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Maximum Sustainable Debt Across Countries:

An Assessment using P-Theory

Yongquan Cao, Wei Jiang, W. Raphael Lam, Neng Wang

WP/25/223

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**2025
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WORKING PAPER

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Prepared by Yongquan Cao*, Wei Jiang*, W. Raphael Lam*, and Neng Wang#

Authorized for distribution by Davide Furceri
October 2025

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RECOMMENDED CITATION: Cao, Yongquan, Wei Jiang, W. Raphael Lam, and Neng Wang. 2025. “Maximum Sustainable Debt across Countries: An Assessment using P-Theory” IMF Working Papers No. 2025/223.

JEL Classification Numbers:	H21, H63, E62, F34
Keywords:	Debt limit; debt carrying capacity; convenience yields, risk premium, asset pricing; maximum sustainable debt
Author’s E-Mail Address:	ycao2@imf.org ; weijiang@ust.hk ; wlam@imf.org ; nw2128@gsb.columbia.edu

* International Monetary Fund

+ University of Science and Technology, Hong Kong

Cheung Kong Graduate School of Business

We would like to thank Vitor Gaspar, Era Dabla-Norris, Davide Furceri, Rodrigo Alfaro, and the participants of the IMF Fiscal Advisory Group and IMF seminars for their valuable feedback and insights. We are also grateful to Hongchi Li for excellent research assistance. The views expressed in IMF Working Papers are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

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Yongquan Cao¹, Wei Jiang², W. Raphael Lam¹, and Neng Wang³

October 20, 2025

Abstract

This paper provides a parsimonious yet tractable approach to evaluating maximum sustainable debt across countries and over time within the p-theory framework developed by [Jiang, Sargent, Wang, and Yang \(2024\)](#). By incorporating tax distortions, asset-pricing components (risk-free rates, convenience yields, and jump-risk premia), and sovereign default risks into the model, we calibrate it for a large sample of over 170 countries. Our illustrative findings show that while current debt levels in many economies remain within maximum sustainable debt levels, debt burdens in many emerging markets and low-income countries are near their respective sustainable levels. In contrast, a few countries that are in—or at high risk of—debt distress have debt levels exceeding their sustainable thresholds. The analysis highlights how sustainable debt estimates evolve over time in response to shifts in financial conditions and macro-fiscal fundamentals. These estimates are particularly sensitive to key parameters—most notably when interest-growth differentials are narrow.

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¹International Monetary Fund

²Cheung Kong Graduate School of Business

³University of Science and Technology, Hong Kong

1 Introduction

Global public debt exceeded \$100 trillion in 2024 and is projected to approach 100% of GDP by the end of the decade—surpassing the pandemic peak—according to the 2025 IMF World Economic Outlook. The debt outlook is also subject to significant upside risks (Furceri, Giannone, Kisat, Lam, and Li (2025)). Public debt could be 20 percentage points higher than projected three years ahead in a severely adverse scenario, driven mainly by heightened policy uncertainty, tighter financial conditions, and rising geopolitical tensions. Hence, it is important to assess the maximum sustainable debt—that is, the debt levels countries can afford without distress—across countries. Such estimates can help inform sound policy decisions. Throughout, quantitative figures are illustrative and meant to complement existing method to assess sovereign risks.

This paper estimates maximum sustainable debt across countries with two main contributions. First, it provides a parsimonious yet tractable framework to determine the sustainable debt ($\bar{b}$) using the p -theory framework proposed by Jiang, Sargent, Wang, and Yang (2024). The setup has a direct asset-pricing mapping—linking r , convenience yields, and jump-risk premia to sovereign spreads. Second, it is the first to implement a comprehensive calibration of $\bar{b}$ for over 170 countries from 2000 to 2024, effectively bridging theoretical foundations with large-scale empirical application.

In the p -theory framework, the government faces hedgeable output shocks and other disturbances (e.g., sudden debt increases). In each period, it selects a tax rate to finance exogenous expenditures while internalizing tax distortions and retains the option to default. Residual deficits are financed through debt issuance, with the government balancing the marginal costs and benefits of borrowing—accounting for interest costs and, where applicable, convenience yields. Focusing on maximum sustainable debt rather than full debt dynamics, the analysis characterizes the maximum sustainable debt threshold, governed by two concise and analytically solvable equations.

The paper demonstrates that the maximum sustainable debt level for a country is shaped by factors that influence the public debt outlook and risks. These include macro-fiscal fundamentals and a measure of the government’s credibility in repaying its obligations. On the fiscal front, the efficiency of tax collection, tax capacity, and the scale of public spending affect the $\bar{b}$. Financing variables such as the global risk-free interest rate, risk premiums from economic volatility, the convenience yield (e.g., arising from safe asset considerations, Krishnamurthy and Vissing-Jorgensen (2012)) on sovereign debt, and the likelihood of abrupt

debt surges through asset pricing channels. Lastly, the model captures the government’s limited commitment to debt repayment through the economic and fiscal costs incurred in default.

Our calibration strategy aligns model parameters systematically with empirical data and relevant literature benchmarks to ensure consistency across income groups as well as individual country characteristics. Empirical data on macro-fiscal variables are primarily sourced from IMF World Economic Outlook (WEO) and IMF Sovereign Debt Monitor databases, while other variables such as institutional strength and fiscal flexibility are drawn from relevant literature and account for country differences. By jointly calibrating these dimensions, the model provides a coherent and empirically grounded estimate of the sustainable debt levels across countries and over time.

Results reveal substantial heterogeneity in maximum sustainable debt ($\bar{b}$) across countries and income groups. Advanced economies (AEs) generally exhibit higher $\bar{b}$, supported by more stable macroeconomic conditions and lower sovereign risks. In contrast, emerging markets (EMs) and low-income countries (LICs) tend to show lower $\bar{b}$ due to higher economic volatility despite high average growth. The calibrated results are highly correlated with the country risk ratings in IMF debt sustainability framework, suggesting our estimates can serve as a useful complementary indicator in monitoring debt risks. Moreover, they vary over time, largely driven by financial conditions and macro-fiscal fundamentals. While sensitivity analyses demonstrate that they are highly responsive to key parameters, particularly when interest-growth differentials (at the verge of default) are small.

Literature Review

A broad literature has sought to quantify countries’ maximum sustainable debt by linking fiscal fundamentals, macroeconomic conditions, and default risk. Classic tax-smoothing models, such as Barro (1979), conceptualize debt as a buffer to minimize tax distortions over time, subject to an intertemporal budget constraint. However, these models assume perfect commitment to repayment and omits default risk. In contrast, sovereign default models (e.g., Arellano (2008)) and fiscal limit approaches (e.g., Bi and Leeper (2013)) explicitly model thresholds beyond which governments can no longer generate sufficient primary surpluses to meet debt repayment. These models emphasize that sustainable debt depends not only on long-run solvency but also on market volatility, perceptions, and institutional constraints. Building on this branch of literature, our paper employs the p-theory framework in Jiang,

Sargent, Wang, and Yang (2024), which integrates fiscal policy distortions, macroeconomic volatility, and sovereign risk in a unified, tractable model. This framework allows us to estimate country-specific debt limits based on structural characteristics and external shocks, providing a coherent basis for cross-country comparisons.

Empirical studies complement theoretical models by estimating debt thresholds and fiscal space (including Ostry, Ghosh, Kim, and Qureshi (2010)) based on observed fiscal behavior. For example, Ghosh, Kim, Mendoza, Ostry, and Qureshi (2013) shows that governments’ ability to adjust primary balances deteriorates at high debt levels—a phenomenon labeled “fiscal fatigue”—and proposes data-driven debt limits based on historical fiscal reactions. Reinhart, Rogoff, and Savastano (2003) highlights “debt intolerance” in emerging markets, where defaults often occur at lower debt ratios than advanced economies due to weak institutions and fragile policy credibility. These insights inform operational frameworks such as the IMF–World Bank Debt Sustainability Framework (IMF (2022)) for low-income countries, which classify countries’ debt-carrying capacity and assign risk ratings based on stress testing and institutional strength. In line with this literature, our paper provides useful indicators across more than 170 countries, which could help complement and inform the sustainability assessments. Finally, we incorporate recent advances in risk-based analysis, such as the Debt-at-Risk metric in Furceri, Giannone, Kisat, Lam, and Li (2025), which quantifies the full distribution of the debt outlook and emphasizes the upside risks of debt outcomes.

Section 2 introduces the methodological framework. Section 3 details the calibration approach and parameter selection. Section 4 presents the core empirical findings. Section 5 offers concluding remarks.

2 Methodology

This paper adopts the theoretical framework in Jiang, Sargent, Wang, and Yang (2024) to assess the maximum sustainable level of debt in a country. The framework offers distinctive advantages by integrating key factors that shape debt dynamics in the context of optimal taxation and debt management. From an asset-pricing perspective, the framework nests sovereign pricing blocks: the risk-free rate, a convenience yield that lowers required returns on safe debt, and a jump-risk premium tied to disaster intensity and tail thickness—linking to observed spreads and the term structure. Specifically, the model synthesizes Arrow’s

one-period-ahead securities and GDP-indexed insurance [Shiller \(1994\)](#), [Barro \(1979\)](#) tax-smoothing insights, sovereign credit constraints following [Eaton and Gersovitz \(1981\)](#), and convenience yields on risk-free government debt highlighted by [Krishnamurthy and Vissing-Jorgensen \(2012\)](#). Additionally, the model incorporates uninsurable jump shocks to output, emphasizing fiscal vulnerabilities from stochastic disturbances.¹ The model does not explicitly consider the maturity structure, currency decomposition, or inflation expectations.

In this framework, the government (i) faces output that evolves according to a geometric jump-diffusion process, with some risks hedgeable through GDP-indexed insurance (Shiller-type assets), while others (e.g., sudden jumps) are not; (ii) collects taxes (which are distortive) to fund exogenous expenditures; (iii) has a default option; and (iv) benefits from convenience yields. The government thus balances the marginal costs and benefits of incurring public debt. The evolution of the debt-to-GDP ratio follows:

$$\underbrace{\dot{b}_t}_{\text{change of debt}} = \underbrace{\gamma - \tau(b_t)}_{\text{primary deficit}} - \underbrace{g \cdot b_t}_{\text{growth}} + \underbrace{(r - \delta + \pi(b/\bar{b})) \cdot b_t}_{\text{interest payment}} + \underbrace{\lambda \cdot b_t}_{\text{hedging cost}} \quad (1)$$

r : risk free rate
 δ : convenience yield
 $\pi(b/\bar{b})$: credit risk premium

The standard debt dynamics in this framework can be decomposed into four main components, each reflecting a channel through which it affects debt accumulation. These channels include: (i) The primary deficit ($\gamma - \tau(b_t)$), reflecting the exogenous level of expenditures exceeding optimal taxes; (ii) Economic growth (g), which reduces debt relative to an expanding output. (iii) Interest costs ($r - \delta + \pi(b/\bar{b})$) on existing debt, in which the innovation in the framework is to encompass several components. The interest cost combines the risk-free rate (r), net of a convenience yield (δ), and increases with credit risk premium $\pi(b/\bar{b}) = \tilde{\zeta}(b/\bar{b})^\omega$. In this expression, $\tilde{\zeta}$ denotes the Poisson arrival rate of jump shocks (reflecting their frequency), and ω governs the fat-tailedness of the shock size distribution. In the model framework, the risk premium increases as debt approaches the sustainable debt $\bar{b}$. The last component is the hedging costs (λ) on existing debt (b), representing management expenses related to economic volatility or the cost of insuring against output volatility.

As documented in [Jiang, Sargent, Wang, and Yang \(2024\)](#), in the presence of a convenience yield, the government optimally frontloads borrowing and backloads taxation—potentially to the point where default becomes preferable. Our focus is on the debt threshold at which

¹Detailed in Section 6 of [Jiang, Sargent, Wang, and Yang \(2024\)](#).

the government becomes indifferent between continuing to service its debt and choosing to default. This threshold—referred to as the maximum sustainable debt—can be derived analytically, as shown in equations (2) and (3). Detailed derivations are provided in Technical Appendix E of [Jiang, Sargent, Wang, and Yang \(2024\)](#).

The intuition is as follows: to determine the level of debt at which the government is willing to default, we compare two value functions—one under continued debt servicing, which requires raising distortionary taxes, and one under default. The tax distortion parameter (φ) captures the deadweight loss associated with raising revenue through distortionary taxation. Default becomes optimal when the marginal value of continuing to tax and service the debt falls below the value of defaulting.

The costs of default are twofold. First, the output loss from default is captured by the parameter α , where a lower α implies a greater loss in output (i.e., the output cost of default is $1 - \alpha$). Second, the default-related tax cost (κ) represents increased inefficiencies or political constraints in tax collection after default. Once default occurs, the government loses access to credit markets permanently.

At the same time, the government’s maximum tax capacity may be lower than the optimal tax rate implied by the model due to institutional or political constraints, denoted by $\bar{\tau}$.² Hence, the actual optimal tax rate is the minimum of the model-implied optimal rate and the tax capacity limit, as shown in equation (2).

Finally, at the default threshold, the change in the debt-to-GDP ratio must be zero (i.e., the government is no longer accumulating or reducing debt), which yields the condition in equation (3).

$$\text{Optimal taxes: } \tau_N = \min \left\{ \bar{\tau}, \frac{1}{\varphi} \left(\sqrt{1 + 2\varphi \left(1 - \alpha + \gamma + \frac{\varphi \kappa \gamma^2}{2\alpha} \right)} - 1 \right) \right\} \quad (2)$$

$$\text{Max sustainable debt: } \bar{b} = \frac{\tau_N - \gamma}{r + \tilde{\zeta} + \lambda - \delta - g}; \quad (3)$$

Note that equations (2) and (3) apply specifically at the default threshold for debt, making the term $r + \tilde{\zeta} + \lambda - \delta - g$ distinct from the standard $r - g$ used in a typical period.

²See [International Monetary Fund \(2025\)](#). Synthesizing cross-country evidence and case work, it finds that comprehensive, sequenced reforms to tax policy, administration, and legal frameworks can plausibly mobilize about 3–5 percentage points of GDP in additional revenue over the medium term, with realized gains critically dependent on sustained implementation and institutional capacity.

In understanding a government’s maximum sustainable debt, it is essential to consider the key factors that interact and shape debt dynamics and the sustainability of public debt. A government’s ability to meet its debt obligations hinges not only on fiscal policy but also on macroeconomic conditions and the strength of its commitment to maintaining debt and avoiding default. In the following, we detail the key fiscal, macroeconomic, and limited commitment factors that influence maximum sustainable level.

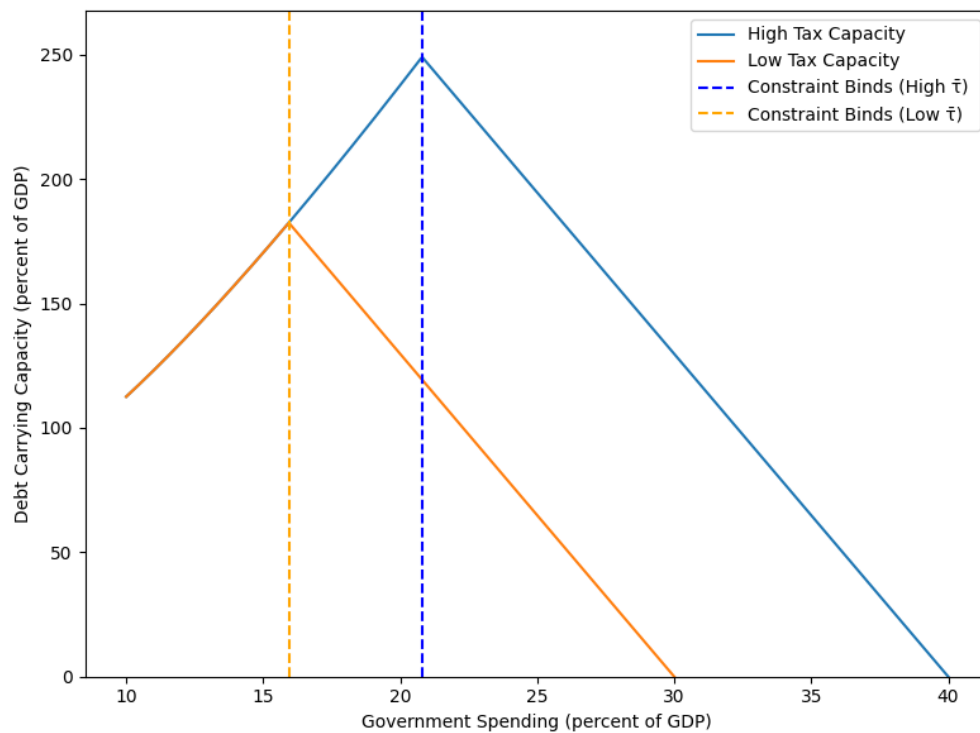
2.1 Fiscal Factors

Fiscal policy is pivotal in determining a government’s maximum sustainable debt, with tax collection costs playing a significant role. The tax distortion parameter (φ) captures the size of the deadweight loss associated with resource misallocation from taxes. Higher distortion (φ) makes servicing debt costly. When tax collection becomes more expensive, the government’s ability to meet its debt obligations decreases, reducing the amount of debt a country can sustain. The government’s tax capacity ($\bar{\tau}$) directly affects the amount of revenue it can collect and service its debt. A higher tax capacity allows the government to collect more revenue, enhancing its ability to sustain higher debt levels without default risk.

In addition to taxation, government spending (γ) also affects the maximum sustainable debt level. While higher spending increases the fiscal burden, it may lead to a higher debt limit if the expenditure is supported by future higher tax revenue that the government can sustain.³ However, if political constraints exist or the optimal taxes are already close to the maximum tax capacity, the government’s debt limit will ultimately be constrained as shown in Figure 1.

³Real-world constraints can diverge from the model’s assumptions that government spending is fixed and taxes are the only fiscal instrument. As in much of the literature, the model assumes taxes adjust flexibly to finance a fixed stream of spending. In practice, however, tax policy changes require legislative approval and are constrained by political and institutional frictions, making them slower and less flexible in responding to fiscal pressures. This limitation does not prevent us from characterizing long-run debt sustainability, since the economy ultimately converges to a new steady state. At the same time, whether through higher taxes or lower spending, fiscal adjustment entails economic costs—partly captured here by the tax distortion assumption. It is worth noting that [Dornbusch \(1986\)](#) emphasizes the importance of gradual adjustment paths when moving from actual to optimal policies, highlighting that transitional dynamics may matter for real-world policy implementation even if they do not alter long-run outcomes.

Figure 1: Maximum Sustainable Debt and Government Spending under Different Tax Capacity



Note: This figure illustrates the model-implied maximum sustainable debt ($\bar{b}$) as a function of primary spending (γ) for two tax capacity assumptions ($\bar{\tau} = 30\%$ and 40%). Parameters the following: $\alpha = 0.95$, $\varphi = 3.7$, $\kappa = 1.3$, $r = 0.9\%$, $\zeta = 8.2\%$, $\lambda = 3.0\%$, $\delta = 0.1\%$, and $g = 4.3\%$. Vertical dashed lines indicate the point where the optimal tax rate reaches the maximum feasible rate $\bar{\tau}$.

2.2 Macroeconomic Factors

Beyond fiscal factors, broader macroeconomic conditions also affect the maximum sustainable debt. Variables such as the risk-free rate, the exogenous probability of a debt surge (a jump shock), economic growth, and the convenience yield could have significant effects. The risk-free rate (r) represents the return on risk-free global investments and directly affects the government's borrowing costs. An increase in the risk-free rate raises borrowing costs, reducing the government's ability to service existing debt and thereby diminishing its maximum sustainable debt.

Similarly, the probability of a sudden debt surge ($\tilde{\zeta}$) reflects the risk of unexpected discrete increases in debt levels (e.g., recognition of off-budget debts). A high probability of such an increase exacerbates fiscal challenges, making investors less willing to lend except at higher interest rates. This, in turn, weakens the government's ability to carry higher debt.

Conversely, economic growth (g) enhances maximum sustainable debt by increasing income levels, broadening the tax base, and improving the government's ability to service debt. The hedging cost (λ), which reflects the additional return demanded by investors for holding riskier debt during periods of volatile growth, can increase borrowing costs and reduce the sustainable debt level.⁴

Finally, the convenience yield (δ), which reflects the attractiveness of government debt due to its liquidity and safety, would help reduce borrowing costs. A higher convenience yield thus enables the government to sustain more debt at lower cost without financial strains. Convenience yields may also be interpreted as a financial repression alternatively.

2.3 Limited Commitment Factors

The final set of factors affecting the maximum sustainable debt arises from the government's limited commitment to honoring its debt. High default-related costs, including on output and revenue losses, deter default and encourage the government to maintain low debt levels. Higher default costs on output ($1 - \alpha$) tend to increase the economic damage, making default less attractive for the government. Consequently, the government is incentivized to

⁴The paper assumes the hedging cost is captured solely by the standard deviation of GDP growth. This simplification is particularly relevant for countries with limited access to international risk-sharing. A more general specification would model hedging costs as a function of the covariance between domestic GDP growth and global capital market returns, which could reduce the effective cost of hedging.

avoid default, enhancing its maximum sustainable debt. Similarly, higher default tax costs (κ) increase the economic losses associated with default, further discouraging default and improving the government’s ability to sustain debt.

3 Data and Calibration

This section calibrates the model parameters using several data sources, including the IMF WEO database for macro-fiscal variables and the IMF Sovereign Debt Monitor database for sovereign yields. The parameters to be calibrated are categorized into fiscal parameters, macroeconomic parameters, and limited commitment parameters in the model.

3.1 Fiscal Factors

The tax distortion parameter (φ) represents the deadweight loss associated with tax collection. Higher tax distortion reduces the optimal tax. The parameter (φ) is set at a value of 3.7 from (Jiang, Sargent, Wang, and Yang, 2024), and is assumed to be constant across countries.

Tax capacity ($\bar{\tau}$) refers to the maximum tax rate a government can impose that is politically feasible. The calibration of $\bar{\tau}$ uses several approaches. For AEs, the parameter on tax capacity $\bar{\tau}$ is set to generate a primary surplus of 5 percent of GDP, which corresponds to the 95th percentile of the distribution of primary balances among advanced economies during the sample period 2000-2024.

For EMs and LICs, the tax capacity parameters ($\bar{\tau}$) use the values from the IMF (2023), with $\bar{\tau}$ set to 5 percent for EMs and 6.7 percent for LICs, respectively. At these levels, tax-to-GDP ratios are higher than the historical average and exceed the historically high tax-to-GDP ratios for some countries. ⁵

Government spending (γ) is calibrated using historical average data on government expenditure during 2000-2024. Data on general government expenditures are used (instead of the

⁵We note that the calibration may result in tax capacity binding for certain countries. Alternatively, we calibrate $\bar{\tau}$ using a uniform, nonbinding value, typically 0.8, which reflects an 80% tax-to-GDP ratio. This approach is particularly applicable to countries where tax capacity is highly constrained, such as large emerging markets e.g., *China* or advanced economies e.g., *Italy*, *the United Kingdom*, and *Israel*.

central government) to capture a more comprehensive measure of fiscal outlays. This approach differs from the other calibration for the United States (e.g., [Jiang, Sargent, Wang, and Yang \(2024\)](#)), which focuses only on federal government expenditures as a measure of fiscal spending.

3.2 Macroeconomic Factors

The risk-free rate (r) represents the return on investments that carry no default risk. The parameter for the global risk-free rate is calibrated based on the effective real interest rate of the U.S. government. Specifically, the effective real interest rate in period t , denoted as r_t , is calculated by taking the ratio of government interest payments in the current period t to the total debt outstanding from the previous period ($t - 1$), and then subtracting the inflation rate for the current period. This adjustment expresses the risk-free rate in real terms, removing the effect of inflation to provide a measure of the real cost of borrowing in a risk-free environment. To emphasize long-term trends and mitigate short-term fluctuations, the data series is averaged over the period 2000–2029. This results in a value of 0.9 percent for the real risk-free rate.

Economic growth (g) is calibrated using the historical average GDP growth since 2000 as a proxy for the long-term growth. For most countries, the calibration relies historical averages. The exception is for Japan, where the calibration uses medium-term growth forecasts instead, because growth has been lower than the historical trend. Economic growth for LICs exhibits the highest average growth rate (4.3 percent), followed by EMs (3.5 percent) and AEs (2.1 percent). However, the distribution of growth rates is more volatile in EMs and LICs (standard deviations of 1.82 percent and 1.84 percent, respectively) compared to AEs (1.11 percent).

The hedging cost (λ) is calibrated based on the standard deviation of historical growth rates across countries. This cost reflects the additional return required by investors to compensate for the volatility of economic output as mentioned above. Output volatility increases progressively from AEs (an average of 1.6 percent) to EMs (3.1 percent) and LICs (3.3 percent), reflecting the higher economic fluctuations typically observed in EMs and LICs.

The convenience yield (δ) represents the benefit or premium of holding government debt as safe assets, often interpreted as a liquidity premium or as reflecting differences in bond structures, such as currency or maturity composition. In the baseline calibration, the convenience

yield parameter δ is set to 0.5 percent for the United States, Japan, and Germany in line with [Krishnamurthy and Vissing-Jorgensen \(2012\)](#), while it is set to 0.1 percent for all other countries. It is set as a positive but small value for technical reasons because the model suggests that the government will only frontload borrowing in the presence of a positive convenience yield.⁶

The parameter for the debt surge probability ($\tilde{\zeta}$) captures the risk of sudden and substantial increases in government debt. While [Jiang, Sargent, Wang, and Yang \(2024\)](#) adopts the disaster risk calibration from [Rebelo, Wang, and Yang \(2022\)](#), which focuses on extreme GDP contractions, this paper considers calibrating the parameter based on the tail risks in debt dynamics. Specifically, we estimate a Pareto distribution for episodes in which the change in the debt-to-GDP ratio exceeds 10 percent. This approach narrows the focus to rare but impactful episodes of debt surges driven by severe shocks or abrupt policy changes. By focusing on the upper tail of the empirical distribution of debt changes, the calibration provides a robust estimate of the likelihood of extreme fiscal events that lead to a debt surge. Based on the estimated Pareto distribution, the calibrated value for the probability of a debt surge ($\tilde{\zeta}$) is at 8.2 percent for LICs, 5.9 percent for EMs, and 4.3 percent for AEs, reflecting the large differences in debt fluctuations and exposure to fiscal shocks across income groups.

3.3 Limited Commitment Factors

Two parameters related to limited commitments are calibrated. First, the default output cost parameter $(1 - \alpha)$ captures the economic consequences of sovereign default. For advanced economies (AEs) with available sovereign spread data, the parameter α is estimated following the methodology in [Jiang, Sargent, Wang, and Yang \(2024\)](#) by matching the model-implied dynamics of debt and spreads to the moments observed in the empirical data. In the model, the default cost determines the maximum sustainable debt of a country, which in turn influences sovereign spreads at different debt levels. The sovereign spread ($\tilde{\zeta}(b/\bar{b})^\omega$) is modeled as a function of the current debt level relative to the maximum sustainable debt threshold; thus, the value of α is solved by minimizing the distance between the data and the model-generated debt level and spread jointly. The data on sovereign spreads are obtained from

⁶As an alternative, we could use a formula from the [Diamond and Van Tassel \(2022\)](#) to capture δ , which assumes a linear relationship between the sovereign bond interest rate and the convenience yield. Specifically, they report that a 1 percentage point increase in a country's interest rate is associated with a 15 basis point increase in its convenience yield. In reality, the convenience yield could also reflect the degree of financial repression.

the IMF Sovereign Spread Monitor.⁷ In cases where sovereign spread data are not available for AEs, the default cost is set at a conservative benchmark of 5 percent. For EMs and LICs, the parameter α is calibrated using the average effective spread at the average debt level, conditional on data availability. Specifically, effective spreads are calculated as the effective interest rate differential relative to the U.S. effective interest rate.⁸ This approach accounts for the possibility that observed borrowing costs reflect more than just the default risk, including other factors such as liquidity premiums or discounts arising from domestic currency issuance or long-term inflation-indexed bonds. The measure of effective interest rate spreads is a more accurate than using the spreads on external sovereign bonds, because the former measure can more accurately capture comprehensive borrowing conditions faced by sovereigns. On average, AEs have a slightly higher default cost (lower α) than EMs and LICs. The data also show that there is large variation in α among EMs but less so among AEs and LICs.

Second, for the default cost on tax collection (κ), the value is set using [Jiang, Sargent, Wang, and Yang \(2024\)](#), which calibrates κ to be 1.3. It measures the potential increase in deadweight loss from taxation once the government enters a default regime, relative to the usual regime, which imposes a deterring effect on government borrowing.

4 Results

In this section, we present a cross-country analysis, time series study, decomposition, and sensitivity analysis.

4.1 Cross-Country Analysis

This section presents the results for over 170 economies. Based on the calibrated parameters, the results show that the maximum sustainable debt varies significantly across countries, as illustrated in [Figure 2](#). Across country groups, AEs exhibit the highest sustainable debt

⁷Spreads are calculated as the difference between a bond’s yield and the linearly interpolated yield of the two base curve bonds (U.S. and German bonds) that bracket the maturity of the given bond. Certain bonds are excluded to ensure smooth base curves: 20-year U.S. bonds are removed, and only the most recently issued bond is retained when multiple bonds mature in a given month. For Germany, green bonds and bonds issued more than nine years ago are excluded. This filtering ensures reliance on liquid, recently issued instruments. The dataset covers over 100 countries and regions from 2012 to 2023.

⁸This is calculated in the same way used in calculating the global risk-free rate.

Table 1: Summary Statistics of Selected Parameters by Country Group

Parameter	Statistic	AEs	EMs	LICs
$\bar{\tau}$ (Tax capacity, percent)	Mean	48.99	41.71	39.87
	Std. Dev	14.82	16.71	25.24
	25th pct	41.76	30.94	26.90
	Median	46.70	36.89	31.62
	75th pct	54.38	48.92	45.25
α (1-Default cost, percent)	Mean	95.42	96.22	95.69
	Std. Dev	1.03	2.05	1.06
	25th pct	95.00	94.00	95.00
	Median	96.00	96.17	95.00
	75th pct	96.00	98.45	96.79
γ (Spending/GDP, percent)	Mean	39.34	29.13	22.91
	Std. Dev	8.50	12.28	15.32
	25th pct	35.75	21.77	15.19
	Median	40.57	26.50	17.88
	75th pct	45.16	33.17	24.81
λ (Hedging cost, percent)	Mean	1.62	3.09	3.28
	Std. Dev	1.25	3.01	1.94
	25th pct	0.75	1.27	1.82
	Median	1.21	2.15	2.73
	75th pct	1.92	3.43	3.88
g (GDP growth, percent)	Mean	2.12	3.53	4.29
	Std. Dev	1.11	1.82	1.84
	25th pct	1.35	2.27	3.11
	Median	2.05	3.39	4.14
	75th pct	2.83	3.96	5.67
Parameter	Description	AEs	EMs	LICs
r (Real risk-free rate, percent)	Effective US rate	0.9	0.9	0.9
δ (Convenience yield, percent)	0.5 for USA, JPN, DEU	0.5 / 0.1	0.1	0.1
	0.1 others			
φ (Tax distortion)	Jiang, Sargent, Wang, and Yang (2024)	3.7	3.7	3.7
κ (Default tax cost)	Jiang, Sargent, Wang, and Yang (2024)	1.3	1.3	1.3
$\tilde{\zeta}$ (Debt surge probability, percent)	Mean	4.3	5.9	8.2

levels, followed by EMs, and LICs, respectively. LICs face the most constrained limits, suggesting they cannot afford high levels of debt before defaulting.

The average maximum sustainable debt across countries in 2024 was about 124 percent of GDP for AEs, 76 percent of GDP for EMs, and 57 percent of GDP for LICs. These large differences primarily reflect underlying variations in key factors. AEs often benefit from relatively stable financing conditions and access to capital markets, characterized by high convenience yields for systemically important countries, lower output volatility, and a low probability of debt surge events (e.g., recognition of contingent liabilities or government arrears). These factors contribute to sustaining higher debt levels relative to fiscal capacity among AEs. In contrast, EMs and LICs typically face higher financing costs, greater economic volatility, and a higher likelihood of sudden debt surges from contingent liabilities. These constraints limit their maximum sustainable debt levels even though the average growth rates are higher than those of AEs. Current debt levels for many EMs and LICs are already close to their estimated sustainable debt levels, suggesting limited fiscal space for additional borrowing without endangering debt sustainability.

Based on the IMF World Economic Outlook projection, Figure 2 illustrates a negative relationship between the gap to maximum sustainable debt and the debt level. In 2024, 54 out of 172 countries had debt levels already exceeding their estimated sustainable level, reflecting high risks to the debt situation. By 2029, this number is projected to decline slightly to 49 countries, considering the benchmark remains at the 2024 maximum sustainable debt estimates. Of the 54 countries with debt exceeding their sustainable level, 37 are projected to have a decline in debt by 2030, which highlights the need for fiscal adjustments in countries with high debt, particularly those with debt levels close to or exceeding their sustainable levels. Such adjustments would help mitigate the risk of debt distress and preserve macroeconomic stability.

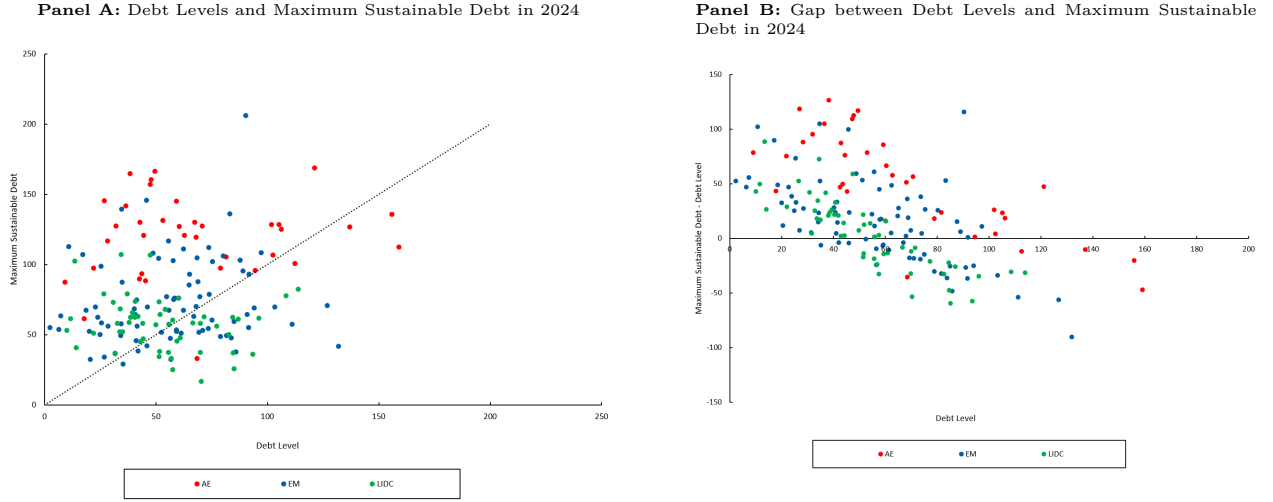
Table 2: Gaps between maximum sustainable debt and debt level in 2024 by Rating Category, LIC DSF (percent)

Rating	# Countries	Gap (percent)
Low	7	28.8
Medium	24	12.6
High	21	3.4
Distress	9	−44.0

Source: IMF and World Bank. <https://www.worldbank.org/en/programs/debt-toolkit/dsa>. The Gap is the difference between maximum sustainable debt and debt level.

Table 3 shows the distribution of debt gaps to maximum sustainable level across countries

Figure 2: Debt Levels and Maximum Sustainable Debt across Countries in 2024.



Note: Panel A illustrates the relationship between actual debt levels and estimated maximum sustainable debt thresholds for 2024. Panel B shows the gap between debt levels and maximum sustainable debt, plotted against debt levels for 2024. Colors indicate country groups: Advanced Economies (AEs, red), Emerging Markets (EMs, blue), and Low-Income Countries (LICs, green).

categorized under the Sovereign Risk and Debt Sustainability Framework for Market Access Countries (MAC SRDSF), leveraging the framework’s multiple dimensions of risk rather than relying on a single aggregate classification. The MAC SRDSF includes a set of mechanical and final assessments across long-term, medium-term, and near-term horizons, as well as indicators such as the gross financing needs (GFN) signal, the debt fanchart signal, and the sustainability classification.

The model-based maximum sustainable debt indicator aligns closely with these components. For example, countries classified as “low risk” under the long-term assessment show an average positive debt gap of 44.0 percent of GDP, compared to only 16.7 percent for those in the “high risk” category—highlighting the model’s sensitivity to differences in long-run fundamentals. Similarly, under the near-term risk assessment (Final Assessment), countries rated as low risk exhibit a gap of 39.2 percent, while those in the high-risk group show a negative gap of −15.0 percent, suggesting that their current debt levels exceed sustainable limits. This distinction is also evident under the overall risk of sovereign stress, where the gap ranges from 48.0 percent (low risk) to −17.2 percent (high risk), underscoring the model’s ability to flag solvency concerns in vulnerable cases.

Importantly, the sustainability assessments (Final Assessment) also reflect a coherent pattern. For example, countries assessed as "sustainable with high probability" based on me-

Table 3: Gaps between maximum sustainable debt and debt level in 2024 by Rating Category, MAC SRDSF (percent)

Indicator Description	Low	Moderate	High	
Long-term Assessment, Final Assessment	43.95	28.90	16.66	
Medium-term Index/Risk Assessment, Mechanical Signal	46.04	20.67	1.96	
Medium-term Index/Risk Assessment, Debt Fanchart, Mechanical Signal	73.62	33.09	3.28	
Medium-term Index/Risk Assessment, Final Assessment	50.23	17.28	2.38	
GFN, Mechanical Signal	44.50	16.9	15.26	
Near-term Risk Assessment, Mechanical Signal	40.20	7.89	-10.81	
Near-term Risk Assessment, Final Assessment	39.17	8.08	-14.99	
Overall Risk of Sovereign Stress, Final Assessment	48.01	17.35	-17.15	
Indicator Description	0	1	2	3
Debt Stabilization in the Baseline (last 2 years), Mechanical Signal (0=No, 1=Yes)	36.50	23.50	–	–
Sustainability Assessment, Mechanical Signal (0=Sustainable with high probability, 1=Sustainable but not with high probability, 2=Unsustainable)	14.57	-26.64	-37.38	–
Sustainability Assessment, Final Assessment (0=Sustainable with high probability, 1=Sustainable but not with high probability, 2=Unsustainable, 3=Sustainable)	36.29	-24.22	-24.19	35.18

Note: Values are simple averages of the gap between maximum sustainable debt and debt level, by rating group. Ratings are based on the latest MAC SRDSF assessments as of June 10, 2025.

chanical signal display an average debt gap of 14.6 percent, while those labeled "unsustainable" show a substantial negative gap of -37.4 percent. The consistency of these relationships across a wide set of SRDSF indicators demonstrates that the model captures not only one-off fiscal imbalances, but also systemic risks that are mirrored in formal IMF debt sustainability diagnostics.

4.2 Maximum Sustainable Debt over Time

In addition to the cross-country analysis, the model framework enables a detailed assessment of how maximum sustainable debt evolves over time for individual countries. This section illustrates the approach using Brazil and the United States. Historical maximum sustainable debt is recalibrated using past vintages of IMF World Economic Outlook forecasts, reflecting changes in growth rates, government spending, global risk-free rates, and growth premia, while other parameters are held constant.⁹ This approach allows for estimating maximum sustainable debt using information available at different points in time, thereby capturing shifts in macroeconomic and financial conditions.

The analysis shows that, for the selected economies, maximum sustainable debt has been relatively stable over time. Fluctuations are primarily driven by changes in growth prospects, risk premia, the global risk-free rate, and shifts in the optimal primary balance resulting from changes in government spending.

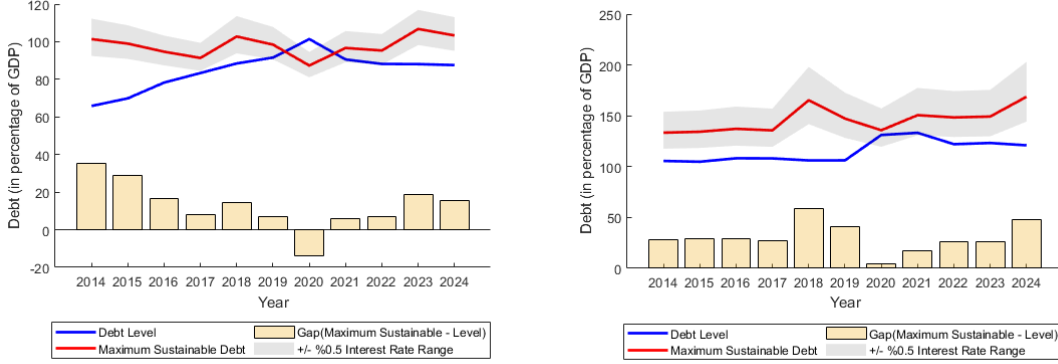
Brazil experienced a notable decline from 113.6 percent of GDP in 2014 to 91.3 percent in 2017, followed by a volatile path through the pandemic and a partial recovery to 103.3 percent in 2024. In the United States, maximum sustainable debt climbed from 160 percent of GDP in 2014 to a peak of 213 percent in 2018, fell to 154 percent in 2020, and recovered close to pre-pandemic levels by 2024.(see Figure 3)

4.3 Driving Factors for Evolving Maximum Sustainable Debt

As the maximum sustainable debt evolves over time as shown in the previous section, it is important to understand the driving forces behind these changes—essentially quantifying the contribution of each key parameter within a trackable framework. This section applies the Shapley decomposition to quantify the individual contributions of selected parameters

⁹Only IMF World Economic Outlook October vintages are used for each year of reference.

Figure 3: Debt Levels and Maximum Sustainable Debt for BRA and USA



Note: The left chart is Brazil and the right chart is the USA. The blue line represents debt levels from the October WEO vintages. The red line illustrates the dynamics of the maximum sustainable debt over 2014-2024. The gaps indicate the difference between the maximum sustainable debt and the debt level for each year. The gray shaded regions highlight the sensitivity of sustainable debt, assuming a 0.5% deviation from the baseline risk-free rate assumption.

to changes in the model-implied maximum sustainable debt b^N .

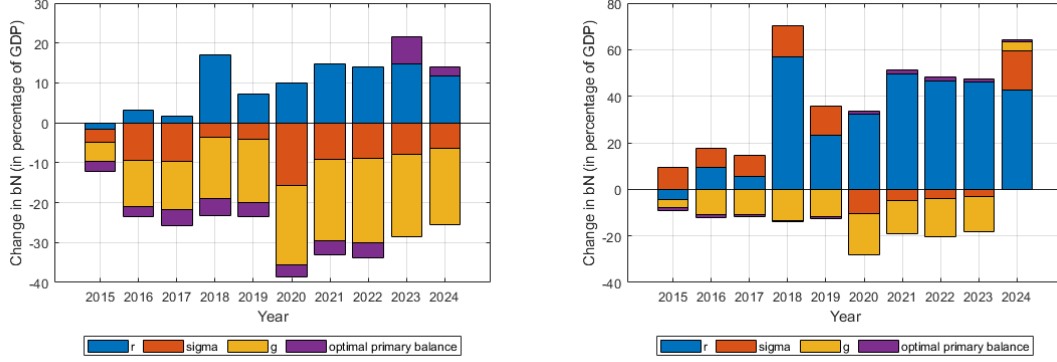
The decomposition is based on the closed-form solution of maximum sustainable debt as in equation 3 and focuses on changes in a subset of parameters—specifically, the government spending-to-GDP ratio (γ), the global risk-free interest rate (r), output volatility (σ), and the GDP growth rate (g). Other structural parameters, including the output cost of default ($1-\alpha$), the tax capacity ceiling ($\bar{\tau}$), the distortion parameter (φ), the tax adjustment cost (κ), disaster risk ($\tilde{\zeta}$), and the convenience yield (δ), are held constant throughout the exercise.

¹⁰

Since the maximum sustainable debt is defined by equations (2) and (3), it depends nonlinearly on the aforementioned parameters. The Shapley decomposition from Shapley (1953) enumerates all permutations of changing parameters. For each permutation, parameters are updated sequentially from the baseline to the counterfactual configuration, and the marginal change in b^N resulting from each parameter update is recorded. The Shapley value for a given parameter is then computed as the average of its marginal contributions across all permutations. This method allows for an exact and interpretable decomposition of the total change into its component drivers, accounting for potential interactions and nonlinearities. It is particularly well-suited to this analysis, where nonlinear interactions across variables may prevail, especially when tax capacity is binding.

¹⁰The decomposition can also applied when comparing two countries.

Figure 4: Decomposition for BRA and USA



Note: The left chart is Brazil and right right is the USA. The Shapley decomposition is based on a closed-form solution of sustainable debt as in equation 3 and focuses on changes in a subset of parameters—specifically, the government spending-to-GDP ratio (γ), the global risk-free interest rate (r), hedging cost (σ), and the GDP growth rate (g). Other structural parameters, including the output cost of default ($1 - \alpha$), the tax capacity ceiling ($\bar{\tau}$), the distortion parameter (φ), the tax adjustment cost (κ), disaster risk ($\hat{\zeta}$), and the convenience yield (δ), are held constant throughout the exercise. The sum of composition will be the difference to the maximum sustainable debt in 2014.

In the pre-COVID period (2014–2019), the United States’ maximum sustainable debt was supported by low interest rates and modest output volatility. During the COVID-19 shock in 2020, a spike in volatility by and a contraction in GDP growth coupled with increase in government spending, led to a marked decline. In the post-COVID period (2021–2024), GDP growth improved and volatility fell, it partially recovered. The actual primary balance contributed to the buildup of debt during the COVID period, and changes in model-based optimal primary balance contributed the least to the overall variation in maximum sustainable debt.

Brazil’s maximum sustainable debt also experienced a partial recovery after COVID, supported by improvements in growth and dampened volatility, but levels remain below earlier highs. GDP growth exerted a major influence on maximum sustainable debt, especially during prolonged recessions. As in the other case, the optimal primary balance had a marginal effect. The increase in spending actually improved maximum sustainable debt, given that the optimal tax rate had not yet reached the economy’s tax capacity.

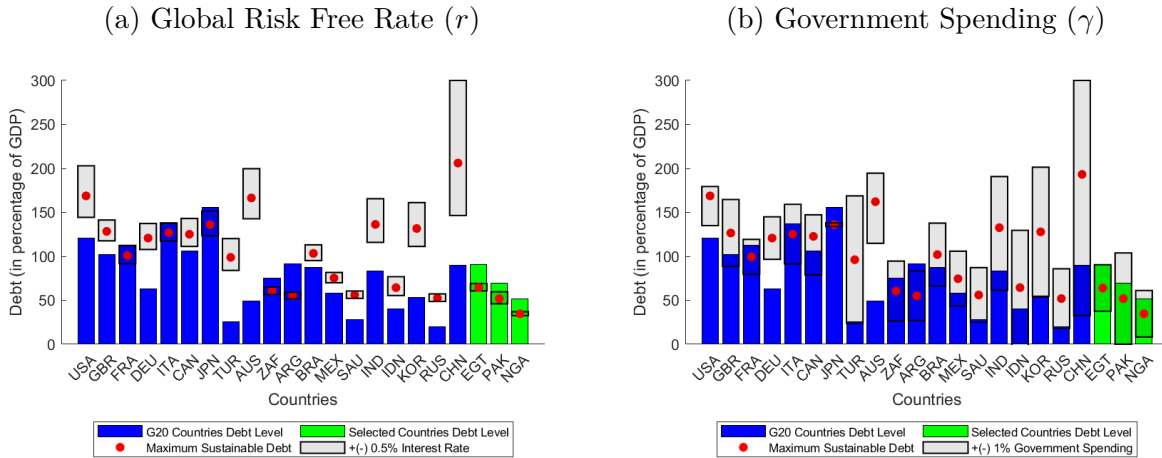
4.4 Sensitivity Analysis

It is inherently uncertain to pin down the precise maximum sustainable debt of a country at any given time, as it depends on parameters that fluctuate over time, many of which

are difficult to observe or estimate reliably. Nonetheless, this section provides sensitivity analyses to illustrate the uncertainty surrounding the estimates. The analysis focuses on two key variables: the global risk-free interest rate and the government spending-to-GDP ratio.¹¹ These variables are widely recognized as critical determinants of how much debt a country can sustain.

Higher global interest rates increase the cost of borrowing, holding other factors constant, thereby lowering the affordable level of debt. At the same time, governments often face growing expenditure pressures. Understanding how government spending affects maximum sustainable debt is therefore crucial. For countries with sufficient fiscal space, higher government spending—if temporarily debt-financed—can be matched by future revenue increases, potentially raising the sustainable debt level. In contrast, countries operating near their tax capacity may experience a reduction in the sustainable level when expenditures rise.

Figure 5: Sensitivity Analysis



Note: Blue bars (Selected G20 Countries) and green bars (selected countries whose maximum sustainable debt is below the current debt level) represent the debt levels from the October 2024 WEO vintage. Japan's data reflects net debt; all other countries use gross general government debt. In Panel (a) Red dots represent baseline maximum sustainable debt in 2024 estimated using the framework [Jiang, Sargent, Wang, and Yang \(2024\)](#). The gray shaded regions indicate the sensitivity of the estimates, assuming a 0.5% deviation from the baseline risk-free rate assumption. In panel (b), we assume a 1.0% of GDP deviation from the baseline government spending assumption.

An increase in the global risk-free rate raises the interest-growth differential ($r + \tilde{\zeta} + \lambda - \delta - g$) at the default threshold. According to Equation 3, this directly affects the debt limit via the denominator of the closed-form solution. Figure 5a illustrates the impact for a selected group

¹¹[Jiang, Sargent, Wang, and Yang \(2024\)](#) provides a comprehensive sensitivity analysis along similar dimensions.

of countries. The shaded area reflects a ± 0.5 percentage point confidence band around the baseline global risk-free rate, consistent with the historical standard deviation of the U.S. effective interest rate over the past 15 years.

The sensitivity of maximum sustainable debt to interest rates is governed analytically by the term:

$$\frac{\partial \bar{b}}{\partial r} = -\frac{\bar{b}}{r + \tilde{\zeta} + \lambda - \delta - g},$$

where $\bar{b}$ is the debt limit. When this denominator is small—particularly when it approaches zero—the debt limit becomes highly sensitive to changes in the interest rate, resulting in a wider confidence band. Moreover, a higher baseline estimate magnifies the absolute effect of marginal changes in r . The same logic applies to the growth rate g and other parameters appearing in the denominator.

A parallel sensitivity analysis is conducted for government spending. Figure 5b shows how maximum sustainable debt responds to a permanent shift in the government spending-to-GDP ratio. The analysis considers a ± 1 percentage point deviation from the baseline, consistent with typical medium-term fiscal adjustments observed in historical data. As with the interest rate channel, the denominator term $(r + \tilde{\zeta} + \lambda - \delta - g)$ governs sensitivity. However, the direction of the effect depends on whether the country is constrained by its tax capacity. In economies with limited tax space, higher spending reduces the feasible primary balance, lowering the debt limit. Conversely, for countries with ample tax capacity, higher spending can be associated with a higher future tax path, thereby increasing the sustainable debt level. These results align with the theoretical predictions in [Jiang, Sargent, Wang, and Yang \(2024\)](#).

5 Conclusion

With global public debt projected to remain elevated by the end of the decade and subject to significant upside risks, understanding the limits of debt sustainability is more urgent than ever. This paper contributes by offering a unified, empirically grounded framework that incorporates tax distortions and asset-pricing components (risk-free rates, convenience yields, and jump-risk premia) to estimate the maximum sustainable debt across a broad set of countries and over time.

Our results underscore that sustainable debt levels are shaped by a complex interplay of

macro-fiscal fundamentals, asset pricing, and sovereign risk. While some advanced economies tend to have higher sustainable debt thresholds, they remain vulnerable to shifts in global risk-free rates. Emerging markets and low-income countries, on the other hand, face tighter constraints, with several already exceeding their estimated sustainable levels—highlighting elevated risks of debt distress.

The framework’s tractability allows for clear identification of country-specific drivers and their relative importance. Sensitivity analyses reveal that sustainable debt estimates are highly responsive to key parameters, particularly when interest-growth differentials are narrow. These findings reinforce the need for dynamic, country-specific assessments to inform prudent fiscal policy and debt management strategies in an increasingly uncertain global environment.

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