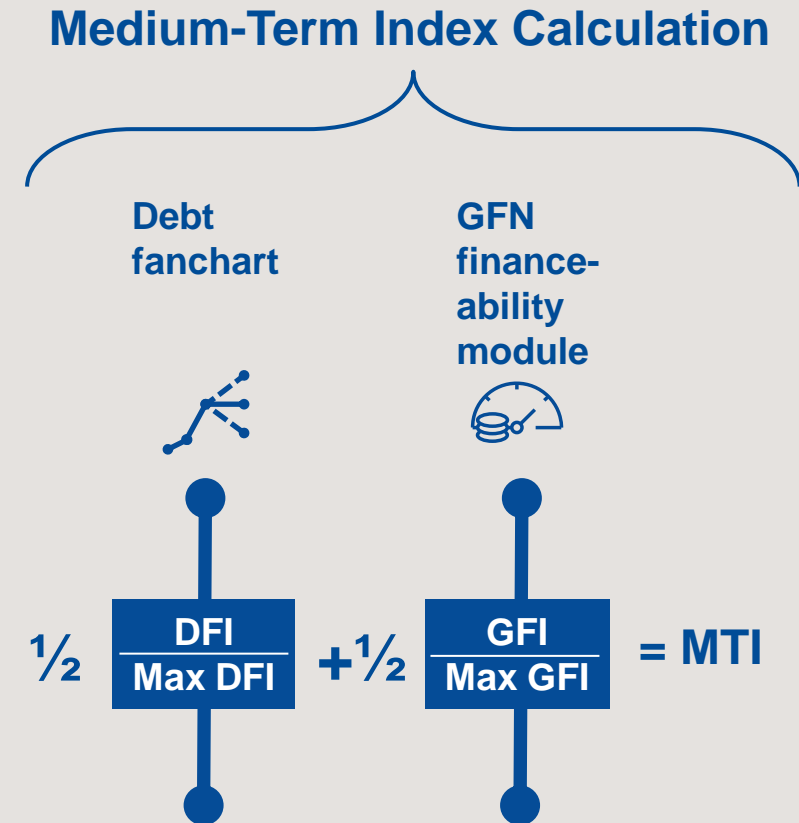
- Economic and fiscal shocks
- Maturity shortening
- Foreign private investor exit

The change in banks' claims (in percent of assets) is calculated. Higher changes imply higher risk

The metric can be elevated by a small banking system or reliance on risky foreign private investors

Aggregating the two medium-term modules

- To conduct a medium-term risk assessment, the Debt Fanchart Index (DFI) and GFN Financeability Index (GFI) need to be aggregated.
- The two indexes are normalized by the maximum values of the indexes in the calibration sample.
- Reflecting their relatively equal explanatory power, they have equal weight. Thus, the MTI is a simple average.
- Like all other risk indexes, it is compared against thresholds for a mechanical signal
- Judgment of medium-term risks is brought in at this part of the analysis (including the results of stress tests)



Specialized tools to inform judgment are being developed

Stress tests for medium-term risks not fully captured by the core tools:



Banking Crisis

Financial sector bailout if signs of overheating



ER Shock

Devaluation if misalignment not eliminated in MT



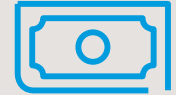
Commodity Prices

Extra scrutiny for exporters (revenue) & importers (subsidy)



Natural Disasters

Rebuilding costs when frequent events occur



Contingent Liabilities

Risks from narrow (less than GG) coverage

Long-term modules for risks beyond the standard 5-year horizon:



Population Aging

Debt impact of long-term pension and health costs



Large Amortizations

Financing risks from large LT debt repayments



Natural Resource Discovery/Depletion

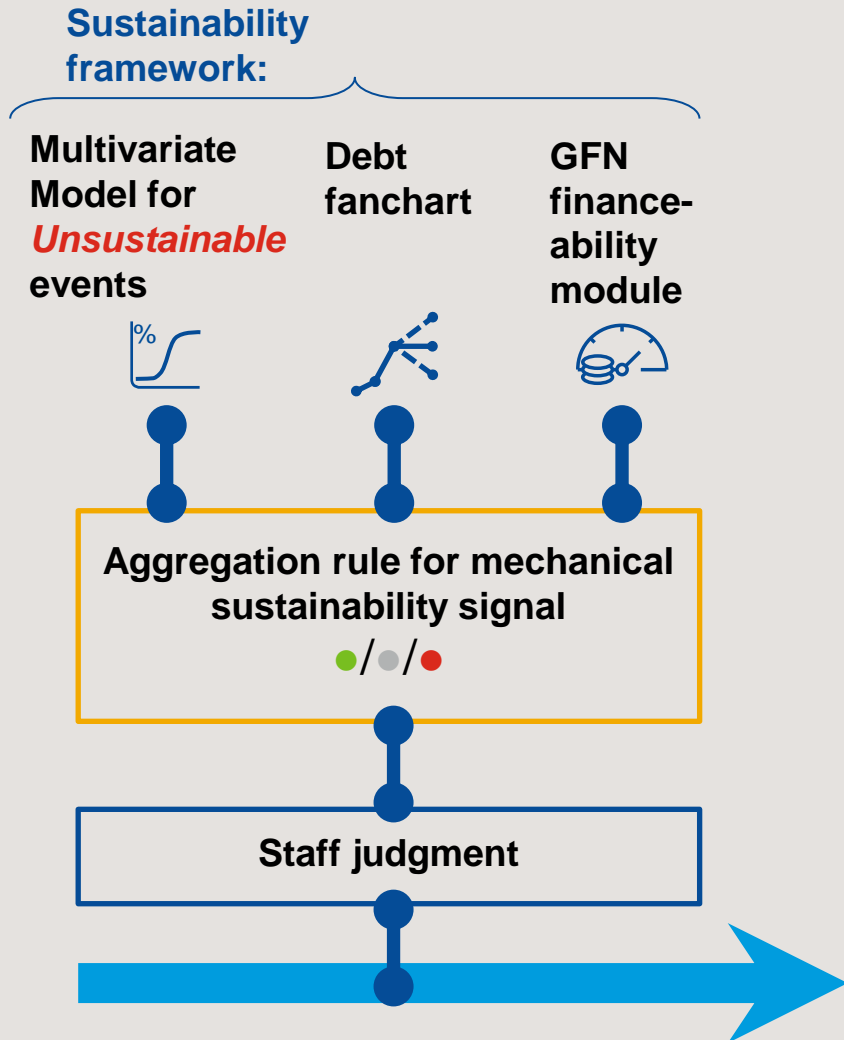
Implications of the launch or winding up of extraction



Climate Change

Effects of mitigation & adaptation investments on debt

Debt sustainability framework (mandatory only for programs): overall description

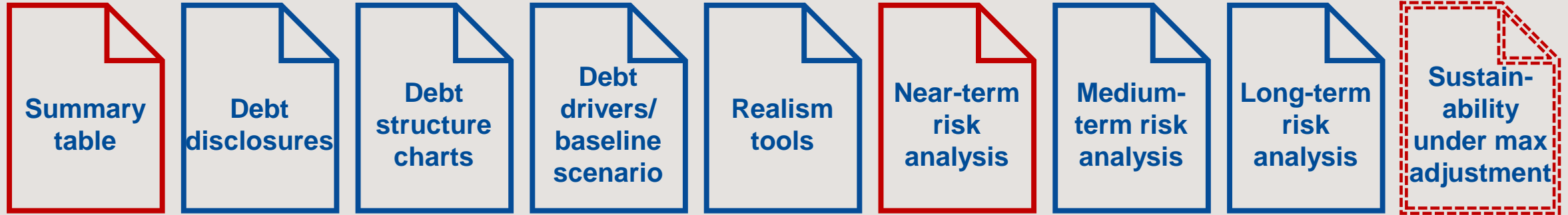


The risk tools are amenable for debt sustainability analysis with limited changes

- Focus on near and medium-term tools recalibrated to predict only unsustainable events.
- Aggregation rule combines information from the three mechanical tools to give a sustainability index
- The index is calculated by the team on the DST sheet in the template.
- The index can be compared against thresholds for a mechanical three-way sustainability assessment
- Staff judgment complements the mechanical results to yield the final bottom line on sustainability.

Reporting requirements

Outputs for the Sovereign Risk and Debt Sustainability Assessment (SRDSA):



Items included in SRDSAs depend on the Relationship with the Fund:

- Non-precautionary programs: *Exclude* near-term risk assessment (including on the summary table). *Include* the sustainability assessment on the summary table
- Surveillance-only: The sustainability adjustment is optional and may require an additional scenario under maximum adjustment (last item with dashed lines).

Writeups are no longer required. The reporting items include commentary fields at the bottom.

The transparency policy entails deletions to some items before publication (red items above):

- Probability of sustainable debt (delete “with a high probability” or “but not with high probability”) ***Except EA, FCL/PLL/SLL.***
- Mechanical signal on sustainability (delete entirely, including on optional alternative scenario)
- Near-term assessment (delete entirely, including on summary table)

Backup slide: Logit model specification

Standard model:

Group	Regressor	Coefficient	
		Estimate	Sig.
Constant	Ones	-2.957	***
Institutions	Institutional quality index	-0.972	***
History	Stress history index	0.521	***
Cyclical position	Current account balance-to-GDP	-0.029	**
	3-year pct. change in REER	0.008	
Debt burden & buffers	Credit-to-GDP gap, if positive (t-1)	0.079	***
	Change in public debt-to-GDP	0.053	***
	Public debt-to-revenue	0.002	**
	FX public debt-to-GDP	0.024	***
Global conditions	International reserves-to-GDP	-0.036	***
	Change in VIX (2010=100)	0.011	***
	Share of currency union MACs in stress	0.000	

With currency union variable:

Group	Regressor	Coefficient	
		Estimate	Sig.
Constant	Ones	-3.151	***
Institutions	Institutional quality index	-1.096	***
History	Stress history index	0.542	***
Cyclical position	Current account balance-to-GDP	-0.031	**
	3-year pct. change in REER	0.009	
Debt burden & buffers	Credit-to-GDP gap, if positive (t-1)	0.082	***
	Change in public debt-to-GDP	0.050	***
	Public debt-to-revenue	0.002	***
	FX public debt-to-GDP	0.024	**
Global conditions	International reserves-to-GDP	-0.032	***
	Change in VIX (2010=100)	0.014	***
	Share of currency union MACs in stress	8.105	***

Backup slide: Stress framework metrics and signals

Index	Component	Weight*	
Debt Fanchart Index (DFI)	Fanchart width	.316	{ DFI below 1.13 is low risk DFI above 2.08 is high risk Otherwise, moderate risk
	Probability of non-stabilization	.326	
	End debt level x institutions	.358	
GFN Financeability Index (GFI)	Average GFN-to-GDP in the baseline	.341	{ GFI below 7.6 is low risk GFI above 17.9 is high risk Otherwise, moderate risk
	Initial bank claims on the government	.324	
	Change in bank claims on the government in stress scenario	.334	
Medium-Term Index (MTI)	Debt Fanchart Index (normalized by 4.5)	.500	{ GFI below .257 is low risk GFI above .395 is high risk Otherwise, moderate risk
	GFN Financeability Index (normalized by 52)	.500	

* Components may not sum to 1 due to rounding.