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The Effects of Fiscal Consolidations on the Debt Distribution

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ABSTRACT: This paper estimates the effects of fiscal expenditure consolidations on the entire distribution of public debt-to-GDP for an unbalanced sample of 192 countries over the period 1991-2021. Employing panel location-scale models, we show that government expenditure cuts significantly lower the location (average) of the future debt-to-GDP distribution and its scale (variance), thus also implying a reduction in the uncertainty surrounding public debt. Consequently, we uncover a downward sloping trend in the effects of government expenditure consolidations across the quantiles of the debt-to-GDP distribution. These effects persist up to a 4-year forecast horizon, with the highest reduction occurring on the right tail of the debt-to-GDP distribution, defined as debt-at-risk. We also show that fiscal expenditure consolidations are more effective in reducing debt-to-GDP when the debt levels are higher and when countries adopt a fiscal rule.

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WORKING PAPERS

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Contents

I. Introduction

Public debt levels are significantly elevated worldwide and are projected to increase further and approach 100 percent of GDP by the end of the decade (IMF 2025) (Figure 1, panel a). Furthermore, the risks associated with these projections are skewed to the upside. Based on the debt-at-risk framework developed by Furceri et al. (2025), it is estimated that in a severe adverse scenario, global public debt could surge to approximately 117 percent of GDP by 2027. This level of debt has not been witnessed since World War II and would be about 20 percentage points higher than current projections (Figure 1, panel b).

High levels of debt and debt-at-risk are concerning as they reduce fiscal space and tend to foreshadow sovereign stress (Furceri et al 2025). To mitigate these risks, several countries would need to adopt fiscal consolidation measures to bring down debt levels and accommodate the increasing spending pressures associated with climate change, defense, and development objectives. The magnitude of the fiscal consolidation depends crucially on its effect on debt over time. However, while several studies in the empirical literature have examined the effect of fiscal consolidations on economic activity (see, for example, Guajarado, Leigh and Pescatori 2014; Alesina, Favero and Giavazzi 2015; Alesina et al. 2016; Carrière-Swallow, David, and Leigh 2021), the relationship between fiscal consolidation and debt (and moreover, on debt risks) remains less well explored.

We shed light on this issue by examining how fiscal consolidations affect the entire future debt distribution. In particular, we extend the location-scale model (Machado and Santos Silva, 2019) into a local projection framework (Jorda, 2005) to estimate impulse response functions across various quantiles of the debt distribution for an unbalanced annual panel of 192 countries from 1991-2021. To identify fiscal shocks, we adopt a methodology similar to that of Auerbach and Gorodnichenko (2013) and Colombo et al. (2024), which relies on forecast errors of government spending.[6] This approach is more suitable than other methods employed in the literature for identifying unanticipated exogenous fiscal shocks across a large set of countries on an annual basis (see discussion in the next section).

[6] We focus on government expenditure shocks as their identification for the large set of countries in our sample is more feasible, and, unlike revenues, they are not driven by cyclical forces. Moreover, the literature on fiscal consolidations shows that expenditure-based consolidations are more effective than tax-based consolidations in reducing debt ratios (see Alesina, Favero and Giavazzi, 2019).

Our findings indicate that government expenditure consolidations reduce both the future level of debt-to-GDP and its associated uncertainty. Specifically, both the location and scale parameters related to the expenditure consolidation variable are negative and statistically significant across all forecast horizons. This suggests that the effects of consolidation intensify in magnitude across the quantiles of the debt-to-GDP distribution, with a more pronounced and persistent negative impact observed in the right tail. In terms of magnitude, a one percent of GDP reduction in government expenditure is found to reduce the 95th quantile of the debt-to GDP distribution (debt-at-risk) by 1 percentage point in the short term and by 1.5 percentage point in the medium term. In contrast, the effects on the left tail of the debt distribution (the 5th quantile) are lower in magnitude and less precisely estimated. These results are robust across several specifications and sensitivity tests.

As the future debt distribution is a function of key fiscal and macroeconomic variables, we study the mechanisms through which expenditure consolidations affect debt risks by analyzing the location and scale effects of such consolidations on various debt drivers—government revenues and government expenditure, real GDP, inflation, and real long-term interest rates. The effects on GDP are estimated in terms of government expenditure multipliers, using the approach proposed by Ramey and Zubairy (2018). The results indicate that spending-based consolidations lead to reductions in revenue levels (due to lower output), price levels, GDP, and interest rates. Notably, and as a novel contribution, fiscal consolidation also negatively affects the scale of many of these variables, thereby reducing both fiscal and macroeconomic uncertainty.

Finally, we extend the analysis to explore potential non-linearity and state-dependency in the effects of fiscal consolidation on the future debt distribution. Among the several structural and cyclical factors we have examined, two stand out: the introduction of fiscal rules and the initial level of public debt. Fiscal rules amplify the impact of fiscal consolidation on both the level of debt and its associated uncertainty. The result implies that fiscal rules further enhance the effects of fiscal consolidation on debt-at-risk: fiscal consolidations reduce the debt-to-GDP ratio by more than 1.2 percentage points in the medium term when a fiscal rule is in place, whereas they result in a medium-term decline of less than 0.5 percentage points when the fiscal rule is absent. This result is consistent with much of the theoretical and empirical literature suggesting that fiscal rules bolster the credibility of fiscal actions. In addition, we find that fiscal consolidations significantly reduce debt-at-risk when debt levels are elevated. This is attributed to the fact that the reduction in both the location and scale of the debt-to-GDP distribution is considerably greater at higher debt levels compared to lower ones.

Our paper engages with two primary streams of literature. The first pertains to the relationship between fiscal actions and debt (see, for example, Reinhart, Reinhart and Rogoff 2015; Kose et al. 2022; Ando et al. 2025). Reinhart, Reinhart and Rogoff (2015) discuss a wide range of options available to countries to reduce public debt. Kose et al. (2022) present alternative policies aimed at lowering public debt ratios, with a focus on developing economies. Ando et al. (2025) empirically examine the effects of fiscal consolidations on public debt in 21 advanced economies and 37 emerging markets. Using a Structural Vector Autoregression approach with (zero and sign) restrictions—assuming that shocks to the primary balance are positively correlated with the primary balance-to-GDP ratio and negatively correlated with GDP, while being orthogonal to general demand and supply shocks—they find mixed evidence that improvements in the primary balance shock reduce public debt ratios. Additionally, they differentiate between successful and unsuccessful shocks by imposing the restriction that a successful primary balance shock lowers public debt ratios, while an unsuccessful one increases them. We contribute to this literature along two key dimensions. First, we analyze the effects of fiscal consolidations across a significantly larger set of countries, including advanced economies, emerging markets, and developing nations. Second, we employ a strategy to identify fiscal shocks, which, as we demonstrate in the next section, allows us to isolate shocks that are unpredictable and exogenous to current and lagged macroeconomic conditions (Ramey, 2016).

We also contribute to a growing body of the literature examining the impact of policy shocks on growth and debt risks. Forni et al. (2024) have examined the impact of monetary policy shocks on the distribution of output. Frangiamore et al. (2025) have extended the analysis to a sample of 20 advanced and 13 emerging market economies. Loria, Matthes and Zhang (2015) have examined whether the asymmetry and tail risks in GDP and industrial production growth observed in the US have been driven by specific structural shocks, such as monetary policy shocks, financial shocks, uncertainty shocks and oil price shocks. Our contribution to these studies lies in our focus on fiscal policy shocks while considering a very large and diverse set of countries. We are closely linked to Frangiamore, Furceri and Giannone (2025), who examine the impact of fiscal spending news shocks on output for the US economy. They find that higher government expenditure not only stimulates growth on average, but also reduces macroeconomic uncertainty, generating a stronger combined effect on growth-at-risk, which translates into higher public spending multipliers at the left tail of output. We extend this work by focusing on public debt and examining both advanced and developing economies as well as potential non-linearities. Lastly, our paper builds on the findings of Furceri et al. (2025), which consider several drivers of debt-at-risk, including budget deficits. In contrast to this paper, we aim to identify causal effects by focusing on plausibly exogenous fiscal policy actions.

The rest of the paper is organized as follows. Section II describes the data and the empirical methodology. Section III presents the baseline results and robustness checks. Section IV discusses the results on the location-scale effects of government expenditure consolidations on key fiscal and macroeconomic variables. Section V explores potential non-linearity. Section VI concludes.

II. Data and methodology

II.1 Data

We construct an unbalanced panel dataset covering 192 countries during the period 1991-2021. The data is at an annual frequency and is sourced from the October releases of the IMF World Economic Outlook (WEO) database.[7] We collect data on debt and other fiscal variables—such as total government expenditure, overall balance and government revenues—as percent of GDP, along with key macroeconomic variables affecting debt dynamics, including long-term real interest rates, inflation and GDP. Moreover, we retrieve the October forecast for the same year of government expenditure, GDP and inflation to identify fiscal shocks following the approach of Colombo et al. (2024) (see section II.3). The list of countries included in the sample and descriptive statistics of the variables used are provided in Table C.1 and C.2 of Annex C.

II.2 Empirical methodology

We employ the location-scale model (Machado and Santos Silva 2019) to examine the effects of fiscal expenditure consolidations on the entire distribution of public debt to GDP. The model enables us to estimate the effects of expenditure consolidations on the location (mean) but also on the scale (variance) of the distribution of debt-to-GDP, allowing us to recover these effects across the entire distribution through the estimation of conditional quantile coefficients.[8] Employing standard quantile regressions in our context is not appropriate due to the panel structure of our dataset, as we cannot incorporate country dummies to control for country fixed effects without introducing an incidental parameters problem. In

[7] The countries included in the sample and the period covered in the analysis are constrained by the availability of data on government expenditure forecasts.

[8] The application of the quantile regression framework in empirical macroeconomic research, along with the growing interest in analyzing the tails of macroeconomic outcomes, has been popularized by Adrian, Boyarchenko, and Giannone (2019) and has seen substantial growth in recent years.

contrast, the location-scale model developed by Machado and Santos Silva (2019) permits countries' characteristics to influence the entire debt-to-GDP distribution rather than merely shifting its position, as is the case with other quantile regression estimators for longitudinal data with fixed effects (see, for example, Koenker 2004 and Canay 2011).

Our baseline specification is an extension of the local projections approach (Jordà, 2005) applied to the location-scale model:

$$d_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X_{i,t}'\beta_{2,h} + \left(\delta_{i,h} + \gamma_{1,h} g_{i,t} + X_{i,t}'\gamma_{2,h}\right)\varepsilon_{i,t+h} \quad (1)$$

where $d_{i,t+h}$ is the debt-to-GDP ratio (percent) observed h years ahead of the fiscal expenditure consolidation, with $h = 0, 1, \cdots, 4$; $g_{i,t}$ is government expenditure as percent of GDP; $X_{i,t}$ is a large vector of control variables included for identification purposes (see details in section II.3); $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects which capture non-time-varying country-specific factors affecting both the level as well as the dispersion of the debt-to-GDP ratio distribution; $\varepsilon_{i,t+h}$ is the error term.

Equation (1) implies that the τ-th conditional quantile of debt-to-GDP is given by:

$$Q_{d_{i,t+h}}\left(\tau | g_{i,t}, X_{i,t}\right) = \left(\alpha_{i,h} + \delta_{i,h} q(\tau)\right) + \beta_{1,h} g_{i,t} + X_{i,t}'\beta_{2,h} + \left(\gamma_{1,h} g_{i,t} + X_{i,t}'\gamma_{2,h}\right) q(\tau) \quad (1)$$

where $q(\tau)$ is the inverse of the cumulative density function of the error term evaluated at the τ-th quantile, namely $q(\tau) = F_{\varepsilon}^{-1}(\tau)$. The quantile regression coefficient capturing the effect of an expenditure shock on a particular quantile of the debt-to-GDP ratio (all else equal) is given by $\beta_{1,h} + \gamma_{1,h} q(\tau)$.

The key parameters linking expenditure consolidations to the predicted debt distribution are therefore the location and scale parameters. The location parameter $\beta_{1,h}$ measures the "average" effects of government expenditure on the debt-to-GDP ratio. In contrast, the scale parameter $\gamma_{1,h}$ determines whether this average effect differs across quantiles. The case of $\gamma_{1,h} = 0$ corresponds to the standard linear local projections, and it implies that government expenditure only shifts the debt-to-GDP distribution, affecting the quantiles uniformly (Panel A in Figure 2). When $\gamma_{1,h} \neq 0$, government expenditure has asymmetric effects on the debt-to-GDP distribution. In particular, if β and γ have the same sign (Panel B Figure 2), the mean and the variance of the predictive distribution are positively correlated. In this scenario, an increase in government expenditure not only shifts the distribution to the right but also increases the right tail more than the left, resulting in a more right-skewed distribution. On the other hand, if β and γ have the opposite sign, the mean and the variance of the conditional distribution are negatively correlated. In this case, an increase in government expenditure shifts the distribution to the right, but the effects are more pronounced on the left tail, thereby increasing downside risk (see Panel C of Figure 2). To illustrate the effects of a reduction in government expenditure, we multiply both coefficients by -1.

In our empirical application, we estimate the quantile coefficients for the grid of quantiles $\tau = 0.05, 0.10, 0.15, \cdots, 0.95$. This approach allows us to assess the heterogeneous effects of fiscal expenditure consolidations across different quantiles of debt-to-GDP distribution. We specifically focus on the regression coefficients for the 95-th quantile, defined as debt-at-risk (Furceri et al., 2025). The estimation of the location-scale model involves the following five steps:

1. Regress $\left(d_{i,t+h} - \sum_t d_{i,t+h}/T\right)$ on $\left(g_{i,t} - \sum_t g_{i,t}/T\right)$ and $\left(X_{i,t} - \sum_t X_{i,t}/T\right)$ to obtain an estimate of the location parameters, $\hat{\beta}_1$ and $\hat{\beta}_2$;
2. Estimate the country fixed effects of the location model $\hat{\alpha}_i = \frac{1}{T}\sum_t\left(d_{i,t+h} - \hat{\beta}_1 g_{i,t} - X'_{i,t}\hat{\beta}_2\right)$ and compute the residuals $\hat{r}_{i,t+h} = d_{i,t+h} - \hat{\alpha}_i - \hat{\beta}_1 g_{i,t} - X'_{i,t}\hat{\beta}_2$;
3. Regress $\left(\left|\hat{r}_{i,t+h}\right| - \sum_t \left|\hat{r}_{i,t+h}\right|/T\right)$ on $\left(g_{i,t} - \sum_t g_{i,t}/T\right)$ and $\left(X_{i,t} - \sum_t X_{i,t}/T\right)$ to estimate the scale parameters, $\hat{\gamma}_1$ and $\hat{\gamma}_2$;
4. Estimate the country fixed effects of the scale model $\hat{\delta}_i = \frac{1}{T}\sum_t\left(\left|\hat{r}_{i,t+h}\right| - \hat{\gamma}_1 g_{i,t} - X'_{i,t}\hat{\gamma}_2\right)$;
5. Compute the standardized residuals $\hat{\varepsilon}_{i,t+h} = \hat{r}_{i,t+h}/\left(\hat{\delta}_i + \hat{\gamma}_1 g_{i,t} + X'_{i,t}\hat{\gamma}_2\right)$ and obtain the desired quantile of the distribution of $\hat{\varepsilon}_{i,t+h}$, which we indicate as $\hat{q}(\tau)$.[9]

We estimate these steps using a one-step GMM estimation procedure (specifically the Stata MM-QR algorithm) and we account for time within-country correlation by computing clustered standard errors at the country level (Rios-Avila 2022).

[9] For the sake of simplicity, we omitted the subscript for the horizon h after the fiscal consolidation, but of course it is considered in the estimation when we move forward, after estimating the contemporaneous effects.

Finally, we also consider the mechanisms through which expenditure consolidations affect the distribution of the future debt-to-GDP ratio, by estimating the dynamic response of the primary balance, inflation, long-term government bond yields, and GDP. [10]

II.3 Identification of the fiscal shocks

To identify public expenditure shocks, we adopt a methodology akin to that of Auerbach and Gorodnichenko (2013) and Colombo et al. (2024), which relies on forecast errors of government spending. This approach is more suitable than other methods employed in the literature for identifying exogenous fiscal shocks across a large set of countries on an annual basis. The reasons are threefold. First, the availability of data at an annual frequency precludes the use of the Structural Vector Autoregression (SVAR) approach proposed by Blanchard and Perotti (2002), which relies on quarterly data and assumes that, due to implementation lags, government spending does not respond to the state of the economy within a quarter. However, in line with the methodology suggested by Blanchard and Perotti (2002), we use the IMF forecasts of government expenditures made in October of the same year to reduce the likelihood that unanticipated changes in government spending are influenced by the potentially endogenous response of fiscal policy to the economic conditions.[11] Second, the lack of publicly available official documentation for many emerging markets and developing economies prevents the use of the narrative approach across a large sample (Romer and Romer 2010; Guajardo, Leigh and Pescatori 2014; Carrière-Swallow, David, and Leigh 2021; Adler et al. 2024). Third, in comparison to other approaches, such as using annual changes in military spending (Miyamoto, Nguyen and Sheremirov 2019), this method inherently addresses the issue of "fiscal foresight," which occurs when agents respond to anticipated rather than realized shocks.[12]

[10] The evolution of debt can be expressed as: $d_{i,t+h} = \frac{1}{[(1+y_{t,h})(1+\pi_{t,h})]^h}\left[d_t\left(1+\sum_{j=1}^{h} r_{i,t+j}\right) - \sum_{j=1}^{h} pb_{i,t+j}\right]$, where $y_{t,h}$ and $\pi_{t,h}$ represent the real GDP growth rate and the inflation rate (geometric averages) between t and $t+h$, respectively; $\sum_{j=1}^{h} r_{i,t+h}$ and $\sum_{j=1}^{h} pb_{i,t+h}$, denote the cumulative ratio between interest payments and debt levels and the cumulative ratio between primary balance and GDP, respectively.

[11] As demonstrated by An et al. (2018), IMF forecasts of fiscal variables are usually very accurate, especially when compared to those of the private sector.

[12] See, for example, Forni and Gambetti (2010), Leeper, Richter and Walker (2012), Leeper, Walker and Yang (2013), and Ben Zeev and Pappa (2017). Agents who receive information regarding future changes in government spending may adjust their consumption and investment decisions well in advance of the actual changes. An econometrician relying on the information contained in the changes in actual spending would use a different information set than that available to economic agents, potentially resulting in biased estimates. By utilizing forecast errors, the econometrician's information becomes aligned with that of economic agents.

Specifically, we identify fiscal shocks by controlling in equation (1) for a large set of variables $X_{i,t}$ to eliminate predictable and endogenous components from government spending.[13] As discussed in Montiel-Olea et al. (2025), the Frisch-Waugh-Lovell theorem indicates that the identified shock in equation (1) represents the residual of the projection of the "impulse variable" $g_{i,t}$ on the set of control variables $X_{i,t}$:

$$\tilde{g}_{i,t} = g_{i,t} - E\left(g_{i,t} | X_{i,t}\right) \quad (3)$$

The set of control variables $X_{i,t}$ includes:

- *The forecast of government expenditure as a percentage of GDP*. This implies that our shock captures the part of government expenditure that is not anticipated. As discussed above, we use the forecasts published in October of the same year to mitigate the risk that unexpected changes in government spending are influenced by the potentially endogenous reaction of fiscal policy to economic conditions. Indeed, even unanticipated changes may be triggered by the business cycle; for instance, if economic growth unexpectedly weakens, the government might be compelled to reduce spending. However, for such responses to affect our estimates, they would need to occur within the same quarter that new economic information becomes available (i.e., between October and December). Given the delays inherent in the legislative process, such rapid adjustments are highly improbable (see also Blanchard and Perotti, 2002).
- *Contemporaneous and lagged endogenous variables*. Following Colombo et al. (2024), we include the October forecasts for the same year of GDP growth and inflation as well as lags of debt-to-GDP ratios, government expenditure (as share of GDP), GDP growth, and inflation. This approach helps ensure that the identified shocks are orthogonal to both current and lagged endogenous macroeconomic variables.

The fiscal shocks identified satisfy the three key characteristics of exogeneity as delineated by Ramey (2016). First, and as previously mentioned, they are uncorrelated with current and lagged endogenous

[13] An alternative approach would be to consider the shocks as instruments for government spending. This approach, however, is problematic in the context of quantile regressions. Although Instrumental Variables (IV) quantile regressions have primarily been utilized in cross-sectional studies (see Chernozhukov and Hansen 2006; Kaplan and Sun 2017), applying these estimators to panel data necessitates the assumption of homogeneous country fixed effects across quantiles. This can be achieved by removing fixed effects in the first stage, as suggested by Canay (2011). Additionally, the inference provided by these estimators accounts solely for heteroskedasticity, which limits their applicability to our dataset due to the presence of serial correlation (within-country) that is mechanically introduced by the local projection method (see Jordà 2005).

variables. We demonstrate this by regressing the fiscal shocks against the first principal component of a set of endogenous macroeconomic variables—such as output, government spending, real exchange rate, and inflation—along with the first principal component of a set of macroeconomic variable forecast errors, such as those related to output, private consumption, and investment. [14] The results (see Table C.3 in Annex C) indicate that none of these variables is significantly correlated with our fiscal shocks. Second, they are unanticipated as they are constructed as unexpected changes in government spending. Third, they are uncorrelated with other non-fiscal shocks—such as the World Uncertainty Index constructed by Ahir, Bloom and Furceri (2022) (both the general index and the indices for the fiscal and political categories), as well as the monetary policy shocks identified by Furceri, Loungani and Zdzienicka (2018) (see Table C.3 in Annex C).

Table C.4 contains descriptive statistics of the government spending shocks, while Figure C.1 shows their distribution for the entire sample and for the sub-samples of Advanced Economies and Emerging Markets and Developing Economies. The average and median of the shock are both approximately zero, indicating an unbiased forecast. The interquartile range (25th to 75th percentile) lies between -1.4% and 1.1%.

III. Baseline results

III.1 Baseline results

Our main result is that fiscal expenditure consolidations are associated with lower future debt levels and debt risks. Figure 3 reports the estimated location and scale parameters ($\beta_{1,h}$ and $\gamma_{1,h}$) for the impact of government expenditure consolidations on the distribution of debt-to-GDP across various forecast horizons. It shows that a one percent of GDP reduction in government expenditure statistically significantly lowers the mean (location) of the debt-to-GDP ratio by about 0.7 percentage point on impact, with a peak response of about 0.9 percentage point after two years. The effect diminishes in the medium term, but it remains statistically significant (left panel). Importantly, and as the key contribution of this paper, spending-based consolidations significantly reduce the scale of the debt-to-GDP distribution in both the short and medium term (right panel). This implies that fiscal consolidation decreases the uncertainty surrounding public debt. In other words, fiscal expenditure consolidations not

[14] We take the first principal component of the variables to capture the time evolution of an underlying factor that accounts for the majority of the variation in these variables. This approach allows us to evaluate whether this factor is significantly correlated with our identified government expenditure shock

only shift the distribution of public debt-to-GDP to the left but also diminish its scale, thereby making instances of very high public debt realizations less likely. The magnitude of these effects is substantial: a one-standard deviation government expenditure consolidation shock is associated with a reduction in the level of debt-to-GDP of about 17% of its standard deviation on impact, with the effect peaking at 23% after 2 years.

The magnitude and statistical significance of the scale parameter also imply that there are asymmetric effects of fiscal expenditure consolidations on the distribution of debt-to-GDP. We show these by plotting the quantile regression effects from the location-scale model $(\beta_{1,h} + \gamma_{1,h} q(\tau))$, as depicted in Figure 4. Each panel of the figure illustrates the impact of government expenditure consolidations on the distribution of debt-to-GDP, from the 5th up to the 95th quantile (x-axis) at each time (year) horizon after the shock. The results point to a significant downward trend in the response of debt-to-GDP to a reduction in government expenditure across quantiles of the debt-to-GDP distribution, a pattern that persists across all forecast horizons considered after the fiscal consolidation.

In particular, for the left tail of the predicted debt distribution (i.e., low debt outcomes), fiscal consolidations affect public debt only in the short run and with small effects in magnitude, which disappear two years after the fiscal consolidation. In contrast, the effects of fiscal consolidations on the right tail of debt-to-GDP (i.e., high debt outcomes) are much stronger and persistent over time. Focusing on the debt-at-risk (the 95th percentile), we find that a one percent of GDP spending cut results in a reduction in debt-at-risk of about 1 percentage point of GDP in the short term and about 1.5 percentage points after five years following the fiscal expenditure consolidation. The magnitude of this effect is significant, as global debt levels at end-2024 were 93 percent of GDP and the global level of debt-at-risk at a three-year forecast horizon is estimated at around 117 percent of GDP (Furceri et al. 2025). As a benchmark, the 2024 IMF Fiscal Monitor recommends a cumulative fiscal adjustment of about 3-4.5 percent of GDP over the medium term, which, according to our calculation, would imply a reduction in the debt-at-risk of approximately 4.5 to 7 percentage points after five years.

In summary, the results indicate that fiscal expenditure consolidations not only reduce future debt-to-GDP ratios but also the uncertainty surrounding them, with stronger and more persistent effects on the right tail of the debt-to-GDP distribution, thereby lowering upside risks to public debt.

III.2 Robustness checks

We perform a series of robustness checks on the baseline results presented in Section III.1 and find that our findings remain consistent across various alternative specifications and conditioning variables.

The baseline model incorporates two lags of debt-to-GDP, government expenditure-to-GDP, and the other macroeconomic variables included in the set of controls. We test the robustness of the baseline model by varying the number of lags to 1, 3 and 4. Figure A.1 in Annex A plots the location-scale (panel (a)) and quantile regression coefficients (panel (b)) corresponding to these alternative lag specifications, demonstrating that the results remain similar to our baseline specification. Next, we assess whether the baseline results are sensitive to extreme values of the debt-to-GDP and government expenditure-to-GDP through three exercises: (i) removing the observations with values of debt-to-GDP below the 1st and above the 99th percentiles; (ii) removing the observations with values of government expenditure-to-GDP below the 1st and above the 99th percentiles; (iii) simultaneously removing the observations with values of debt-to-GDP and government expenditure-to-GDP below their 1st percentile and above their 99th percentile. The results, plotted in Figure A.2 of Annex A, remain very similar to the baseline model. We also use the government balance in place of government expenditure and estimate the effects of fiscal consolidations in terms of an increase in the fiscal balance. The results show that the location effects are very similar, but scale effects are somewhat weaker relative to the baseline model (Figure A.3 of Annex A). Consequently, the effects across quantiles are less asymmetric, although there is still a degree of asymmetry in the medium term, with more pronounced effects on the right tail three and four years following the fiscal balance consolidation.

Our results are also robust to alternative empirical methodologies used to obtain an estimate of the quantile effects of fiscal expenditure consolidations on debt-to-GDP. As discussed in section II, the approach proposed by Machado and Santos Silva (2019) is very helpful to estimate quantile regressions on panel data with fixed effects, and to obtain clustered standard errors. However, a more restrictive way of controlling for fixed effects is to remove the country fixed effects in the first stage, as proposed by Canay (2011), and then estimate quantile regressions in a second step with the fixed effects removed. This approach, however, suffers from the restrictive assumptions that the fixed effects are independent from the quantiles, a restriction which is relaxed in our approach. Nevertheless, we examine the implications of applying this alternative strategy. We estimate quantile regressions as in Koenker and Basset (1987), using the same variables included in the baseline model, with the Canay (2011) approach to control for country fixed effects. First, we regress the debt-to-GDP on country dummies. Then, we take the residuals from this regression and use them as dependent variables in the quantile regressions. The results, represented by the purple dashed lines in Figure A.4 of Annex A, reveal a lower degree of asymmetry across quantiles, yet the downward-sloping trend is largely confirmed at various horizons following the fiscal consolidation.

Finally, our results remain robust to alternative methods of addressing the endogeneity of the government expenditure variable. Specifically, we compute the Inverse Quantile Regression (IQR) estimator, proposed by Chernozukov and Hansen (2006), which treats the explanatory variable as endogenous and uses an instrumental variable to identify the causal quantile effects. As this estimator is developed in the cross-sectional data framework, we use the Canay (2011) approach to purge the country fixed effects. Following Ramey and Zubairy (2018) and Colombo et al. (2024), we use these purged forecast errors as instruments for government expenditure. In the first stage, we regress the forecast errors of the real government expenditure growth rate—defined as the actual government spending growth rate minus the October IMF forecast for the same year—on the same set of control variables used in the baseline model (equation (1)). We then compute the residuals and use them as instruments for government expenditure. The results, depicted by the blue dashed lines in Figure A.4 of Annex A, present a qualitatively similar picture to the baseline model, confirming the prevalence of asymmetric effects of fiscal expenditure consolidations on the quantiles of debt-to-GDP.

IV. Mechanisms

In this section, we explore the effects of fiscal consolidations on the drivers of debt. We first focus on the future government balance as share of GDP and its components, namely government revenues and government expenditure. We estimate equation (1) with these variables as dependent variables instead of debt-to-GDP. The results suggest that expenditure consolidations increase the future fiscal balance and reduce the uncertainty around it (Figure 5). In other words, contemporaneous fiscal consolidation significantly reduces the risks of experiencing high deficits in the future.

These effects arise primarily from a reduction in fiscal expenditure, as expected, but they are also influenced by a decrease in revenue. A potential explanation for the decline in revenue is the reduction in both inflation and real GDP associated with the consolidation. Additionally, fiscal consolidations may lower long-term interest rates by bolstering market confidence in the sustainability of public finances. To explore these channels, we next examine the reaction of inflation, real GDP and long-term interest rates to consolidation.[15] As illustrated in Figure 6, inflation declines modestly, with the peak decline observed two years after the fiscal consolidation; however, there are no statistically significant effects on the scale of the inflation distribution. In contrast, we find statistically significant negative fiscal multipliers, which are lower than one, consistent with the estimates in the literature (see, e.g., Colombo et al., 2024 and Ramey and Zubairy, 2018 among others). The estimated magnitude of the multipliers is also consistent with the view that fiscal consolidations, on average, do not generate output losses of sufficient size to render efforts to lower public debt ratios self-defeating. Additionally, and a novel contribution to the literature on fiscal multipliers, we find that fiscal consolidation also reduces the scale of the future output distribution. The result aligns with the reduction in the risk to the public debt outlook and to the credit market, leading to lower macroeconomic uncertainty after the fiscal expenditure consolidation.

Finally, expenditure consolidations have statistically significant and negative effects on long-term interest rates, especially after two years. This finding is consistent with standard neo-classical theory, which emphasizes improvements in credit market conditions and crowding-in effects on private economic activity, resulting from reductions in government expenditure. Interestingly, the result also points to a reduction in the scale of the interest rate distribution, which goes down significantly up to three years from the fiscal consolidation. This implies that fiscal expenditure consolidation could reduce the risk and uncertainty in the credit market, potentially via a risk-premium channel that reduces the risk of sovereign distress.

These empirical results suggest that an improving future fiscal balance is the primary driver behind reductions in debt-to-GDP ratios. According to the standard debt dynamic equation, improvements in the fiscal balance—holding all else constant—reduce the debt-to-GDP ratio on a one-to-one basis. Applying this relationship to the estimated coefficients one year after consolidation indicates that 0.55 percentage points (approximately 70%) of the 0.8 percentage point reduction in average future debt-to-GDP can be attributed to the fiscal balance improvement. The remaining reduction is explained by the effects of fiscal consolidation on other macroeconomic variables included in the debt equation, such as GDP growth and interest rates.

[15] For GDP, and to be consistent with the literature, we estimate the multipliers using the Ramey and Zubairy (2018) approach, employing one-step estimation strategy. This closely follows Colombo et al. (2024), who estimate government spending multipliers for a similar dataset as the one used in this study. We extend their approach to the location-scale framework.

V. Heterogeneous effects of fiscal expenditure consolidations on public debt ratios and debt-at-risk

V.1 Does it matter whether the countries adopt a fiscal rule or not?

Fiscal rules play an important role in enhancing fiscal discipline and ensuring long-term sustainability of government budgets amid rising public debt levels. The rules are long lasting numerical limits on government budgetary aggregates, introduced with the aim of constraining fiscal policy (Davoodi et al. 2022). Given the observed increasing trend in public debt levels, an increasing number of countries have introduced fiscal rules in order to ensure fiscal sustainability in the long run (Heinemann, Moessinger and Yeter 2018). As argued by Alesina and Perotti (1996), the benefits of such numerical limits to induce fiscal discipline are obvious, as they can reduce political distortions and opportunism to run large and persistent fiscal deficits. Recent empirical evidence shows that fiscal rules can indeed increase fiscal discipline (see, e.g., Heinemann, Moessinger and Yeter 2018; Acalin et al. 2025). Therefore, the presence of fiscal rules could improve the credibility of fiscal expenditure consolidations and reduce the risk of future fiscal slippages (IMF, 2024; Furceri et al. 2025).

Given this potential important role of fiscal rules, this section analyzes whether there are heterogeneous effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk depending on the adoption of such fiscal targets. For this exercise, we use the fiscal rule dataset from Acalin et al. (2025). The dataset covers 106 IMF members that have adopted fiscal rules (national and supranational) at some point over the period 1985 to 2024.[16] Our measure of a fiscal rule is a binary variable which equals one if the country adopts a fiscal rule in a given year. In particular, we consider a general fiscal rule, constructing a dummy which equals one if the country adopts any type of fiscal rules, and zero otherwise. We additionally consider fiscal rules on public debt (Annex A contains results for the rules on budget balance, government expenditure and revenues as well).

To estimate the effects of fiscal expenditure consolidations on debt-to-GDP conditional on the adoption of fiscal rules, we extend the baseline model in equation (1) as follows:

[16] This means that the remaining IMF members have never adopted a fiscal rule during the period considered and therefore they are assigned a value of zero.

$$d_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h} \quad (4)$$

where the regressors are interacted with the fiscal rule dummy variable $R_{i,t}$ and with its complement. Therefore, $\beta_{1,h,R}$ measures the location effects of fiscal consolidations on debt-to-GDP if a fiscal rule is in place, whereas $\beta_{1,h,NR}$ is the corresponding estimate in the absence of a fiscal rule. Similarly, $\gamma_{1,h,R}$ measures the scale effects of fiscal consolidations on debt-to-GDP when there is a fiscal rule, whereas $\gamma_{1,h,NR}$ provides the scale effects when there is no fiscal rule. Quantile effects for the two cases follow from the location-scale model in equation (4), and we focus on the 95th quantile of debt-to-GDP to analyze the heterogeneous effects of government expenditure consolidations on the debt-at-risk conditional on the adoption of a fiscal rule.

The results presented in Figure 7 indicate that fiscal expenditure consolidations tend to be more effective in reducing debt risks when fiscal rules are adopted. Specifically, fiscal consolidations reduce the debt-to-GDP ratio by more than 1.2 percentage points in the medium term when a fiscal rule is in place. In contrast, when the fiscal rule is absent, the reductions are modest, resulting in a decline of less than 0.5 percentage points in the medium term. This difference is statistically significant (see Table 1, panel (a)). In addition, for most horizons following the consolidation, the scale effects are stronger and more precisely estimated when a fiscal rule is in place, with the difference compared to no fiscal rule case being statistically significant at the 5% on impact and at the 10% after four years (see Table 1 panel (a)). As a result, government expenditure consolidations are more effective in reducing the debt-at-risk when a fiscal rule is in place, with a reduction of about 2 percentage points after four years, compared to 0.5 percentage points (not statistically significant) in the absence of a fiscal rule (Figure 7, panel (a)). The difference in effects at horizon 4 between countries that adopt a fiscal rule and those that do not, as well as the difference observed at impact (horizon 0), are statistically significant at the 5% level (see Table 1, panel (a)).

The results are consistent when examining countries that adopt a fiscal rule imposing targets on public debt, as illustrated in Figure 7, panel (b), and Table 1, panel (b).[17] These findings suggest that debt

[17] Figure A.5 and Table A.1 in Annex A demonstrate that the results are robust when considering other types of fiscal rules, including budget balance rules, expenditure rules, and revenue rules. However, the difference is less pronounced in the case of revenue rules, as the impulse response functions (IRFs) exhibit wider confidence intervals for the group of countries adopting revenue rules.

rules enhance fiscal discipline, making fiscal expenditure consolidations more effective in reducing not only the level of future public debt ratios but also their uncertainty and upside risks.[18]

Finally, we apply an alternative methodology, detailed in Annex A and similar to the one used in Section V.2 (see equation (5)), which employs a recent index measuring the strength of the fiscal rule (Acalin et al. 2025). Although this index is only available for a subset of countries in our sample, the results in Figure A.6 and Table A.2 reveal a similar pattern to that obtained from the baseline analysis, indicating that stronger fiscal rules correlate with greater effects of expenditure consolidations on public debt ratios.

V.2 Is there a role for the initial debt levels?

The initial debt level is an important factor determining the exposure of a country to public debt risks. Countries with already high debt face (in the absence of a consolidation effort) a higher future debt burden and, therefore, may be considered as not being able to preserve debt sustainability. High debt levels are also a leading indicator of fiscal and sovereign distress (Moreno Badia et al. 2022). Furceri et al. (2025) demonstrate that economic and financial factors contribute more significantly to upside public debt risks when initial debt levels are elevated. Therefore, in this section, we analyze whether the initial debt levels of countries shape the effectiveness of government expenditure consolidations in reducing upside debt risks. To do so, we extend the baseline model in equation (1) with a smooth transition function as follows:

$$\begin{aligned} d_{i,t+h} = \alpha_{i,h} &+ F(z_i) \times \left[\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}\right] + \left(1 - F(z_i)\right) \times \left[\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}\right] \\ &+ \left\{\delta_{i,h} + F(z_i) \times \left[\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}\right]\right. \\ &\left.+ \left(1 - F(z_i)\right) \times \left[\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}\right]\right\}\varepsilon_{i,t+h} \end{aligned} \qquad (5)$$

with $F(z_i) = \frac{e^{-\gamma z_i}}{1+e^{-\gamma z_i}}$ and $\gamma > 0$[19].

[18] Furthermore, we investigate the mechanisms analyzed in Section III based on the adoption of a fiscal rule. Our findings indicate that the larger effects of expenditure consolidations on public debt ratios and debt-at-risk, observed when a fiscal rule is in place, are primarily explained by lower costs in terms of output losses (see Figures B.1, B.2 and Table B.1 for the general fiscal rule and Figures B.3, B.4 and Table B.2 for the debt rule in Annex B).

[19] Following Auerbach and Gorodnichenko (2013), Colombo et al. (2024) and Bettarelli et al. (2025), we calibrate the parameter γ and we choose an intermediate value, as in Bettarelli et al. (2025), which is equal to 5. However, we check

The variable z_i is the debt-to-GDP of country i normalized to have mean zero and unitary variance. We use a cross-country normalization to analyze whether the effects of fiscal expenditure consolidations on debt-to-GDP are different in countries with average higher debt levels relative to countries with average lower debt levels. Given $z_i = (\bar{d}_i - \bar{d})/sd(\bar{d}_i)$, $F(z_i)$ tends to zero as z_i increases, namely when countries have very high debt levels. Therefore, $\beta_{1,h,L}$ and $\gamma_{1,h,L}$ provide, respectively, the location and scale effects of fiscal expenditure consolidations on debt-to-GDP in countries with very low level of public debt, whereas $\beta_{1,h,H}$ and $\gamma_{1,h,H}$ measure the effects of fiscal expenditure consolidations on debt-to-GDP when debt-levels are very high.

The results show that government expenditure consolidations lower the debt-at-risk more substantially when debt levels are higher. As shown in Figure 8, the reduction in the location of the debt-to-GDP distribution is much larger when debt levels are high versus when they are low. The difference between the location effects for high and low debt countries is also statistically different from zero from horizon 0 to horizon 3, as shown in Table 2. Moreover, expenditure consolidations also more strongly decrease the uncertainty of debt-to-GDP in the medium term when debt levels are elevated. Consequently, we observe greater effects of fiscal expenditure consolidations on debt-at-risk in countries with high initial debt levels, with an effect size approximately four times larger than that observed in countries with lower debt levels. This difference is statistically significant at the 5% level (at the 3-year horizon), as indicated in Table 2.[20,21]

V.3 Other sources of heterogeneity

We have conducted a series of additional exercises, not included in this paper, that examine various country characteristics and economic and financial conditions which have been found to shape the effect of fiscal policy on economic activity. Among the factors considered, we find a significant role for the

whether alternative values of this parameter affect the results. Figure A.7 in the Annex shows that the results remain robust to setting this parameter to a lower or higher value, e.g., $\gamma = 2.5$ and $\gamma = 7$.

[20] We also use an alternative methodology, following IMF (2024) and Furceri et al. (2025), where we construct four dummy variables, each equal 1 if the lag of debt-to-GDP lies in one of the four quartiles of the debt-to-GDP distribution, and we add interaction terms between these four dummy variables and the regressors in the baseline model and consider the first quartile as “low initial debt level” and the fourth quartile as “high initial debt level”. The methodology is detailed in Annex A and the results are represented in Figure A.8, which points at similar conclusions.

[21] We also test the mechanisms studied in section III in the case of high and low debt levels and find that the channel contributing the most to the higher effects of expenditure consolidations on debt ratios and debt risks is the stronger reduction in output uncertainty following the consolidation (see Figures B.5 and B.6 and Table B.3 in Annex B).

country's income levels. In particular, the results suggest that expenditure consolidation reduces debt risks more in Advanced Economies (AEs) than in Emerging Market and Developing Economies (EMDEs), primarily due to stronger location effects. While the scale effects are stronger in AEs compared to the EMDEs, their difference is only statistically significant on impact. Consequently, the effects on debt-at-risk are much larger in AEs: a one percentage point reduction in the ratio of government expenditure to GDP leads to a medium-term decline in the debt-at-risk of about 3 percentage points of GDP in AEs, compared to less than 1 percentage point in EMDEs. These results align with the findings from previous sections regarding fiscal rules and debt, as AEs are generally characterized by stronger fiscal rules and higher debt levels. They are also consistent with evidence in Furceri et al. (2025), which suggests that primary deficits are a more important driver of upside debt risks in AEs than in EMDEs.

The empirical evidence also indicates that the effects of expenditure consolidations on debt ratios and debt risks are marginally greater in countries with lower levels of informality and higher levels of institutional quality. However, there are no significant differences based on trade openness and exchange rate regimes, nor do these effects vary under different economic and financial conditions, such as the business cycle, low interest rates during the Zero Lower Bound period, and financial stress.

VI. Conclusions

This paper presents new empirical evidence on the effects of government expenditure consolidations on the entire public debt-to-GDP distribution, emphasizing the role of expenditure cuts in mitigating upside risks to debt ratios. It does so by extending the debt-at-risk framework recently introduced by the IMF (2024) and Furceri et al. (2025).

We constructed an unbalanced panel dataset covering 192 countries from 1991 to 2021 and applied panel quantile regressions. Our findings indicate that government expenditure consolidations shift the debt-to-GDP distribution to the left and reduce its scale, with asymmetric effects across quantiles. Specifically, while the effects on the left tail of public debt ratios are nearly negligible, those on the right tail are highly statistically significant, economically substantial, and persistent.

These effects are influenced by two main factors. First, the impact of fiscal consolidation on reducing debt and associated risks is greater when robust fiscal rules are in place. Second, the effects are significantly larger for countries that begin consolidation with high public debt levels. These results have important policy implications. First and foremost, countries with very high debt ratios should consider government expenditure consolidation measures to mitigate the upside risks to public debt: high public debt ratios require stabilization and consolidation of public spending is even more effective in reducing debt in this context. Second, implementing fiscal consolidations within credible medium-term frameworks guided by fiscal rules would enhance the credibility of the fiscal measures and their effectiveness in reducing debt risks.

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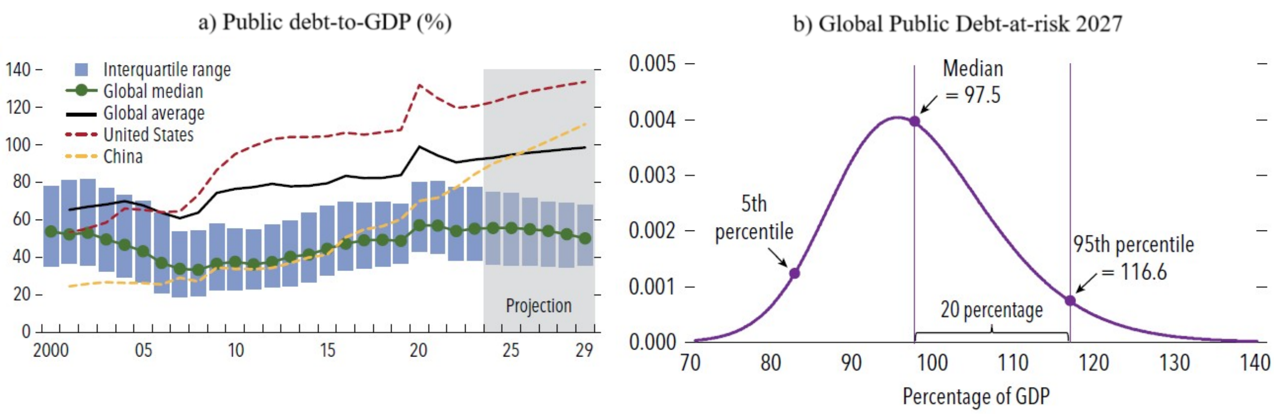
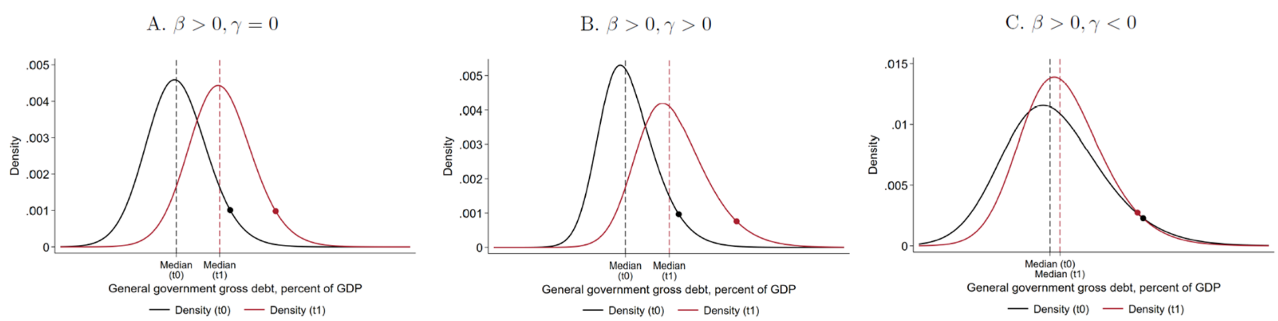
Figures

Figure 1: Global public debt-to-GDP and projected debt-at-risk.



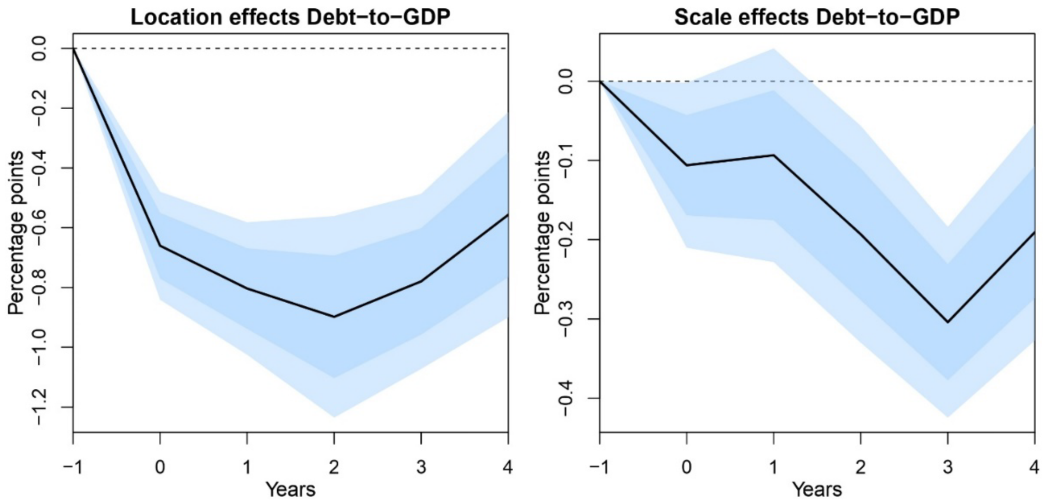
Note: Source IMF Fiscal Monitor (2024, 2025). Panel (a) shows the time evolution of public debt-to-GDP ratios. Panel (b) shows the predicted probability density function of debt-to-GDP for 2027 conditional on various economic, financial and political factors, based on information up to December 2024 (see IMF 2025 and Furceri et al. 2025).

Figure 2: Illustrative example on how the location and scale coefficients affect the debt-to-GDP distribution.



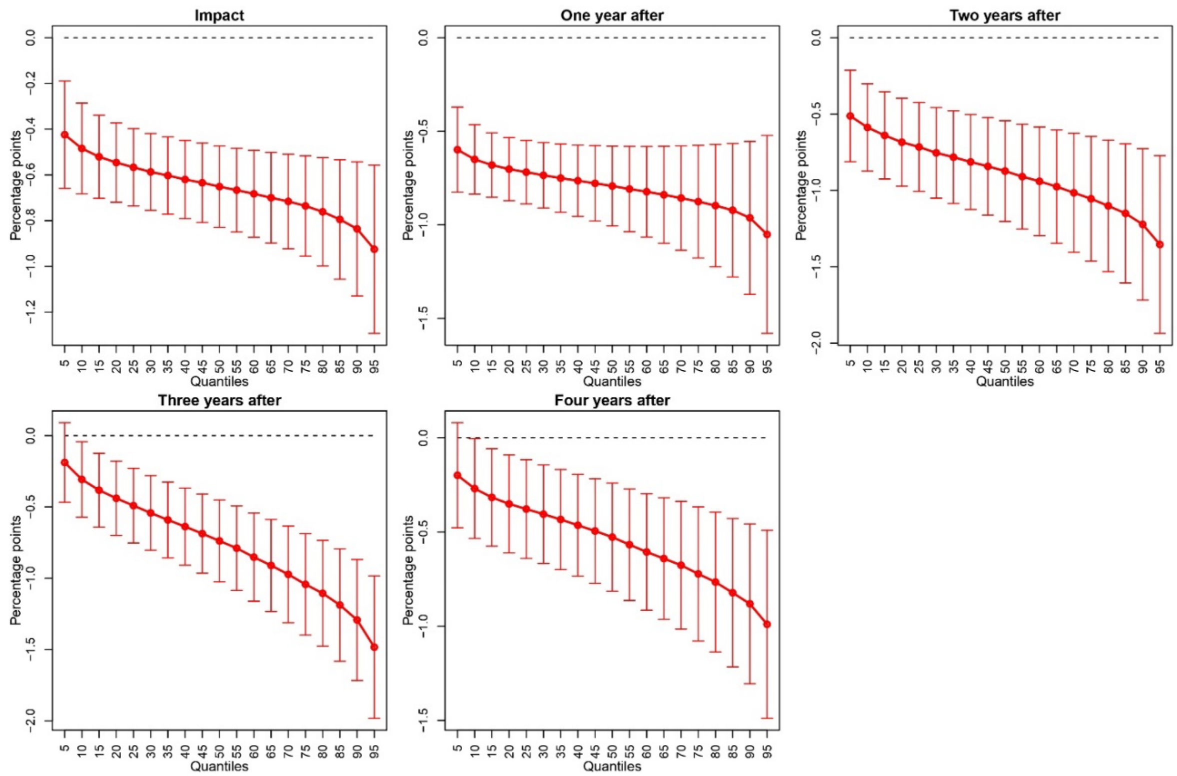
Note: The plot shows an illustrative example of how changes in a predictor affect the predicted conditional density of debt-to-GDP through the location-scale effects. β indicates the location coefficient whereas γ the scale coefficient. $t0$ is before the change in the predictor while $t1$ indicates the period after the change in the predictor.

Figure 3: Location and scale effects of fiscal expenditure consolidations on debt-to-GDP.



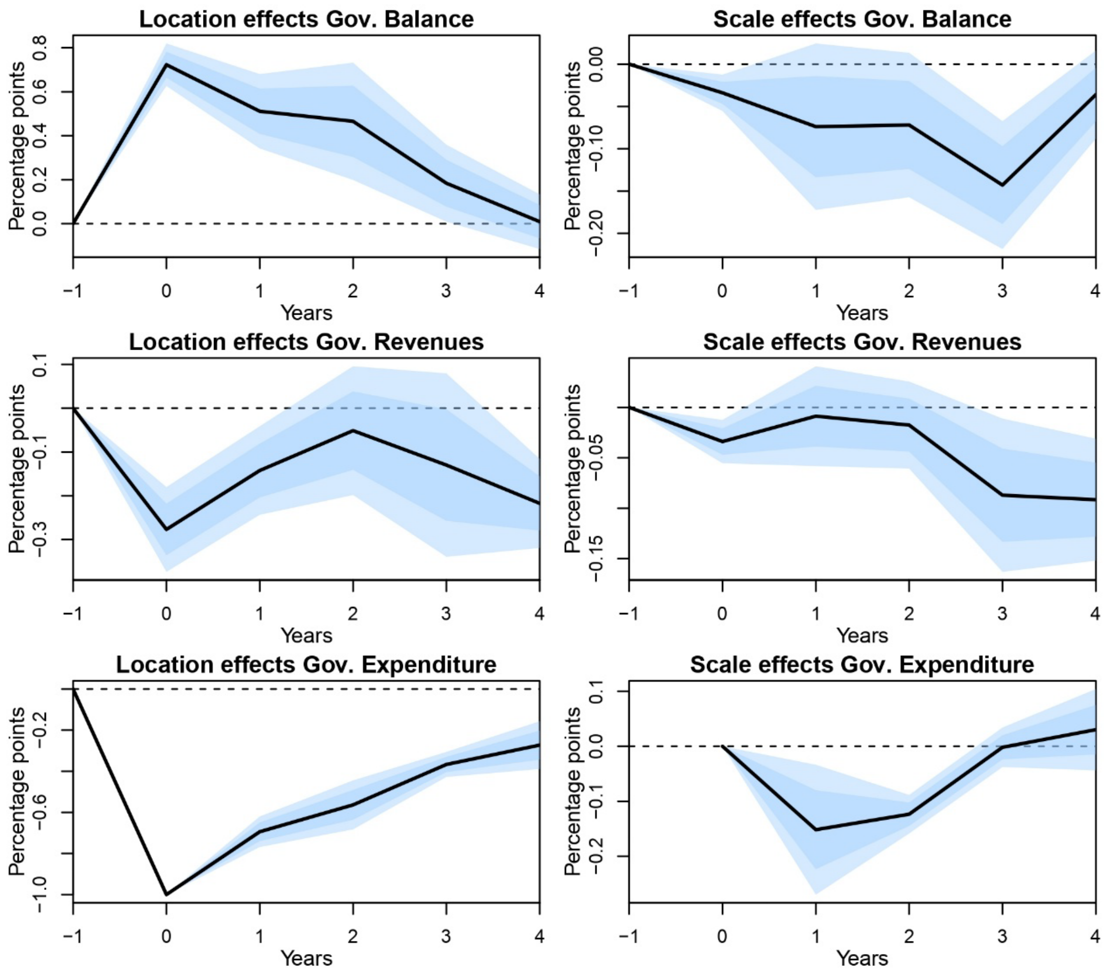
Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the debt-to-GDP distribution. The black solid lines represent the point estimates while darker and lighter shaded areas are, respectively, 68% and 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X'_{i,t}\beta_{2,h} + (\delta_{i,h} + \gamma_{1,h} g_{i,t} + X'_{i,t}\gamma_{2,h})\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Figure 4: Quantile effects of fiscal expenditure consolidation on debt-to-GDP.



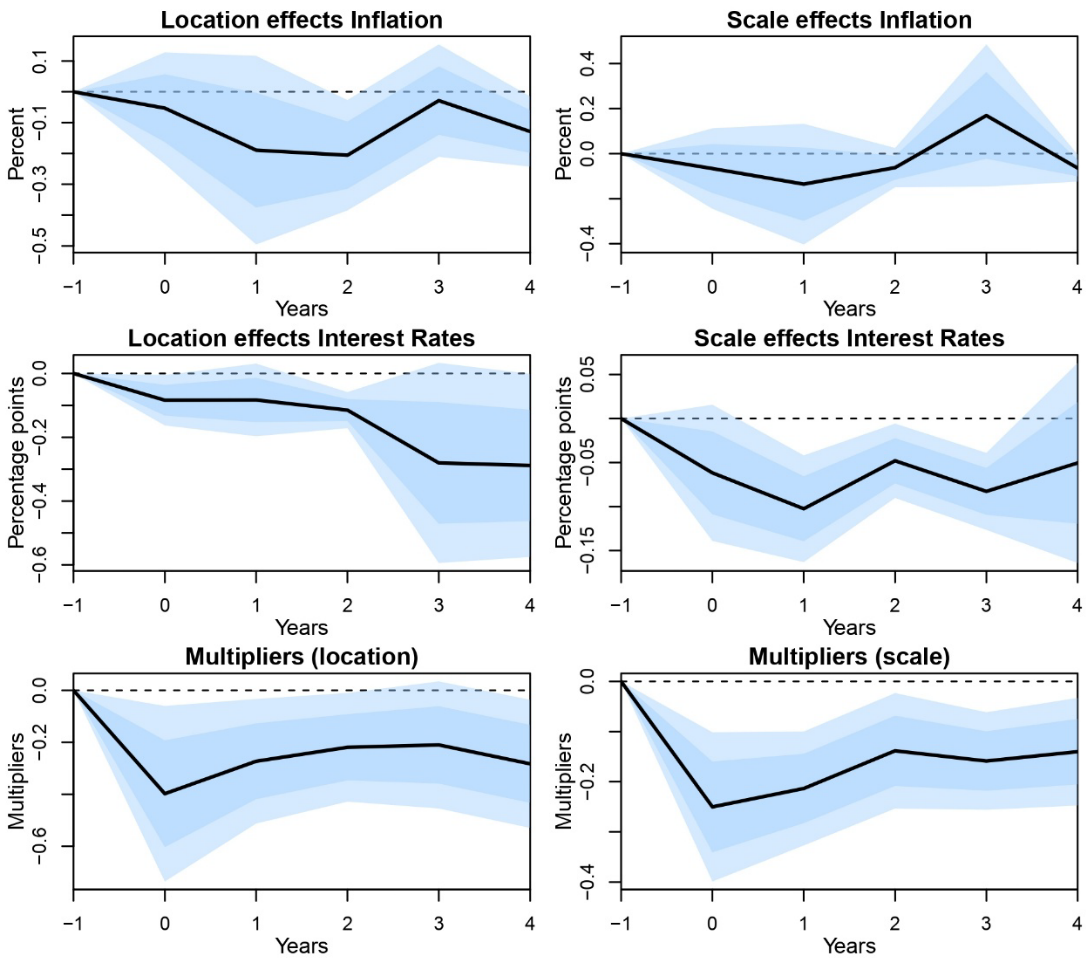
Note: The graph shows the effects of the expenditure consolidation on various quantiles of debt-to-GDP, from the 5-th up to the 95-th (x-axis). Each panel shows these effects at different years after the consolidation, across quantiles. Lines with dots represent the point estimate, whereas the whiskers are the 90% confidence intervals based on clustered standard errors at the country level. These estimates are based on a sample of 192 countries over the period 1991-2021, retrieving the conditional quantile function $Q_{d_{i,t+h}}(\tau|g_{i,t}, X_{i,t}) = (\alpha_{i,h} + \delta_{i,h}q(\tau)) + \beta_{1,h}g_{i,t} + X'_{i,t}\beta_{2,h} + (\gamma_{1,h}g_{i,t} + X'_{i,t}\gamma_{2,h})q(\tau)$ and thus an estimate of the quantile coefficient $\beta_{1,h} + \gamma_{1,h}q(\tau)$ at the τ-th quantile, from the location scale model $d_{i,t+h} = \alpha_{i,h} + \beta_{1,h}g_{i,t} + X'_{i,t}\beta_{2,h} + (\delta_{i,h} + \gamma_{1,h}g_{i,t} + X'_{i,t}\gamma_{2,h})\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Figure 5: Location and scale effects of fiscal expenditure consolidations on selected government budgetary variables.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the government budgetary variables. The first line is for the government balance as percent of GDP. The second line is for the government revenues as percent of GDP. The third line is for the government expenditure as percent of GDP. The black solid lines represent the point estimates while darker and lighter shaded areas are, respectively, 68% and 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $y_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X'_{i,t}\beta_{2,h} + \left(\delta_{i,h} + \gamma_{1,h} g_{i,t} + X'_{i,t}\gamma_{2,h}\right)\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected government budgetary variable, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

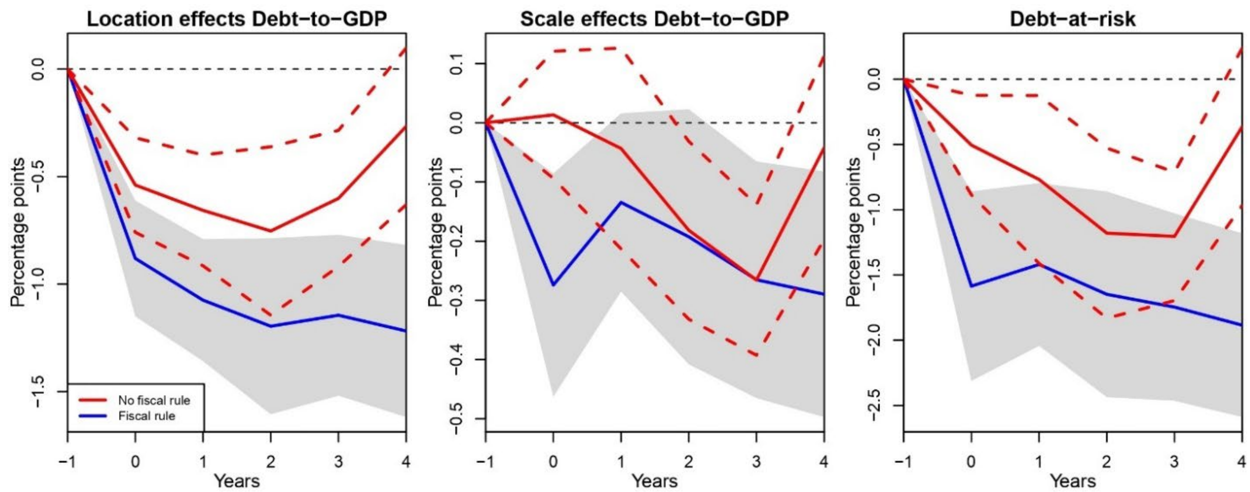
Figure 6: Location and scale effects of fiscal expenditure consolidations on selected macroeconomic variables.



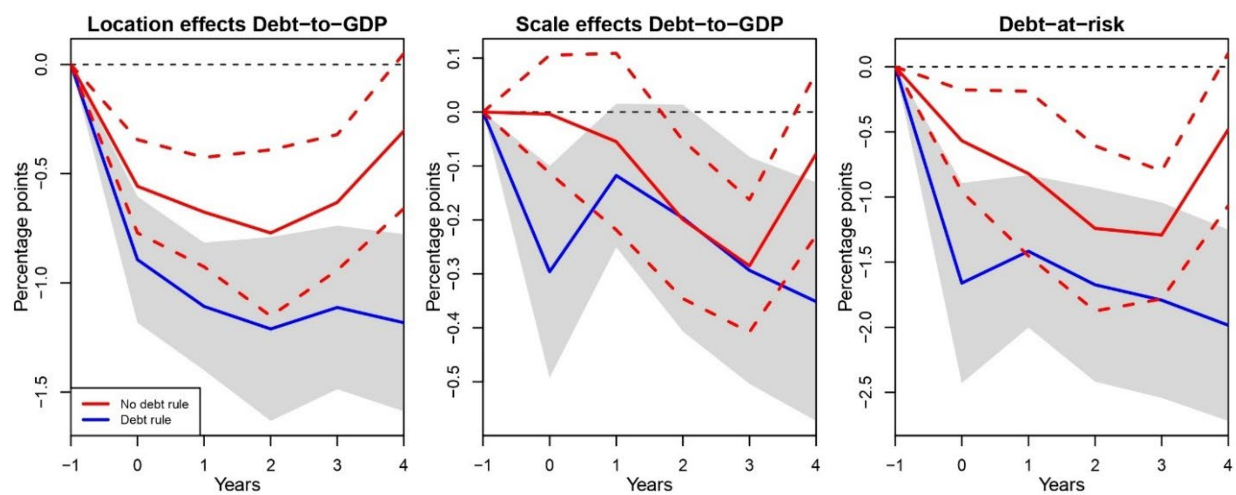
Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of selected macroeconomic variables. The first line is for inflation. The second line is for the real long-term interest rates. The results for GDP are reported in terms of multipliers. The black solid lines represent the point estimates while darker and lighter shaded areas are, respectively, 68% and 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $y_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X'_{i,t}\beta_{2,h} + (\delta_{i,h} + \gamma_{1,h} g_{i,t} + X'_{i,t}\gamma_{2,h})\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected macroeconomic variable, e.g. inflation or interest rate, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). For GDP we estimate the multipliers using the Ramey and Zubairy (2018) approach that we extend to the location-scale model.

Figure 7: Effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk in countries adopting and not adopting a general fiscal rule and a rule on public debt.

(a) General fiscal rule

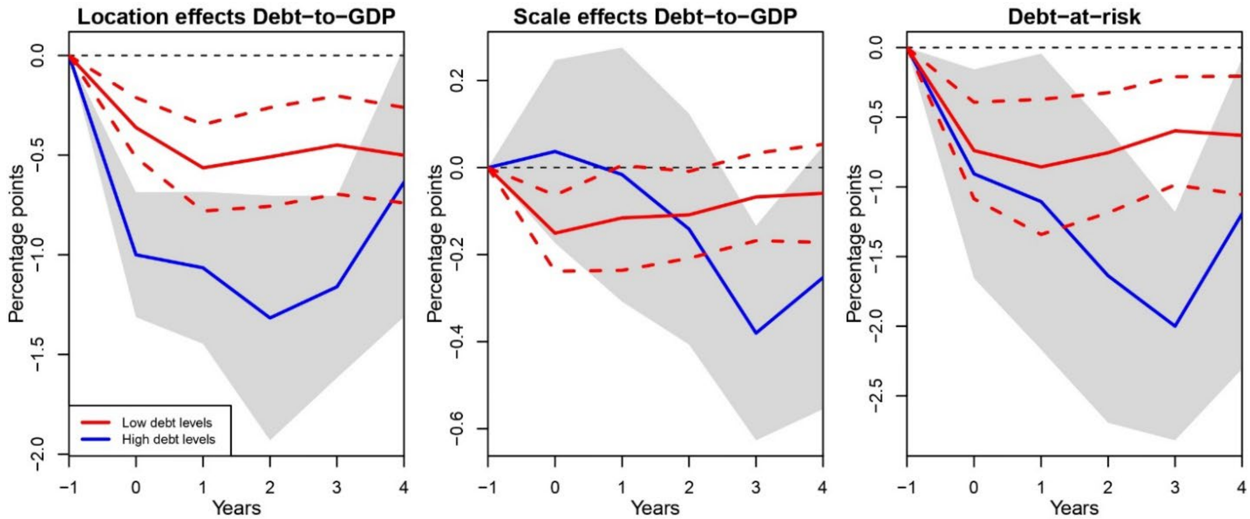


(b) Debt rule



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location, scale and 95-th quantile (debt-at-risk) of the debt-to-GDP distribution in countries adopting (blue lines) and not adopting (red lines) a general fiscal rule (panel a) and a debt rule (panel b). Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h}$, where the effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $R_{i,t}$ is a dummy variable which takes 1 if the fiscal rule is in place, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Figure 8: Effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk conditional on the country's debt levels.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location, scale and 95-th quantile (debt-at-risk) of the debt-to-GDP distribution in countries with high (blue lines) and low (red lines) debt levels. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + F(z_i) \times [\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}] + (1 - F(z_i)) \times [\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}] + \{\delta_{i,h} + F(z_i) \times [\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}] + (1 - F(z_i)) \times [\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}]\}\varepsilon_{i,t+h}$, where $F(z_i) = \frac{e^{-\gamma z_i}}{1+e^{-\gamma z_i}}$, z_i is the debt-to-GDP normalized as $z_i = (\bar{d}_i - \bar{d})/sd(\bar{d}_i)$. The effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Tables

Table 1: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations on debt-to-GDP in countries adopting and not adopting a fiscal rule.

(a) General fiscal rule

Horizon	Location model	Scale model	Debt-at-risk
0	0.1051	0.0253	0.0287
1	0.0516	0.4839	0.2055
2	0.1511	0.9412	0.4006
3	0.0462	0.9975	0.2775
4	0.0010	0.0832	0.0022

(b) Debt rule

Horizon	Location model	Scale model	Debt-at-risk
0	0.1225	0.0296	0.0364
1	0.0458	0.5960	0.2221
2	0.1513	0.9835	0.4095
3	0.0727	0.9534	0.3256
4	0.0023	0.0658	0.0034

Note: The null hypothesis is that the difference between the coefficients in the two regimes is zero.

Table 2: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations on debt-to-GDP conditional on the country's debt level.

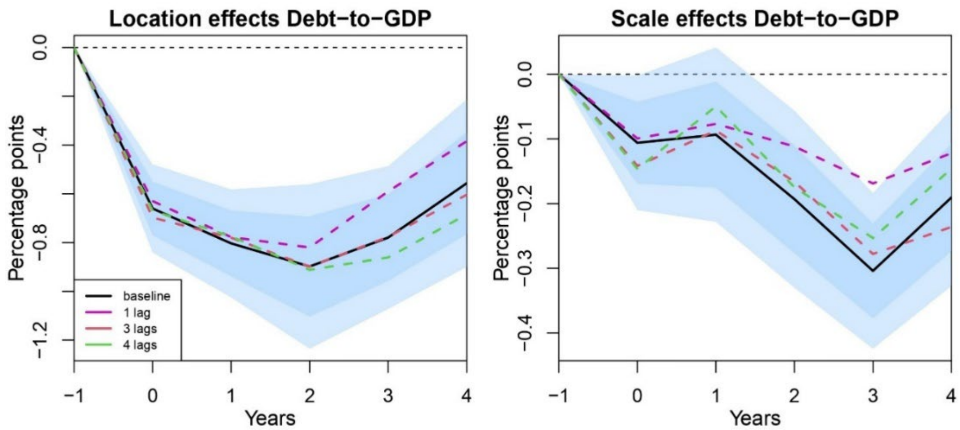
Horizon	Location model	Scale model	Debt-at-risk
0	0.0050	0.2001	0.7543
1	0.0850	0.6396	0.7513
2	0.0671	0.8592	0.2389
3	0.0332	0.0673	0.0136
4	0.7788	0.3703	0.4778

Note: The null hypothesis is that the difference between the coefficients in the two regimes is zero.

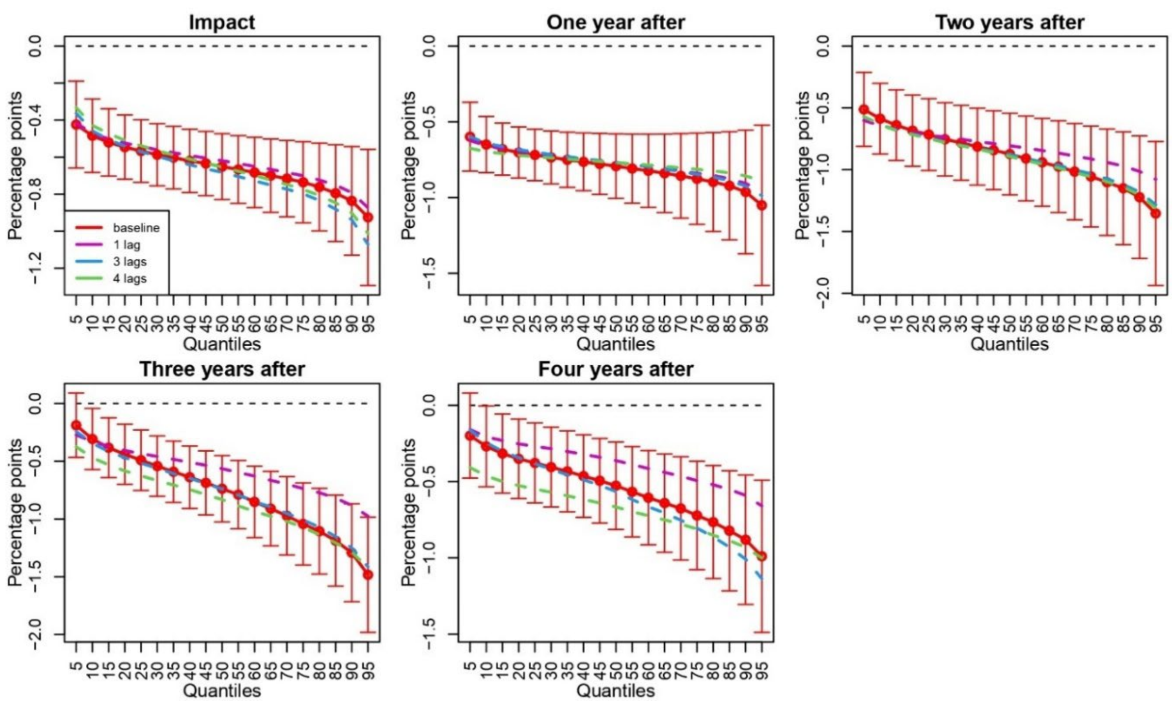
Annex A: Robustness checks

Figure A.1: Robustness checks using different numbers of lags.

(a) Location-scale effects



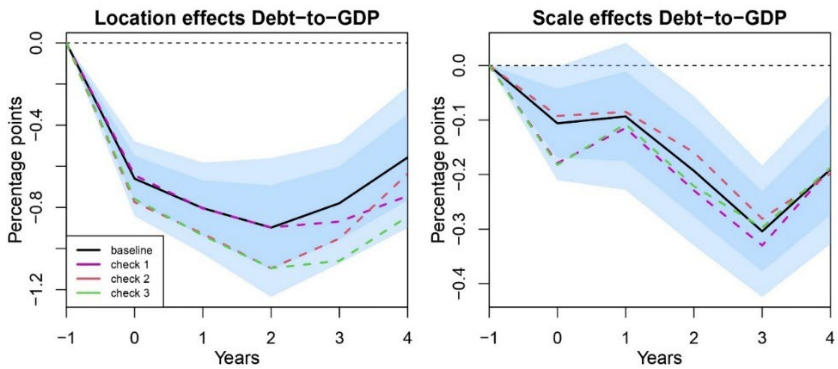
(b) Quantile effects



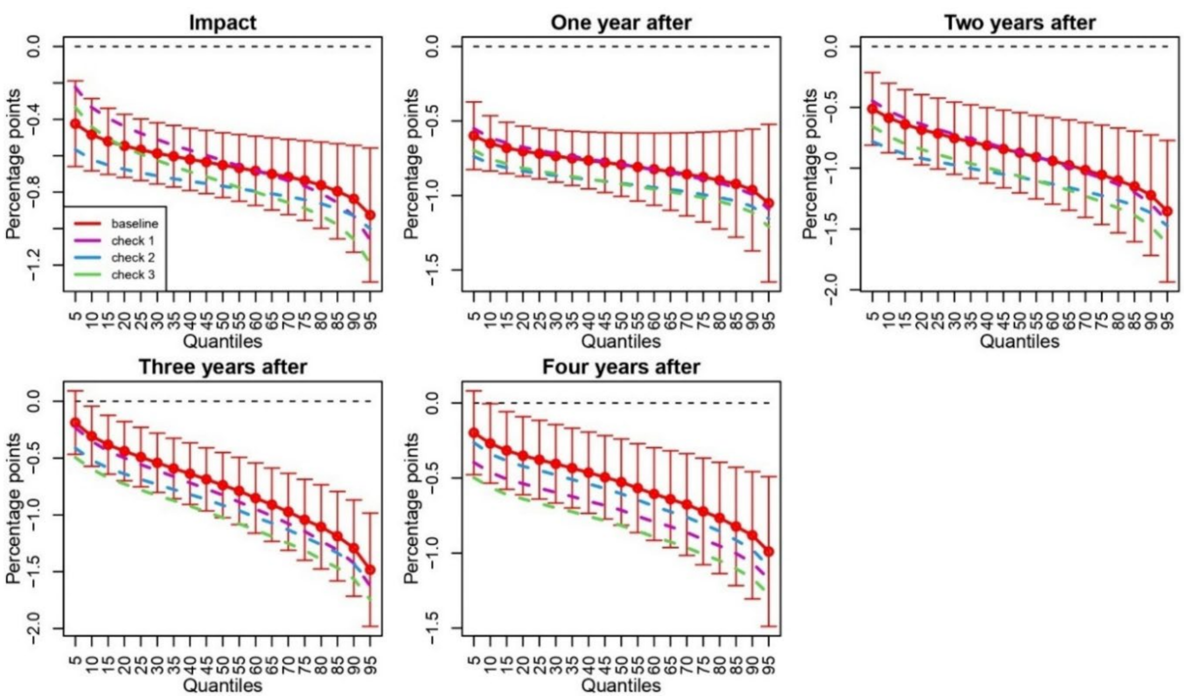
Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale (panel a) and on the quantiles (panel b) of the debt-to-GDP distribution from the baseline model and add the results obtained with different number of lags using colored dashed lines. In panel (a) the darker and lighter shaded areas are the 68% and 90% confidence intervals for the location-scale effects and in panel (b) the whiskers represent the 90% confidence intervals for the quantile coefficients, from the baseline model, based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X'_{i,t}\beta_{2,h} + (\delta_{i,h} + \gamma_{1,h} g_{i,t} + X'_{i,t}\gamma_{2,h})\varepsilon_{i,t+h}$, changing the number of lags. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). The quantile effects in panel (b) are estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$.

Figure A.2: Robustness checks removing extreme values from the debt-to-GDP and government expenditure-to-GDP.

(a) Location-scale effects



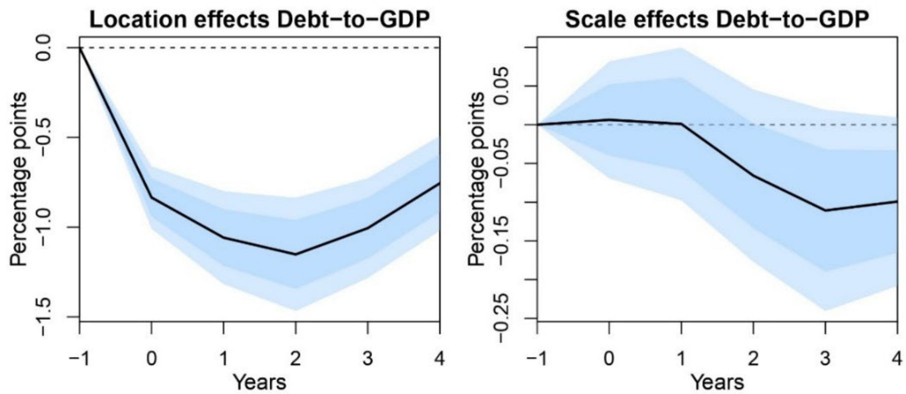
(b) Quantile effects



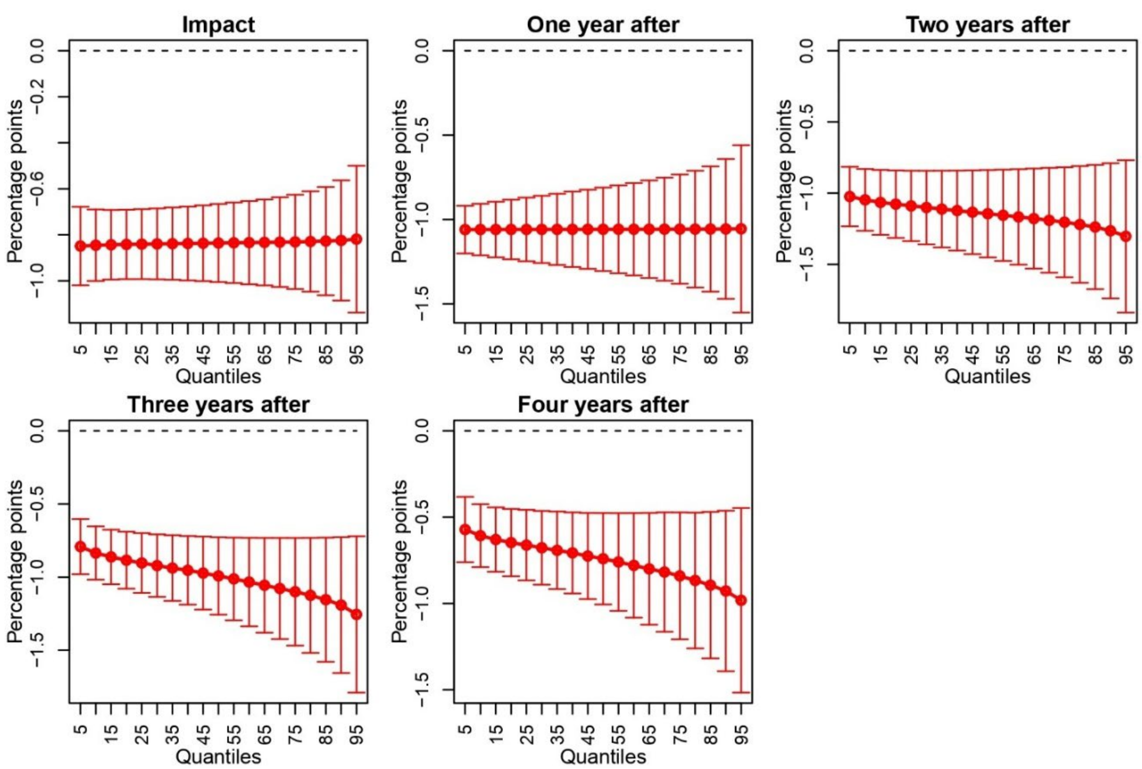
Note: : The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale (panel a) and on the quantiles (panel b) of the debt-to-GDP distribution from the baseline model and from three robustness checks where check 1, 2 and 3 refers to, respectively, the exercise of removing extreme values from the debt-to-GDP, from the government expenditure-to-GDP and from the two variables simultaneously, whose results are represented by colored dashed lines. In panel (a) the darker and lighter shaded areas are the 68% and 90% confidence intervals for the location-scale effects and in panel (b) the whiskers represent the 90% confidence intervals for the quantile coefficients, from the baseline model, based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X'_{i,t}\beta_{2,h} + \left(\delta_{i,h} + \gamma_{1,h} g_{i,t} + X'_{i,t}\gamma_{2,h}\right)\varepsilon_{i,t+h}$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). The quantile effects in panel (b) are estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$.

Figure A.3: Robustness checks replacing the ratio between government expenditure and GDP with the ratio between the government balance and GDP as impulse variable.

(a) Location-scale effects

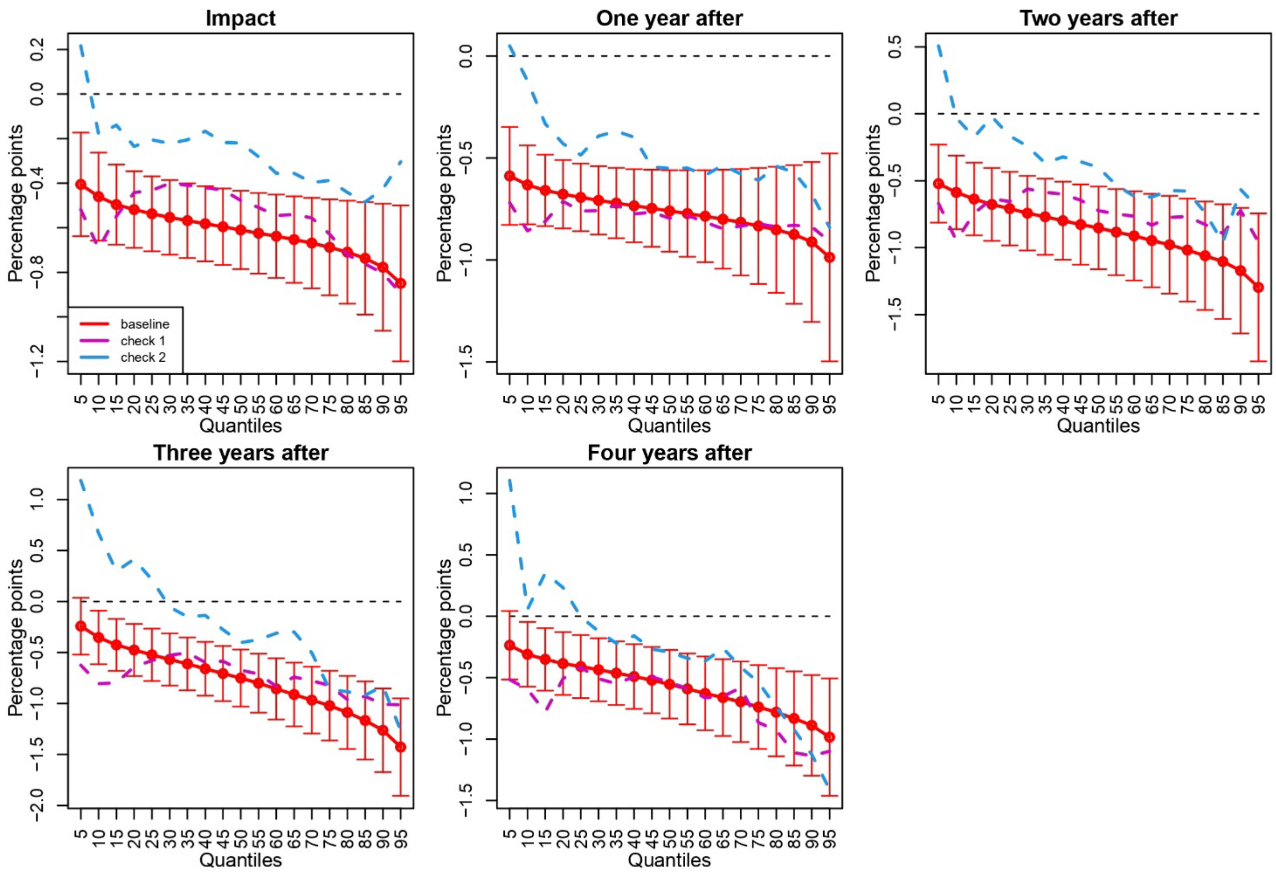


(b) Quantile effects



Note: The graph shows the dynamic effects of fiscal balance consolidations on the location and scale (panel a) and on the quantiles (panel b) of the debt-to-GDP distribution obtained by replacing the government expenditure-to-GDP ratio with the fiscal balance-to-GDP ratio in the location scale model $d_{i,t+h} = \alpha_{i,h} + \beta_{1,h} g_{i,t} + X'_{i,t}\beta_{2,h} + \left(\delta_{i,h} + \gamma_{1,h} b_{i,t} + X'_{i,t}\gamma_{2,h}\right)\varepsilon_{i,t+h}$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $b_{i,t}$ is the fiscal balance-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). The quantile effects in panel (b) are estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$. In panel (a) the darker and lighter shaded areas are the 68% and 90% confidence intervals for the location-scale effects and in panel (b) the whiskers represent the 90% confidence intervals for the quantile coefficients.

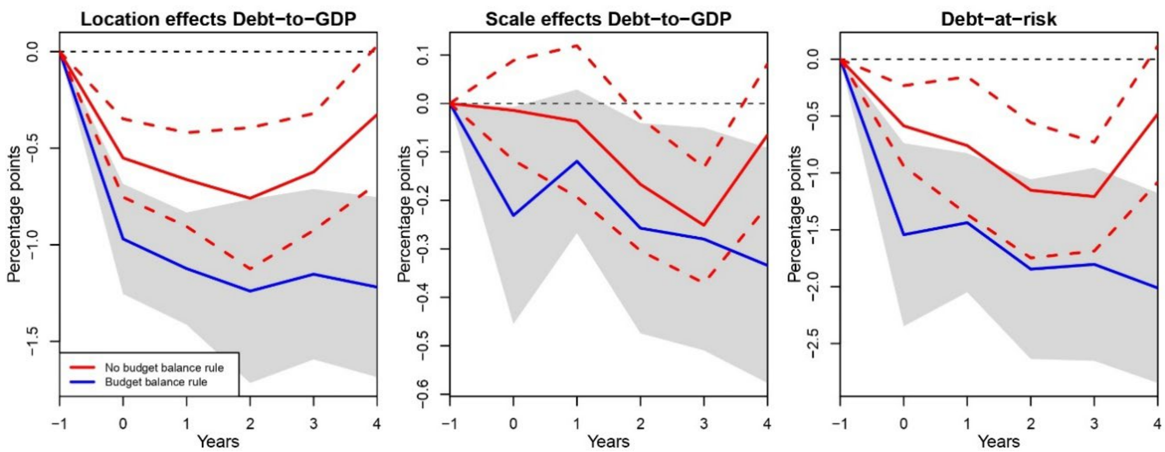
Figure A.4: Robustness checks on the quantile effects using alternative estimators for cross-sectional data.



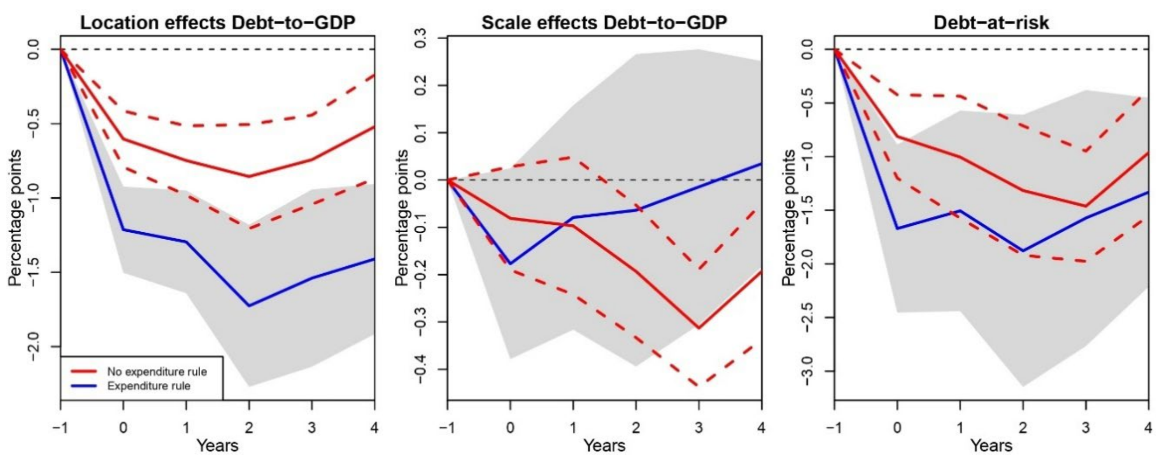
Note: The graph shows the effects of the expenditure consolidation on various quantiles of debt-to-GDP, from the 5-th up to the 95-th (x-axis) obtained from the baseline empirical strategy and compares them with two alternative empirical exercises. Check 1 refers to the application of quantile regressions for cross-sectional data and check 2 refers to the application of IV quantile regressions for cross-sectional data. The results from the baseline empirical strategy are represented by the red lines with dots, with the associated 90% confidence intervals represented by whiskers, and are based on retrieving the conditional quantile function $Q_{d_{i,t+h}}\left(\tau|g_{i,t}, X_{i,t}\right) = \left(\alpha_{i,h} + \delta_{i,h}q(\tau)\right) + \beta_{1,h}g_{i,t} + X_{i,t}'\beta_{2,h} + \left(\gamma_{1,h}g_{i,t} + X_{i,t}'\gamma_{2,h}\right)q(\tau)$ and thus an estimate of the quantile coefficient $\beta_{1,h} + \gamma_{1,h}q(\tau)$ at the τ-th quantile, from the location scale model $d_{i,t+h} = \alpha_{i,h} + \beta_{1,h}g_{i,t} + X_{i,t}'\beta_{2,h} + \left(\delta_{i,h} + \gamma_{1,h}g_{i,t} + X_{i,t}'\gamma_{2,h}\right)\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X_{i,t}'$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). Check 1 and 2, instead, are based on the estimation of standard quantile regressions $Q_\tau\left(d_{i,t+h} - \hat{\alpha}_i\right) = \beta_{0,\tau} + \beta_{1,\tau}g_{i,t} + X_{i,t}'\beta_{2,\tau} + \omega_{\tau,i,t+h}$, without and with IV for $g_{i,t}$, where $\hat{\alpha}_i$ are the country fixed effects estimated in a first stage, following the approach in Canay (2011). In the estimation without IV, $X_{i,t}'$ contains the same controls as in the baseline model. In the IV estimation, $X_{i,t}'$ only contains lags of debt-to-GDP and government expenditure, since the IV is constructed as forecast errors in government expenditure purged from the same set of control variables in the baseline model (see Colombo et al. 2024).

Figure A.5: Effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk in countries adopting and not adopting a budget balance rule, an expenditure rule and a revenues rule.

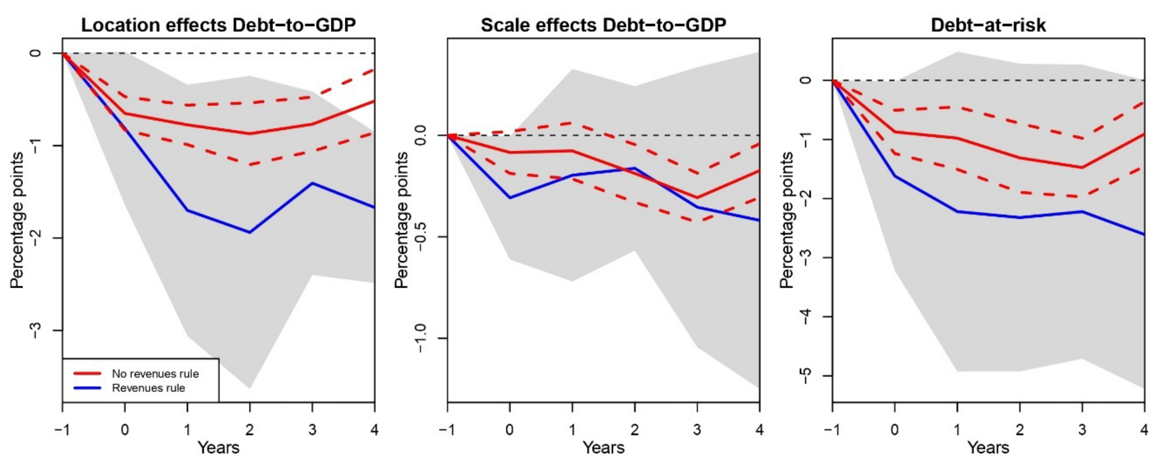
(a) Budget balance rule



(b) Expenditure rule



(c) Revenues rule



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location, scale and 95-th quantile (debt-at-risk) of the debt-to-GDP distribution in countries adopting (blue lines) and not adopting (red lines) a budget balance rule (panel a), a fiscal rule on public expenditure (panel b) and a fiscal rule on public revenues (panel c). Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h}$, where the effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $R_{i,t}$ is a dummy variable which takes 1 if the specific fiscal rule is in place, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Table A.1: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations on debt-to-GDP in countries adopting and not adopting a fiscal rule on the budget balance, expenditure and revenues.

(a) Budget balance rule

Horizon	Location model	Scale model	Debt-at-risk
0	0.0467	0.1349	0.0670
1	0.0248	0.4770	0.1456
2	0.1353	0.5070	0.1748
3	0.0703	0.8483	0.2714
4	0.0040	0.0872	0.0054

(b) Expenditure rule

Horizon	Location model	Scale model	Debt-at-risk
0	0.0034	0.4802	0.1020
1	0.0203	0.9160	0.4389
2	0.0158	0.5415	0.4842
3	0.0302	0.1095	0.8810
4	0.0022	0.1179	0.4839

(c) Revenues rule

Horizon	Location model	Scale model	Debt-at-risk
0	0.7505	0.2471	0.4507
1	0.2640	0.7116	0.4533
2	0.3061	0.9229	0.5296
3	0.3064	0.9115	0.6263
4	0.0266	0.6287	0.2887

Results based on the strength of the fiscal rule

As we indicate in the paper, we apply an alternative methodology to using the dummy variables for the fiscal rules, whose results are presented in the paper. We use a recent index which measures the strength of the fiscal rule. This index is available for a subset of countries. We extend the baseline model in equation (1) of the paper, by modeling non-linear interactions with a smooth transition function based on this index. We exploit both cross-country and time variation by normalizing the index as follows: $z_{i,t} = (s_{i,t} - \bar{s})/sd(s_{i,t})$. We use the value of the stringency index contemporaneously, as implementing reforms on fiscal rules usually takes a long legislative process, thus this rules out any endogeneity issue of the stringency index. Since the index is available for only those countries which adopt a fiscal rule, this empirical exercise will focus on this subset of countries. The model is represented as follows:

$$
\begin{aligned}
d_{i,t+h} = \alpha_{i,h} + F\left(z_{i,t}\right) \times \left[\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}\right] + \left(1 - F\left(z_{i,t}\right)\right) \times \left[\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}\right] \\
+ \left\{\delta_{i,h} + F\left(z_{i,t}\right) \times \left[\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}\right] \right. \\
\left. + \left(1 - F\left(z_{i,t}\right)\right) \times \left[\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}\right]\right\} \varepsilon_{i,t+h}
\end{aligned}
$$

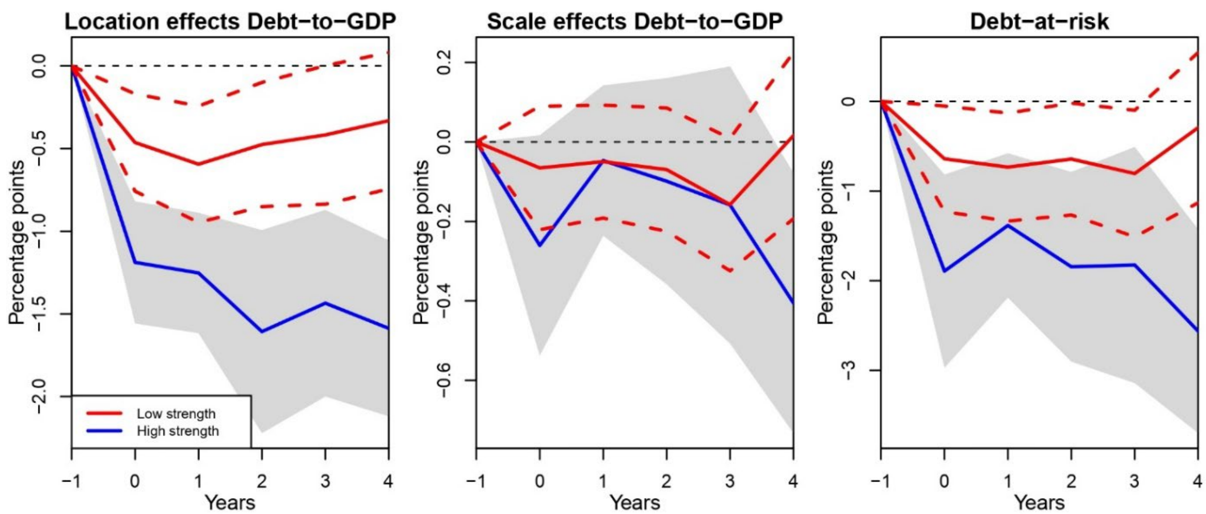
with $F\left(z_{i,t}\right) = \frac{e^{-\gamma z_{i,t}}}{1+e^{-\gamma z_{i,t}}}$ and $\gamma = 5$.

$\beta_{1,h,L}$ and $\gamma_{1,h,L}$ will give us, respectively, the location and scale effects of fiscal expenditure consolidations on debt-to-GDP for the lower fiscal rule strength regime, whereas $\beta_{1,h,H}$ and $\gamma_{1,h,H}$ will measure the effects of fiscal expenditure consolidations on debt-to-GDP when the strength of the fiscal rule is higher.

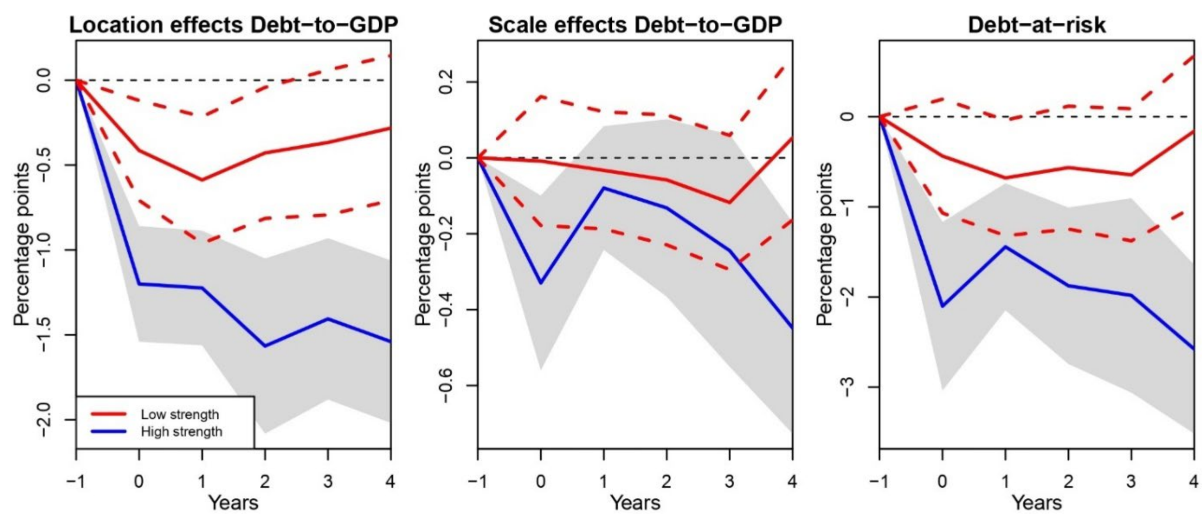
The results are in Figure A.6 and the test of the significance of the difference between the effects for the high fiscal rule strength and low fiscal rule strength are in Table A.2. They show that the effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk are higher the stronger is the stringency of the fiscal rule. The expenditure consolidation lowers the debt-to-GDP by more than 1 percentage points on impact and by more than 1.5 percentage points in the medium-term when the fiscal rule is tighter. This result is similar for the general fiscal rule and for the rule on debt. For the general fiscal rule, the scale effects are significantly higher in the high rule strength regime only four years after the fiscal shock, whereas for the debt rule these effects are significantly higher both on impact and after four years. This leads the impact on the debt-at-risk to be much higher when the fiscal rules are tighter. The drop is 2 percentage points on impact in the high fiscal rule strength regime against a 0.5 percentage points reduction when the fiscal rule is looser, and in the case of the debt rule this last effect is not significant. In the medium term the difference in the response between the two regimes sharpen, and the debt-at-risk drops by about 2.5 percentage points when the fiscal rule is tighter whereas there are no effects when the fiscal rule is looser. In the case of the general fiscal rule the difference in the effects on the debt-at-risk between the two regimes is statistically significant at horizons 2 and 4, whereas in the case of the debt rule at horizon 0, 2 and 4.

Figure A.6: Effects of fiscal consolidations on debt conditional on the strength of the fiscal rule.

(a) General fiscal rule



(b) Debt rule



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location, scale and 95-th quantile (debt-at-risk) of the debt-to-GDP distribution conditional on the strength of the general fiscal rule (panel a) and debt rule (panel b). The blue lines are for the regime of high strength while the red ones for the low strength regime. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are based on the location-scale model $d_{i,t+h} = \alpha_{i,h} + F(z_{i,t}) \times [\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}] + \left(1 - F(z_{i,t})\right) \times [\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}] + \left\{\delta_{i,h} + F(z_{i,t}) \times [\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}] + \left(1 - F(z_{i,t})\right) \times [\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}]\right\} \varepsilon_{i,t+h}$ where the effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $F(z_{i,t}) = \frac{e^{-\gamma z_{i,t}}}{1+e^{-\gamma z_{i,t}}}$, $z_{i,t}$ is the fiscal rule stringency index normalized to have mean 0 and unitary standard deviation as follows $z_{i,t} = (s_{i,t} - \bar{s})/sd(s_{i,t})$, and γ is set to an intermediate value equal to 5, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). The effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$.

Table A.2: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations on debt-to-GDP conditional on the strength of general fiscal rule and debt rule.

(a) General fiscal rule

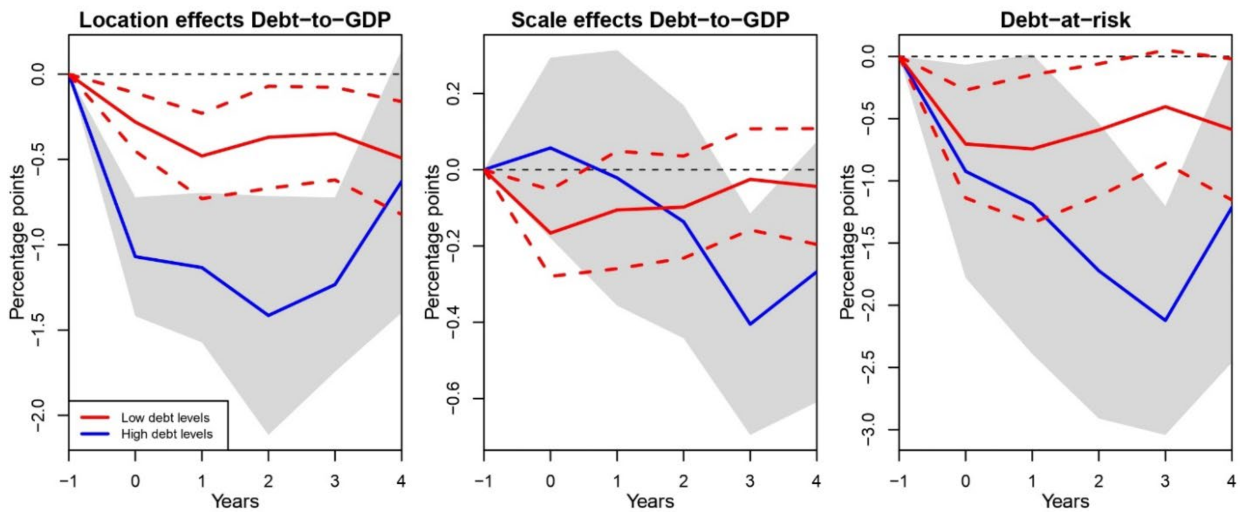
Horizon	Location model	Scale model	Debt-at-risk
0	0.0170	0.3594	0.1205
1	0.0368	0.9846	0.2687
2	0.0122	0.8632	0.0987
3	0.0255	0.9969	0.2968
4	0.0030	0.0861	0.0122

(b) Debt rule

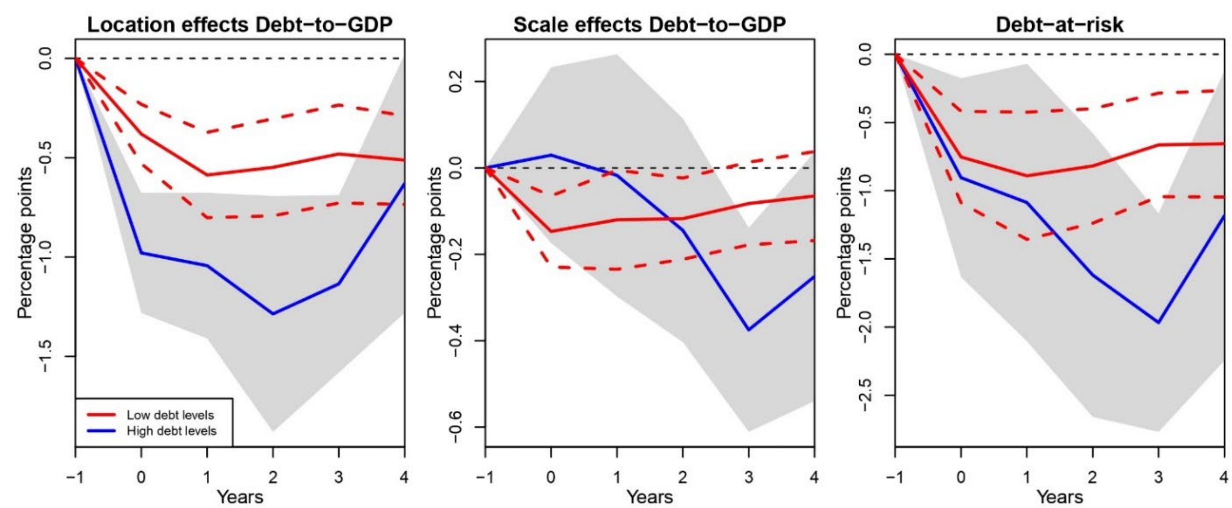
Horizon	Location model	Scale model	Debt-at-risk
0	0.0061	0.0956	0.0259
1	0.0418	0.7360	0.1836
2	0.0044	0.6617	0.0479
3	0.0121	0.5791	0.1157
4	0.0021	0.0215	0.0024

Figure A.7: Effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk conditional on the country's debt levels (alternative values of γ).

(a) $\gamma = 2.5$



(b) $\gamma = 7$



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location, scale and 95-th quantile (debt-at-risk) of the debt-to-GDP distribution in countries with high (blue lines) and low (red lines) debt levels changing the value of γ in the smooth transition function (see below) which in the baseline model is set to an intermediate value equal to 5. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + F(z_i) \times [\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}] + (1 - F(z_i)) \times [\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}] + \{\delta_{i,h} + F(z_i) \times [\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}] + (1 - F(z_i)) \times [\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}]\}\varepsilon_{i,t+h}$, where $F(z_i) = \frac{e^{-\gamma z_i}}{1+e^{-\gamma z_i}}$, z_i is the debt-to-GDP normalized as $z_i = (\bar{d}_i - \bar{d})/sd(\bar{d}_i)$ and γ is set alternatively to 2.5 (panel a) and 7 (panel b). The effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $d_{i,t+h}$ is the debt-to-GDP ratio, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). The effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$.

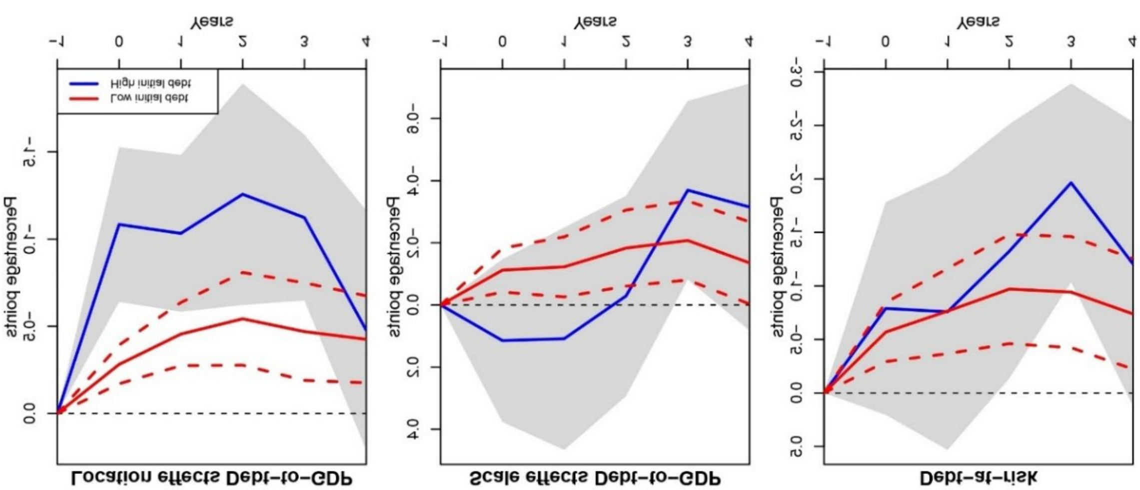
Results based on dummies for different levels of public debt ratios

Here we provide details on the alternative methodology to the one used in the main paper, to obtain an estimate of the effects of government expenditure consolidations on debt ratios depending on the initial level of public debt. We adopt the approach in IMF (2024) and Furceri et al. (2024), by constructing four dummy variables, each equal to 1 if the initial level of public debt ratios lies in one of the fourth quartile, namely $\mathbf{1}\{Q(d_{i,t} = k)\}$ for $k = 1, 2, 3, 4$ indicating the quartile of the debt-to-GDP distribution. The baseline model is extended as follows:

$$d_{i,t+h} = \alpha_{i,h} + \sum_{k=1}^{4} (\beta_{1,h,k} g_{i,t} + X'_{i,t}\beta_{2,h,k}) \times \mathbf{1}\{Q(d_{i,t} = k)\} + \left[\delta_{i,h} + \sum_{k=1}^{4} (\gamma_{1,h,k} g_{i,t} + X'_{i,t}\gamma_{2,h,k}) \times \mathbf{1}\{Q(d_{i,t} = k)\}\right] \varepsilon_{i,t+h}$$

Following IMF (2024) and Furceri et al. (2024), we define "low initial debt" as the first quartile of debt-to-GDP ($k = 1$) and "high initial debt" as the fourth quartile of debt-to-GDP ($k = 4$). The results are in Figure A.8

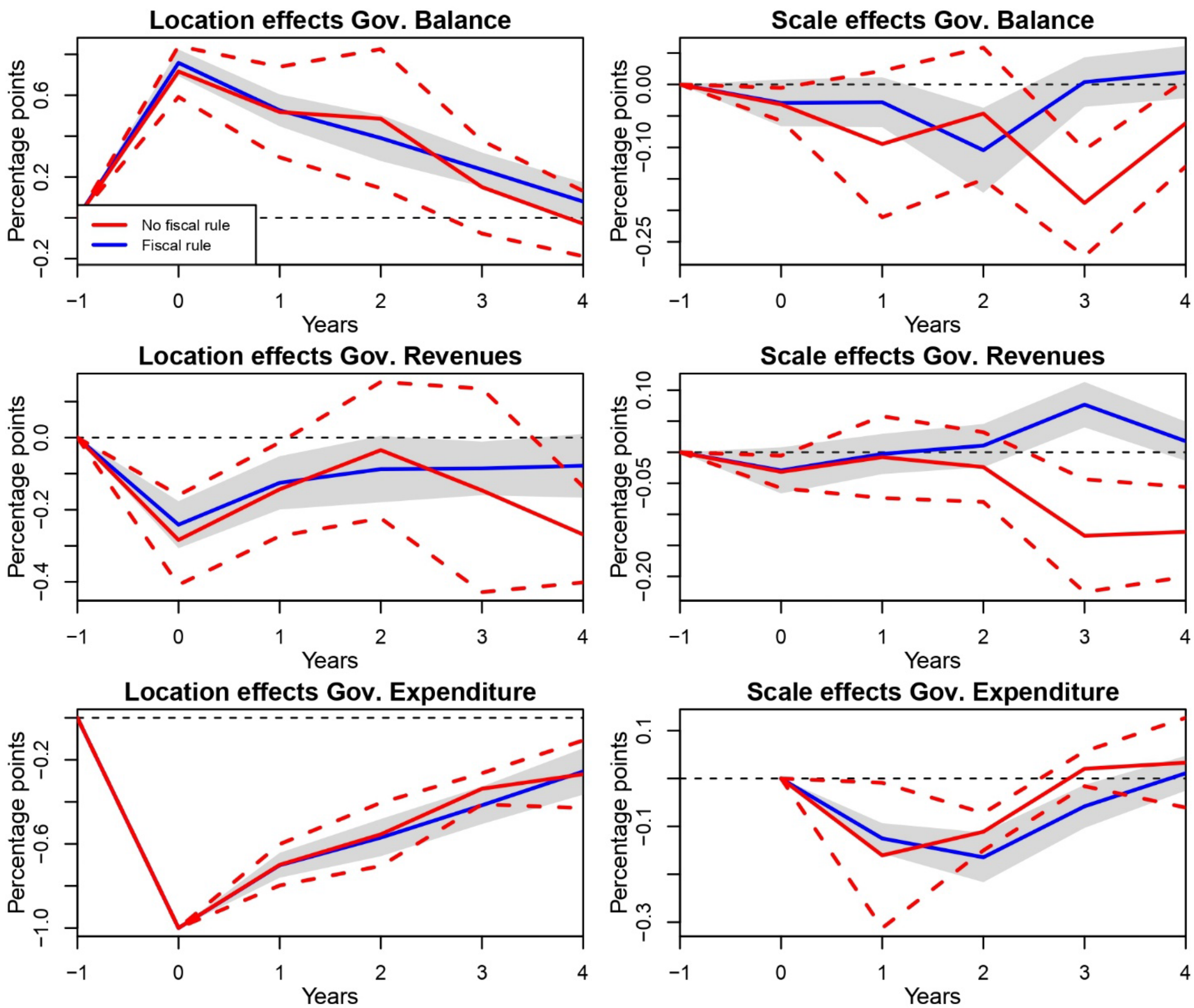
Figure A.8: Effects of fiscal expenditure consolidations on debt-to-GDP and debt-at-risk conditional on the country's debt levels (robustness checks using dummies for high versus low initial debt levels).



Note: The plot shows robustness checks for the results in section V.2, using an alternative strategy to discriminate between high and low debt levels. We construct four dummy variables, each equal 1 if the lag of debt-to-GDP lies in one of the four quartiles of the debt-to-GDP distribution, and we add interaction terms between these four dummy variables and the regressors in the baseline model. Following IMF (2024) and Furceri et al. (2025), we consider the first quartile as "low initial debt level" and the fourth quartile as "high initial debt level", and we plot the results of the coefficients associated with the interaction between government expenditure and the two dummy variables for the first and fourth quartile. The estimates are based on a sample of 192 countries over the period 1991-2021, using the following location-scale model $d_{i,t+h} = \alpha_{i,h} + \sum_{k=1}^{4}(\beta_{1,h,k} g_{i,t} + X'_{i,t}\beta_{2,h,k}) \times \mathbf{1}\{Q(d_{i,t} = k)\} + [\delta_{i,h} + \sum_{k=1}^{4}(\gamma_{1,h,k} g_{i,t} + X'_{i,t}\gamma_{2,h,k}) \times \mathbf{1}\{Q(d_{i,t} = k)\}]\varepsilon_{i,t+h}$. The red solid lines represent the results for the low initial debt level regime, with the dashed red lines being the associated 90% confidence intervals. The blue solid lines represent the results for the high initial debt level regime, with the gray shaded areas being the associated 90% confidence intervals. The effect on the 95-th quantile (debt-at-risk) is estimated as $\beta_{1,h} + \gamma_{1,h} q(\tau)$ in the two regimes, for $\tau = 0.95$.

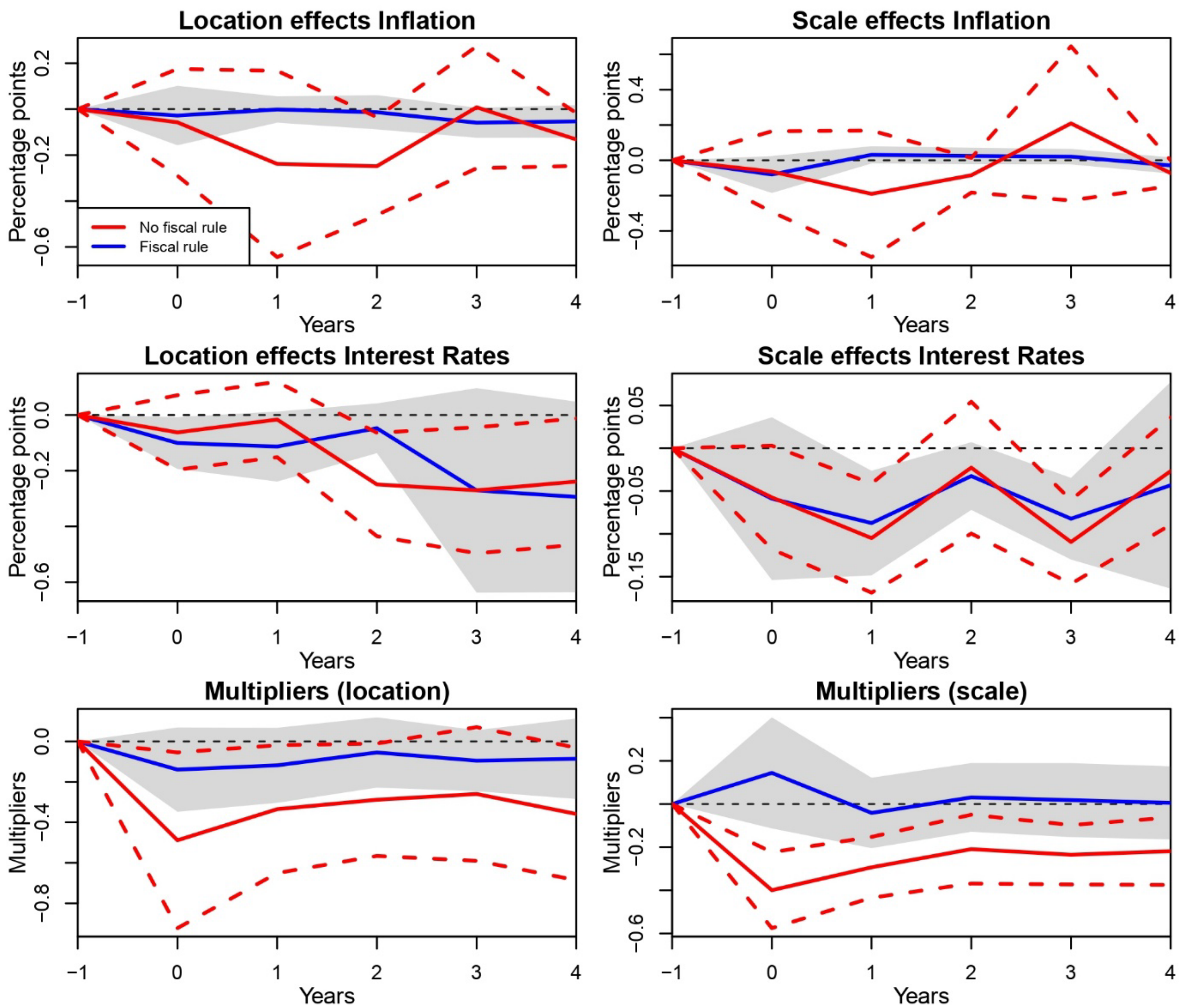
Annex B: Additional results

Figure B.1: Location and scale effects of fiscal expenditure consolidations on selected government budgetary variables in countries adopting and not adopting a general fiscal rule.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the distribution of selected government budgetary variables in countries adopting (blue lines) and not adopting (red lines) a general fiscal rule. The first line is for the government balance as percent of GDP. The second line is for the government revenues as percent of GDP. The third line is for the government expenditure as percent of GDP. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $y_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected government budgetary variable, $R_{i,t}$ is a dummy variable which takes 1 if the fiscal rule is in place, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Figure B.2: Location and scale effects of fiscal expenditure consolidations on selected macroeconomic variables in countries adopting and not adopting a general fiscal rule.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the distribution of selected macroeconomic variables in countries adopting (blue lines) and not adopting (red lines) a general fiscal rule. The first line is for inflation. The second line is for the real long-term interest rates. The results for GDP are reported in terms of multipliers. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $y_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected macroeconomic variable, e.g. inflation or interest rate, $R_{i,t}$ is a dummy variable which takes 1 if the fiscal rule is in place, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). For GDP we estimate the multipliers using the Ramey and Zubairy (2018) approach that we extend to the location-scale model.

Table B.1: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations in countries adopting and not adopting a general fiscal rule, on selected government budgetary variables and macroeconomic variables.

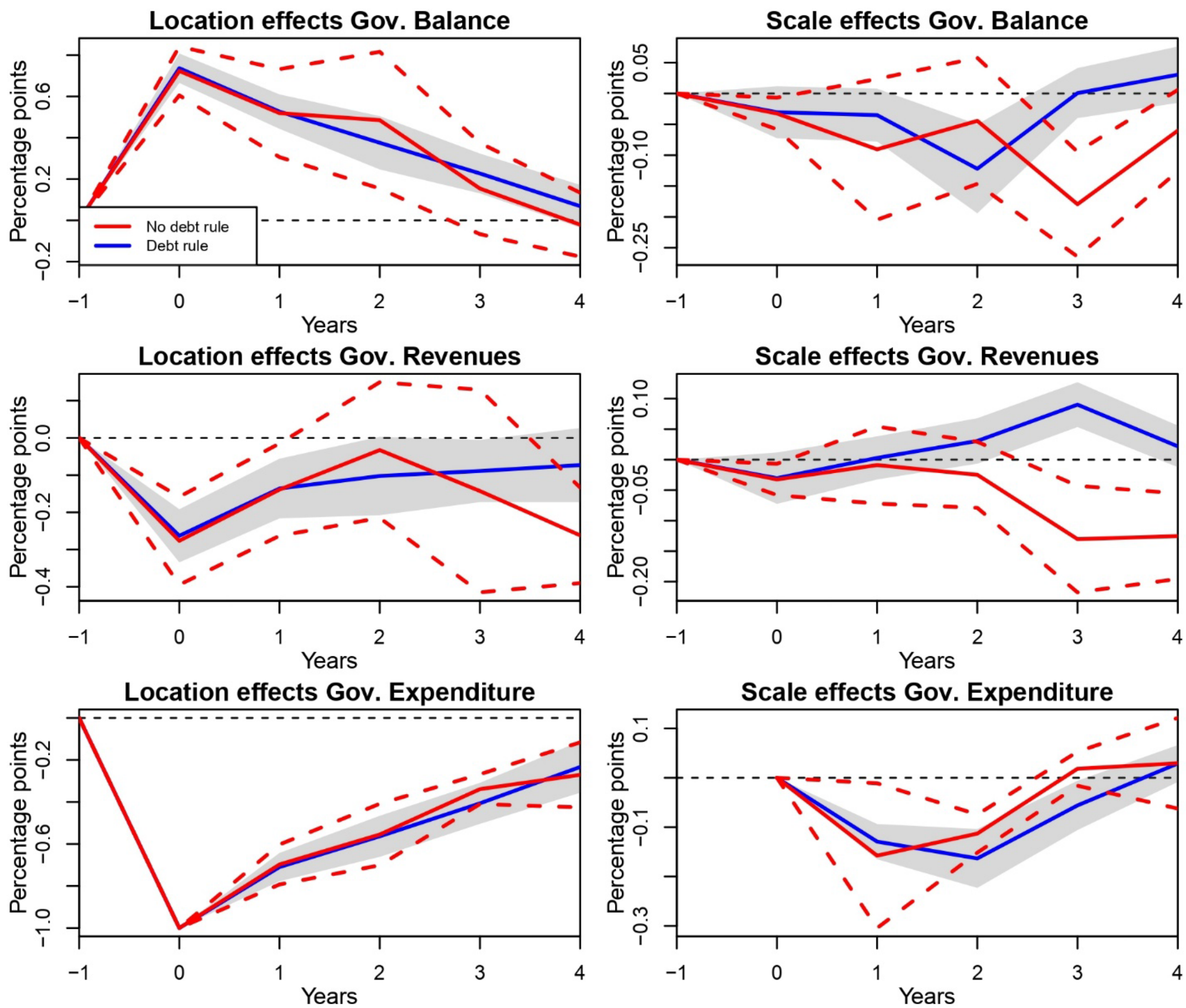
(a) Government budgetary variables

	Gov. Balance		Gov. Revenues		Gov. Expenditure	
Horizon	Location model	Scale model	Location model	Scale model	Location model	Scale model
0	0.6016	0.9335	0.6016	0.9335		
1	0.9522	0.3535	0.8330	0.9120	0.9777	0.6851
2	0.6564	0.4458	0.6663	0.3990	0.8793	0.1492
3	0.5556	0.0005	0.7269	0.0003	0.2602	0.0217
4	0.3288	0.0931	0.0463	0.0017	0.9145	0.7170

(b) Macroeconomic variables

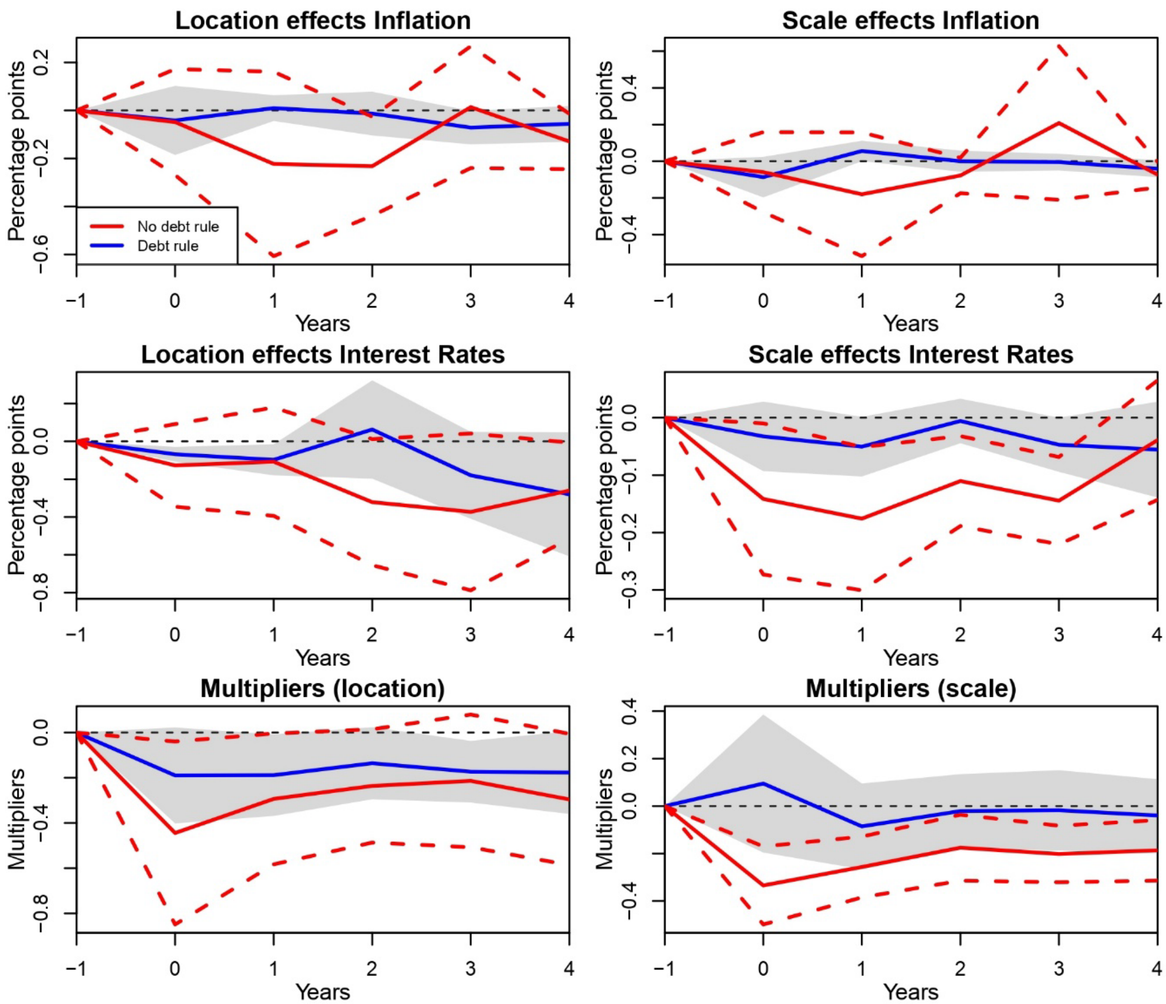
	Inflation		Interest Rates		Multipliers	
Horizon	Location model	Scale model	Location model	Scale model	Location model	Scale model
0	0.8517	0.9109	0.6789	0.9769	0.2249	0.0049
1	0.3435	0.3211	0.2306	0.5899	0.3419	0.0540
2	0.0614	0.0859	0.1638	0.8141	0.2411	0.1233
3	0.7086	0.4842	0.9972	0.4838	0.4442	0.0935
4	0.0941	0.3252	0.6634	0.7999	0.2408	0.1567

Figure B.3: Location and scale effects of fiscal expenditure consolidations on selected government budgetary variables in countries adopting and not adopting a debt rule.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the distribution of selected government budgetary variables in countries adopting (blue lines) and not adopting (red lines) a debt rule. The first line is for the government balance as percent of GDP. The second line is for the government revenues as percent of GDP. The third line is for the government expenditure as percent of GDP. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $y_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected government budgetary variable, $R_{i,t}$ is a dummy variable which takes 1 if the fiscal rule is in place, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Figure B.4: Location and scale effects of fiscal expenditure consolidations on selected macroeconomic variables in countries adopting and not adopting a debt rule.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the distribution of selected macroeconomic variables in countries adopting (blue lines) and not adopting (red lines) a debt rule. The first line is for inflation. The second line is for the real long-term interest rates. The results for GDP are reported in terms of multipliers. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $y_{i,t+h} = \alpha_{i,h} + R_{i,t} \times [\beta_{1,h,R} g_{i,t} + X'_{i,t}\beta_{2,h,R}] + (1 - R_{i,t}) \times [\beta_{1,h,NR} g_{i,t} + X'_{i,t}\beta_{2,h,NR}] + \{\delta_{i,h} + R_{i,t} \times [\gamma_{1,h,R} g_{i,t} + X'_{i,t}\gamma_{2,h,R}] + (1 - R_{i,t}) \times [\gamma_{1,h,NR} g_{i,t} + X'_{i,t}\gamma_{2,h,NR}]\}\varepsilon_{i,t+h}$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected macroeconomic variable, e.g. inflation or interest rate, $R_{i,t}$ is a dummy variable which takes 1 if the fiscal rule is in place, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). For GDP we estimate the multipliers using the Ramey and Zubairy (2018) approach that we extend to the location-scale model.

Table B.2: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations in countries adopting and not adopting a debt rule, on selected government budgetary variables and macroeconomic variables.

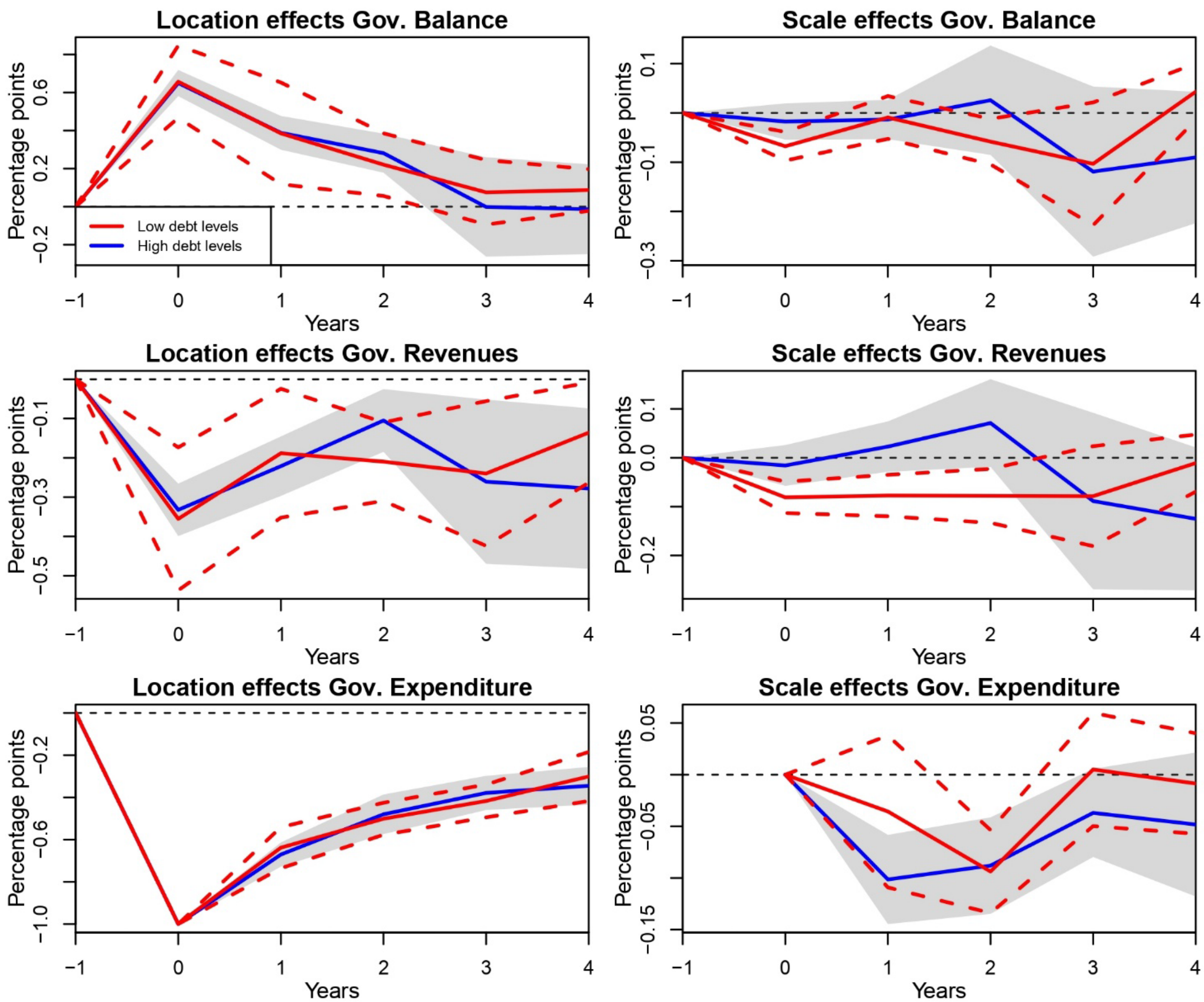
(a) Government budgetary variables

	Gov. Balance		Gov. Revenues		Gov. Expenditure	
Horizon	Location model	Scale model	Location model	Scale model	Location model	Scale model
0	0.8668	0.9467	0.8668	0.9467		
1	0.9568	0.4340	0.9721	0.7970	0.8609	0.7356
2	0.6029	0.3085	0.5709	0.1815	0.9332	0.2162
3	0.6139	0.0012	0.7525	0.0001	0.3566	0.0377
4	0.4240	0.0628	0.0555	0.0014	0.7627	0.9924

(b) Macroeconomic variables

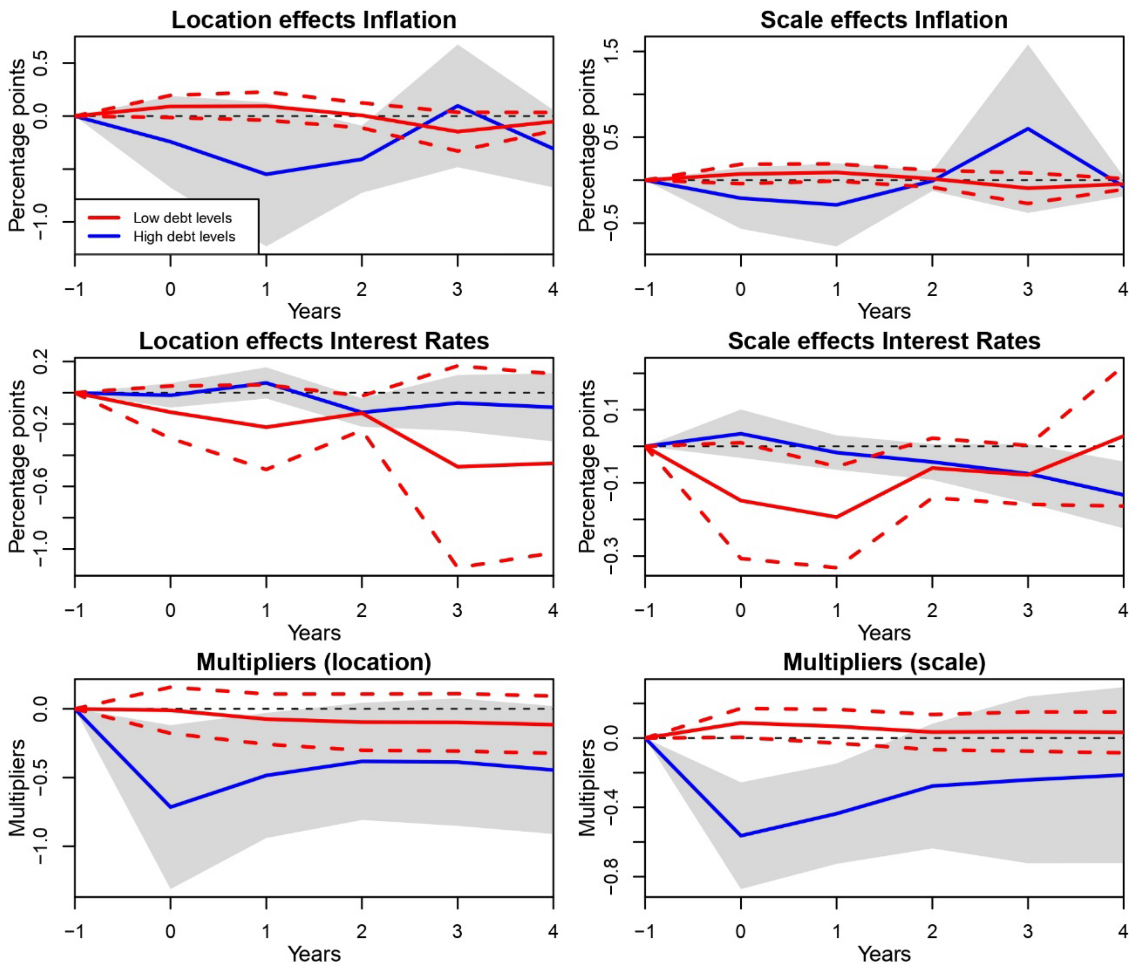
	Inflation		Interest Rates		Multipliers	
Horizon	Location model	Scale model	Location model	Scale model	Location model	Scale model
0	0.9657	0.8509	0.6746	0.0870	0.3517	0.0312
1	0.3268	0.2635	0.9525	0.0399	0.6202	0.1751
2	0.0826	0.2436	0.2638	0.0616	0.5732	0.2613
3	0.6197	0.4072	0.1729	0.0747	0.8345	0.1758
4	0.1308	0.4473	0.8764	0.7855	0.5798	0.2620

Figure B.5: Location and scale effects of fiscal expenditure consolidations on selected government budgetary variables conditional on the country's debt levels.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the distribution of selected government budgetary variables in countries with high (blue lines) and low (red lines) debt levels. The first line is for the government balance as percent of GDP. The second line is for the government revenues as percent of GDP. The third line is for the government expenditure as percent of GDP. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + F(z_i) \times [\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}] + (1 - F(z_i)) \times [\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}] + \{\delta_{i,h} + F(z_i) \times [\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}] + (1 - F(z_i)) \times [\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}]\}\varepsilon_{i,t+h}$, where $F(z_i) = \frac{e^{-\gamma z_i}}{1+e^{-\gamma z_i}}$, z_i is the debt-to-GDP normalized as $z_i = (\bar{d}_i - \bar{d})/sd(\bar{d}_i)$. i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected government budgetary variable, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details).

Figure B.6: Location and scale effects of fiscal expenditure consolidations on selected macroeconomic variables conditional on the country's debt levels.



Note: The graph shows the dynamic effects of fiscal expenditure consolidations on the location and scale of the distribution of selected macroeconomic variables in countries with high (blue lines) and low (red lines) debt levels. The first line is for inflation. The second line is for the real long-term interest rates. The results for GDP are reported in terms of multipliers. Shaded areas and dashed lines are the associated 90% confidence intervals based on standard errors clustered at the country level. The years after the shock are indicated in the x-axis. Estimates are obtained using a sample of 192 countries over the period 1991-2021, using the location-scale model $d_{i,t+h} = \alpha_{i,h} + F(z_i) \times [\beta_{1,h,L} g_{i,t} + X'_{i,t}\beta_{2,h,L}] + (1 - F(z_i)) \times [\beta_{1,h,H} g_{i,t} + X'_{i,t}\beta_{2,h,H}] + \{\delta_{i,h} + F(z_i) \times [\gamma_{1,h,L} g_{i,t} + X'_{i,t}\gamma_{2,h,L}] + (1 - F(z_i)) \times [\gamma_{1,h,H} g_{i,t} + X'_{i,t}\gamma_{2,h,H}]\}\varepsilon_{i,t+h}$, where $F(z_i) = \frac{e^{-\gamma z_i}}{1+e^{-\gamma z_i}}$, z_i is the debt-to-GDP normalized as $z_i = (\bar{d}_i - \bar{d})/sd(\bar{d}_i)$, where i refers to the country, t the time and h the horizons (years) after the fiscal shock. $y_{i,t+h}$ is the selected macroeconomic variable, e.g. inflation or interest rate, $\alpha_{i,h}$ and $\delta_{i,h}$ are country fixed effects in the location and scale equation, respectively, $g_{i,t}$ is the government expenditure-to-GDP ratio and $X'_{i,t}$ is a set of control variables useful for the identification of the fiscal shock (see section II.3 for further details). For GDP we estimate the multipliers using the Ramey and Zubairy (2018) approach that we extend to the location-scale model.

Table B.3: p-values for the test of significance of the difference between the effects of fiscal expenditure consolidations conditional on the country's debt levels, on selected government budgetary variables and macroeconomic variables.

(a) Government budgetary variables

	Gov. Balance		Gov. Revenues		Gov. Expenditure	
Horizon	Location model	Scale model	Location model	Scale model	Location model	Scale model
0	0.9592	0.1116	0.8609	0.0697		
1	0.9887	0.9146	0.7881	0.0261	0.6676	0.2526
2	0.6445	0.3055	0.2103	0.0375	0.7852	0.8864
3	0.7212	0.9143	0.9138	0.9445	0.5967	0.3644
4	0.5749	0.1799	0.3874	0.2919	0.6533	0.4850

(b) Macroeconomic variables

	Inflation		Interest Rates		Multipliers	
Horizon	Location model	Scale model	Location model	Scale model	Location model	Scale model
0	0.2324	0.2178	0.4011	0.1214	0.1062	0.0029
1	0.1436	0.2443	0.1591	0.0838	0.2385	0.0170
2	0.0335	0.8011	0.9673	0.8043	0.3961	0.2385
3	0.5723	0.3192	0.3886	0.9667	0.4206	0.4256
4	0.2710	0.6994	0.4072	0.2726	0.3583	0.5040

Annex C: Descriptive statistics

Table C.1: List of the 192 countries included in the dataset.

Afghanistan	Central African Republic	Ghana	Lesotho	Pakistan	Sudan
Albania	Chad	Greece	Liberia	Palau	Suriname
Algeria	Chile	Grenada	Lithuania	Panama	Sweden
Angola	China	Guatemala	Luxembourg	Papua New Guinea	Switzerland
Antigua and Barbuda	Colombia	Guinea	Madagascar	Paraguay	Syria
Argentina	Comoros	Guinea-Bissau	Malawi	Peru	São Tomé and Príncipe
Armenia	Congo, Republic of	Guyana	Malaysia	Philippines	Taiwan Province of China
Aruba	Costa Rica	Haiti	Maldives	Poland	Tajikistan
Australia	Croatia	Honduras	Mali	Portugal	Tanzania
Austria	Cyprus	Hong Kong SAR	Malta	Puerto Rico	Thailand
Azerbaijan	Czech Republic	Hungary	Marshall Islands	Qatar	Timor-Leste, Dem. Rep. of
Bahamas, The	Côte d'Ivoire	Iceland	Mauritania	Romania	Togo
Bahrain	Democratic Republic of the Congo	India	Mauritius	Russia	Tonga
Bangladesh	Denmark	Indonesia	Mexico	Rwanda	Trinidad and Tobago
Barbados	Djibouti	Iran	Micronesia, Fed. States of	Samoa	Tunisia
Belarus	Dominica	Iraq	Moldova	San Marino	Turkmenistan
Belgium	Dominican Republic	Ireland	Mongolia	Saudi Arabia	Tuvalu
Belize	Ecuador	Israel	Montenegro, Rep. of	Senegal	Türkiye
Benin	Egypt	Italy	Morocco	Serbia	Uganda
Bhutan	El Salvador	Jamaica	Mozambique	Seychelles	Ukraine
Bolivia	Equatorial Guinea	Japan	Myanmar	Sierra Leone	United Arab Emirates
Bosnia and Herzegovina	Eritrea	Jordan	Namibia	Singapore	United Kingdom
Botswana	Estonia	Kazakhstan	Nauru	Slovak Republic	United States

Table C.1: List of the 192 countries included in the dataset. (Continued)

Brazil	Eswatini	Kenya	Nepal	Slovenia	Uruguay
Brunei Darussalam	Ethiopia	Kiribati	Netherlands	Solomon Islands	Uzbekistan
Bulgaria	Fiji	Korea	New Zealand	South Africa	Vanuatu
Burkina Faso	Finland	Kosovo	Nicaragua	South Sudan	Venezuela
Burundi	France	Kuwait	Niger	Spain	Vietnam
Cabo Verde	Gabon	Kyrgyz Republic	Nigeria	Sri Lanka	West Bank and Gaza
Cambodia	Gambia, The	Lao P.D.R.	North Macedonia	St. Kitts and Nevis	Yemen
Cameroon	Georgia	Latvia	Norway	St. Lucia	Zambia
Canada	Germany	Lebanon	Oman	St. Vincent and the Grenadines	Zimbabwe

Table C.2: Descriptive statistics

	# obs.	Mean	Std. Dev.	Min	Max
Debt-to-GDP	4369	55.745	43.281	0.052	600.117
Government expenditure (percent of GDP)	4369	31.489	14.251	2.483	134.665
Log of real GDP	4369	6.141	3.560	-8.062	16.219
Log of real government expenditure	4369	4.890	3.456	-9.178	14.532
Inflation (percent)	4369	5.523	13.788	-129.936	648.424
Real interest rate	4148	-0.318	39.114	-99.955	2459.488
Government balance (percent of GDP)	4367	-2.301	6.189	-55.407	125.135
Government revenues (percent of GDP)	4367	29.182	14.874	0.637	166.030
Forecast of government expenditure (percent of GDP)	4369	1.32E+09	7.24E+09	0	1.36E+11
Forecast of inflation (percent)	4369	-1.461	92.175	-2222.67	2137.346
Forecast of log of real GDP	4369	10.779	9.805	-18.804	36.732

Table C.3: Regressions of the implied government expenditure shock from the baseline local projections on selected variables.

First principal component of selected macro-variables (contemporaneous)	0.358 (0.393)
First principal component of the first lag of selected macro-variables	-0.371 (0.271)
First principal component of forecast errors of selected macro-variables	0.060 (0.107)
World Uncertainty Index (Ahir, Bloom and Furceri 2022)	0.192 (0.362)
World Uncertainty Index - Fiscal Policy (Ahir, Bloom and Furceri 2022)	0.494 (1.681)
World Uncertainty Index - Political (Ahir, Bloom and Furceri 2022)	-0.042 (0.607)
Monetary policy shocks (Furceri, Loungani and Zdzienicka 2018)	-0.017 (0.083)

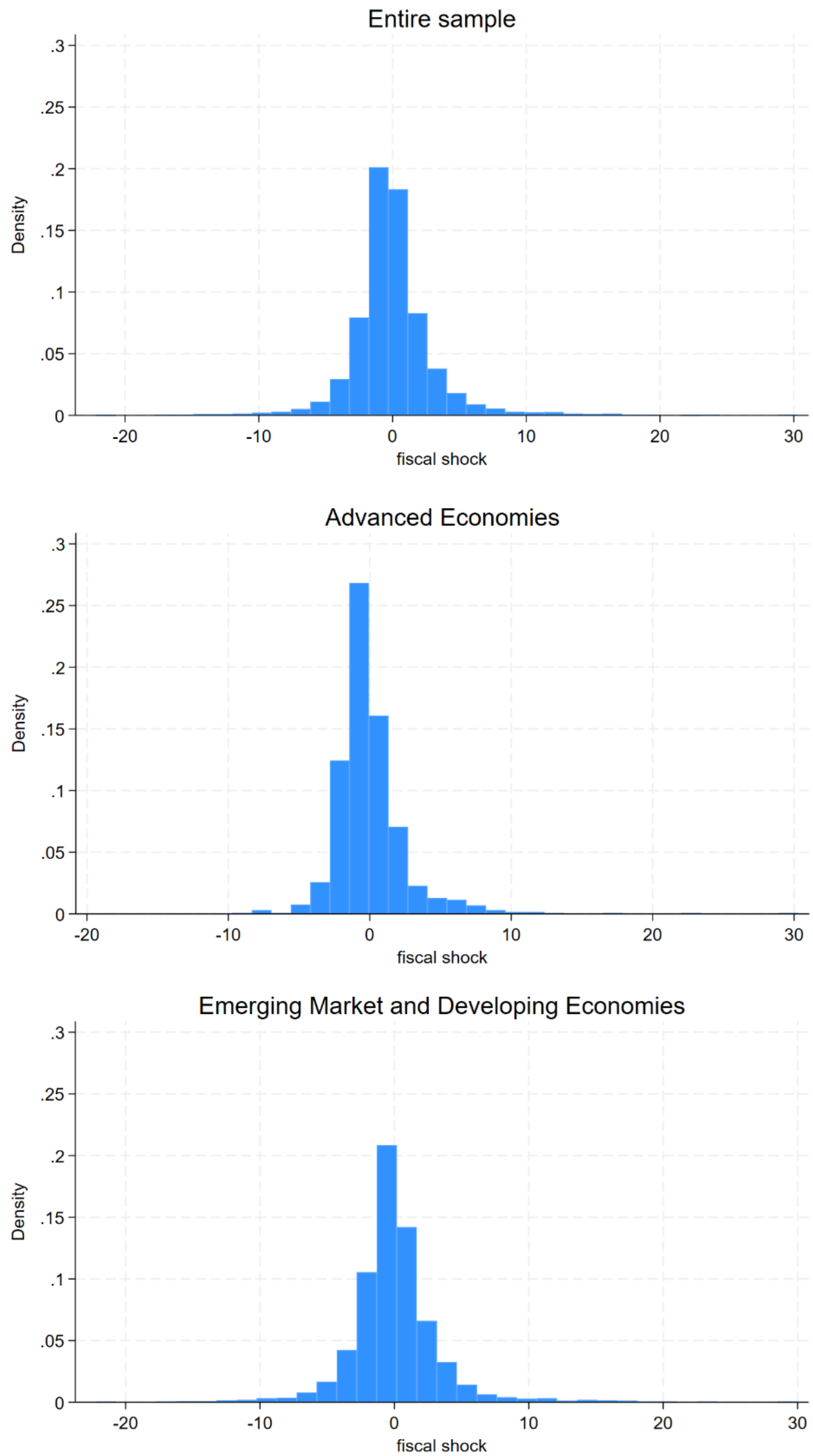
Note: The table reports the coefficients of the regressions of the fiscal shocks on each of the variables indicated in the first column, with robust standard errors in brackets. Country and time fixed effects are controlled for but not reported. The selected macro-variables include inflation, output, government expenditure, short-term interest rates, and exchange rates (national currency per U.S. dollar). The forecast errors are those of output, inflation and interest rates.

Table C.4: Descriptive statistics of the government spending shock.

Mean	Std. Dev.	Min	25-th quantile	75-th quantile	Max
-9.00e-16	3.285	-22.173	-1.411	1.090	30.285

Note: The government spending shock is defined as the innovation implied by the local projections, which—according to the Frisch-Waugh-Lovell theorem—corresponds to the residual from projecting the impulse variable $g_{i,t}$ onto the set of control variables $X_{i,t}$, that is, $\tilde{g}_{i,t} = g_{i,t} - E(g_{i,t}|X_{i,t})$ (see Montiel-Olea et al. 2025).

Figure C.1: Distribution of government expenditure shocks.



Note: The government spending shock is defined as the innovation implied by the local projections, which—according to the Frisch-Waugh-Lovell theorem—corresponds to the residual from projecting the impulse variable $g_{i,t}$ onto the set of control variables $X_{i,t}$, that is, $\tilde{g}_{i,t} = g_{i,t} - E(g_{i,t}|X_{i,t})$ (see Montiel-Olea et al. 2025).

PUBLICATIONS