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## Robust Fiscal Stabilization

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# Robust Fiscal Stabilization\*

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## Abstract

Any fiscal path is sustainable if future fiscal policy responds sufficiently to high deficits. Previous work found that Congress reduced the deficit during 1984-2003 when projected deficits rose. We find that this year-to-year feedback has disappeared: Congress on average during 2004-2024 did not respond to the projected deficit. We quantify how strong fiscal feedback needs to be going forward in order to keep the debt-GDP ratio below 250% in one hundred years, taking as given the debt sensitivity of interest rates implicit in official projections. Without fiscal risk, the government can succeed either by modestly and gradually reducing the deficit or by suddenly and permanently reducing the deficit once this century by 1.5% of GDP. When considering large transitory deficit shocks like the COVID-19 pandemic and persistent interest rate shocks, keeping the debt ratio below 250% with 95% probability requires stronger gradual feedback – 0.5%-1.2% of GDP average deficit reduction in the next decade – though less strong than actually observed during 1984-2003. Successful sudden feedback requires being able to undertake 1.5%-of-GDP deficit reductions twice in twelve-year periods, suggesting that a “wait-and-see” approach to successful deficit reduction sometimes allows little waiting.

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# 1 Introduction

Over the years, governments have struggled to develop approaches that constrain fiscal policy to achieve certain objectives, such as preventing large deficits, without placing undue limits on their ability to conduct countercyclical policy. The sequence of attempts by the European Union to modify the rules first established in the early 1990s with the adoption of the Stability and Growth Pact provides ample evidence of the challenge that this trade-off between constraint and flexibility presents (see, e.g., Blanchard, Leandro, and Zettelmeyer 2021, Buti, Friis, and Torre 2022).

The literature studying the effects of fiscal rules, surveyed recently by Potrafke (2023), suggests that they can lower deficits and reduce economic fluctuations. However, a central issue is their credibility and enforcement. This is particularly true for the United States given that there is no supranational government (unlike for EU member countries) or constitutional restriction (as exists for most US states) behind any budget rules adopted.

The U.S. experience is one of successive attempts at budget control, including the Gramm-Rudman-Hollings deficit targets of the mid-1980s and targets for discretionary spending and so-called “PAYGO” rules for taxes and entitlement spending beginning in the 1990s (Auerbach 2008). In the end, such rules bind only if they remain in effect and have been repealed or superseded whenever it was the will of Congress to do so, making it is hard to assess whether they served as anything more than statements of intent. Therefore, we rely below on empirical evidence regarding the tendency of Congress to react to budgetary conditions over recent decades, without regard to the budget rules that may have been in effect at the time. We also assess the likelihood that the type of behavior observed over this period will keep the United States on a path that is sustainable, in the broad sense that plausible policy actions along the path can avoid a fiscal crisis. To do so, we use dynamic stochastic analysis to evaluate fiscal paths, as recommended by Blanchard, Leandro, and Zettelmeyer (2021), although we do so not only for paths based on current policy, but also those for different potential fiscal stabilization approaches.

Empirically, we replicate earlier findings that fiscal feedback, in the form of increases in the primary surplus in response to high levels of projected deficits, prevailed in the 1984-2003 period, the first twenty years of available data. However, we present new evidence that Congress’s gradual year-to-year fiscal feedback has since disappeared. Congress during the 2004-2024 period on average increased the deficit, and those deficit increases did not fall when projected deficits rose. The change in Congressional behavior is visually evident in scatterplots that control only for the lagged output gap.

Motivated by our empirical findings, we study two questions numerically. First, how strong does gradual fiscal feedback – akin to Congress’s behavior during the 1984-2003 period – need to be in order to keep the debt-GDP ratio from rising to very high levels over the next century? Second, what “wait-and-see” strategy of foregoing immediate deficit reduction – akin to Congress’s behavior in the 2004-2024 period – and taking action only when it must be taken would achieve the same debt stabilization success?

We find that fiscal feedback of the strength observed empirically during the 1984-2003 period is more than sufficient to keep the debt ratio below 250% one hundred years from now. We further find that the debt-based feedback estimated empirically over the 1916-1995 period by Bohn (1998) is also sufficient to meet the 250% stability criterion. Translating our findings into current policy, we consider what the 10-year deficit path would look like if the fiscal feedback rules necessary to meet the stability criterion were followed. Relative to the CBO projection for the next 10 years, there would be smaller deficits and a lower national debt, especially for the feedback rules strong enough to maintain

fiscal stability in the presence of shocks.

Finally, we analyze wait-and-see strategies in which Congress suddenly reduces the deficit by a large amount (1.5% of GDP) when real debt service exceeds 2% of GDP, the deficit reduction trigger suggested by Furman and Summers (2020). We find that meeting the stability criterion requires a willingness to enact at least two large deficit reductions within eleven years of each other in adverse states of the world. The wait-and-see approach is therefore a kind of “deficit gamble” (Ball, Elmendorf, and Mankiw 1998): advantageous shocks enable the government to avoid the deficit reduction required under gradual feedback, while adverse shocks require the government to reduce the deficit strongly and repeatedly.

## 2 Gradual Fiscal Feedback has Disappeared

### 2.1 Design and Data

A key question that arises in assessing whether a government’s fiscal policy is on a sustainable path is how responsive the government is to deficits and accumulation of debt (e.g., Mehrotra and Sergeyev 2021). In an early contribution, Bohn (1998) estimated that the primary surplus was an increasing function of the debt-to-GDP ratio for the United States over the period 1916-1995, and that as a consequence the path of US fiscal policy was sustainable in the sense of obeying the government’s intertemporal budget constraint. This question also is central to the literature on the Fiscal Theory of the Price Level in distinguishing whether fiscal policy is “Ricardian” or “non-Ricardian” (Aiyagari and Gertler 1985), and hence whether prices will respond to impending fiscal imbalances.

A problem with many estimates of the responsiveness of fiscal policy to the government’s fiscal situation is that changes in primary balances do not necessarily reflect active government policy decisions. For example, automatic stabilizers could account for large fluctuations in primary surpluses. For some purposes, such passive fiscal policy reactions should also be taken into account. However, even controlling for the state of the economy, e.g., through the use of a measure of the full-employment primary deficit or surplus as a dependent variable, fails to control for other factors influencing primary balances, such as changes in the income distribution, fluctuations in capital gains realizations, or other realizations of economic uncertainty such as health care cost growth.

In response to this challenge, Auerbach (2003) measured fiscal policy changes based on semiannual estimates by the Congressional Budget Office (CBO) of the fiscal impacts of new legislation during the relevant period of observation. Twice per year – typically first in the winter then again in the summer – CBO updates its deficit forecast. It separates each update into three sources of changes: legislative, economic, and technical. Legislative impacts comprise changes caused by legislation enacted since the last update. Economic impacts comprise changes caused by updates to CBO’s macroeconomic forecast since the last update, for example changes to the GDP growth or interest rate forecast. Technical impacts comprise changes caused by new information on expected revenues and outlays conditional on the macroeconomic forecast, such as new information on benefit take-up.

Auerbach (2003) estimates the impact of projected surpluses on legislated surplus changes, while controlling for the output gap and scaling all values by potential GDP. In his preferred specification, he regresses

$$\Delta s_t = \alpha + \beta \mathbb{E}[s_{t-1}] + \gamma y_{t-1} + \epsilon_t \quad (1)$$

where  $t$  denotes a semi-annual period,  $\mathbb{E}[s_{t-1}]$  denotes CBO’s forecast as of period  $t - 1$  of the average surplus scaled by potential GDP over the coming five years beginning with period  $t$ ,  $\Delta s_t$  denotes CBO’s estimate at the end of period  $t$  of the impact of legislated enacted during period  $t$  on the average primary surplus scaled by potential GDP over the coming five years beginning with period  $t$ , and  $y_{t-1}$  denotes the output gap (defined to be positive when output is below potential) during the last full quarter before period  $t$ , equal to the difference between CBO’s estimate of actual and potential GDP as a share of potential GDP. Auerbach (2003) finds that a discount factor of 0.5 approximately maximizes goodness-of-fit, so he weights five-year averages such that each successive fiscal year’s surplus is accorded half of the weight of the prior fiscal year’s.<sup>1</sup>

Table 1 presents summary statistics.<sup>2</sup> Panel A uses the full sample from the second period of the 1984 fiscal year through the second period of the 2024 fiscal year. Panel B restricts attention to the original Auerbach (2003) sample comprising the second period of 1984 through the first period of 2003. Panel C restricts attention to the subsample comprising the first period of 2004 through the second period of 2023, excluding the second period of 2020. We omit the second period of 2020 from our subsample analyses because that data point from the beginning of the COVID pandemic includes the CARES Act and is a major outlier in our analyses; our conclusions strengthen when including that data point, as we note below. The table reports that the mean legislated surplus change is an average of  $-0.3\%$  of GDP over the coming five years.

## 2.2 Fiscal Feedback over the 1984-2003 Period

Panel A of Table 2 replicates the Auerbach (2003) original results using his original twenty-year time period 1984-2003.<sup>3</sup> The first column displays the key fiscal feedback result: when the projected average surplus over the coming five years rose by 1% of GDP, Congress enacted legislation to reduce the average surplus over the coming five years by 0.15% of GDP. Given that our observations are semiannual, this indicates that legislation offset nearly one third of changes in the projected surplus within a year. The robust standard error implies that the relationship is very statistically significant with a  $t$ -statistic of 5. Columns 2 and 3 indicate that approximately 40% of the legislated surplus response derives from a reduction in revenue while 60% derives from an increase in primary outlays. Legislative changes in revenues and primary spending, as well as their difference (primary surpluses), responded in a debt-stabilizing manner.

New in our analysis, we nonparametrically plot the relationship underlying Table 2a’s column 1 result. We use deficit terminology rather than surplus terminology in order to be maximally familiar to readers. Figure 1a plots residuals from a regression of the legislated primary deficit reduction (i.e., our primary surplus increase dependent variable) on the lagged output gap, versus residuals from a regression of the projected deficit (i.e., the negative of our projected surplus explanatory variable) on the lagged output gap, having added back the respective mean to each. We denote a year’s first

<sup>1</sup>For observations ending in the winter, the weights used for changes in year  $t$ ,  $t + 1$ , ...,  $t + 4$  are (to two decimal places) 0.52, 0.26, 0.13, 0.06, and 0.03. For observations ending in the summer, the year  $t$  observation’s weight is divided by 2 (because part of the fiscal year had already occurred before the beginning of the observation period), with all other observations’ weights scaled up proportionally so that the weights still sum to one.

<sup>2</sup>The construction of the observations themselves is described in the Appendix, in Tables A-2 and A-3.

<sup>3</sup>Results deviate slightly due to using an updated potential GDP series.

period with the suffix “a” and its second period with the suffix “b”. The figure shows that when CBO projected high deficits, Congress reacted by reducing the deficit. The 0.15 slope of the best-fit line exactly equals the negative of Table 2a’s  $-0.15$  coefficient. The non-parametric relationship appears linear, supporting equation 1’s assumed linear relationship. Moreover, the scatter plot shows that no outlier or single era drives the result.

Particular episodes in the 1984-2003 period embody the statistical relationship. In the first period of 1991 the projected five-year surplus averaged  $-3.4\%$  of potential GDP, and Congress enacted legislation including outlay reductions and tax increases of similar magnitudes that cumulatively increased the weighted surplus over the five-year window by  $0.8\%$  of GDP. In the second period of 2001, the projected surplus averaged  $2.8\%$  of potential GDP, and Congress enacted the 2001 tax cut legislation as well as spending increases that cumulatively reduced the surplus over those five years by  $0.7\%$  of GDP.<sup>4</sup>

The remaining columns of Table 2a supplement Auerbach (2003) with new specification robustness tests. Columns 4-6 replace projected surpluses with the projected change in the debt-to-GDP ratio between  $t$  and  $t + 4$ , the projected  $t + 4$  debt-to-GDP ratio, and the lagged debt-to-GDP ratio, respectively. Column 7 adds the projected  $t + 4$  debt ratio to the column 1 specification.

Column 5 finds the Bohn-like result that projected debt-to-GDP ratio positively and significantly predicts legislated changes in the primary surplus. A 10%-of-GDP higher projected  $t + 4$  debt ratio was followed on average by a  $0.16\%$  legislated increase in the surplus over the coming five years, with a  $t$ -statistic of 2.3. Relative to columns 1 and 5, columns 4 and 6 find statistically similarly sized but less significant relationships with the projected debt ratio change and the lagged debt ratio, respectively. Column 7 finds that when both the projected surplus and the projected  $t + 4$  debt ratio are included, the coefficient on projected surplus remains similarly sized and significant while the coefficient on the projected debt ratio changes sign and becomes insignificant. Hence, we find statistically significant feedback onto legislated surplus changes both from projected surplus and from the projected debt ratio, but more robustly from the projected surplus.

Finally and though not our focus, Table 2a reports a robust negative relationship between the lagged output gap and the projected surplus. When the lagged output gap is 1% of GDP larger (i.e., GDP is 1% more below potential), Congress enacted legislation that reduced the average surplus over the coming five years by  $0.13\%$  of GDP. This relationship is statistically significant with a  $t$ -statistic of nearly 4. This Congressional response to the output gap is consistent with fiscal stabilization policy.

## 2.3 Fiscal Feedback 2004-2024

We present new evidence that Congressional responses to both the budget and the economy have statistically disappeared in the ensuing two decades. Figure 1b repeats the analysis of Figure 1a, except that the sample comprises the first period of 2004 through the second period of 2024, omitting the second period of 2020 (the beginning of the COVID pandemic) as discussed above.<sup>5</sup> Figure 1b shows that the strong positive relationship from the 1984-2003 period has disappeared. In the last two decades, Congress on average increased the deficit, and those deficit increases did not vary with CBO’s deficit projections.

<sup>4</sup>These particular relationships also hold after residualizing with the lagged output gap, as shown in Figure 1a’s 1991a and 2001b data points.

<sup>5</sup>Results for the full sample period 1984-2024 are shown in the Appendix, in Tables A-1b and A-1c.

The first column of Table 2b, for the period 2004-2024 (excluding the second observation from 2020) reports a slightly positive coefficient of 0.027, with a robust standard error of 0.069 implying no statistically significant relationship. When including the omitted 2020 second-period data point, the estimate grows more positive (see Appendix Table A-1a). The 95% confidence interval in Table 2b column 1 rejects the 1984-2003 estimate of  $-0.15$  in Table 2a column 1. The various permutations in the remaining columns confirm no statistically significant relationship remains.

Figure 1c combines the legislated surplus results from the two time periods into a single graph to illustrate the difference between the two. Not only has the impact of the budget forecast on policy adjustments (indicated by the slope of the line) disappeared, but the policy adjustments (indicated by the height of the line) have also shifted downward, meaning that for any given projected budget surplus, current policy adjustments have shifted more toward deficit increases. Notably, both series have many data points in the projected deficit range of 1.5% to 4% of GDP and exhibit differently sloped relationships with the outcome in that overlapping range.

Figure 2a repeats the Table 2 column 1 analyses for different rolling time periods of up to 20 years. Specifically, the 2003 value plots the point estimate and 95% confidence interval from the first period of 1984 through the second period of 2003, nearly equaling the Table 2a column 1 result except that it includes the data point for the second period of 2003. All subsequent values  $t$  plot the analogous estimates for a twenty-year rolling sample comprising observations from the first period of  $t - 19$  through the second period of  $t$ . Hence, the 2024 value plots the point estimate and 95% confidence interval from the first period of 2005 through the second period of 2024. All values for years  $t < 2003$  plot the analogous estimates for the rolling sample comprising observations from the second period of 1984 through the second period of  $t$ .

The figure shows that the responsiveness of fiscal policy to the projected surplus was approximately stable through the mid-2000s, subject to the caveat that the confidence intervals are wider in the earliest samples, which have the fewest data points. Since the mid-2000s, fiscal responsiveness generally weakened. From after the Great Recession to the present, fiscal policy has on average not reacted to the projected surplus. Though confidence intervals are substantial, several reject the original Auerbach (2003) point estimate. While some recent estimates are influenced by the fiscal responses during the COVID-19 pandemic even after having removed the 2020 second-period outlier, the 2020 estimate uses only pre-pandemic data and also rejects the original Auerbach (2003) point estimate.

Figure 2b repeats Figure 2a except for the lagged output gap explanatory variable, rather than the projected surplus explanatory variable. Though not the focus of this paper, Figure 2b shows an analogous result to Figure 2a: the previously substantial and statistically significant relationship between the legislated surplus and the output gap has attenuated toward zero and become statistically insignificant. This may seem surprising given the massive fiscal response to the Covid pandemic, but balanced against that episode are such actions as enacting a large tax cut in 2017 when fiscal conditions were not favorable and the economy was relatively strong.

These results suggest cumulatively that, for a given trajectory of budget surpluses traced out by current law, the government responsiveness has declined in recent years, reducing the inherent stability of the fiscal adjustment process. At the same time, policy for a given fiscal situation has shifted more toward deficit increases. In short, policy has moved toward higher deficits and away from reacting to them. These changes leave aside the further potentially negative impact on budgets of the apparently weaker countercyclical responsiveness. Especially if output multipliers are stronger in recessions than

in expansions (e.g., Auerbach and Gorodnichenko 2012), weaker countercyclical fiscal policy responses may imply higher net debt accumulation over the business cycle.

### 3 How Likely is a Fiscal Crisis?

Even if the federal government follows its recent passive behavior regarding fiscal conditions, the likelihood of a fiscal crisis depends on many factors, including the underlying trends in the primary surplus, the distribution of shocks to the budget, the distribution of interest rates and economic growth rates, and the responsiveness of interest rates to fiscal conditions, in particular the debt-GDP ratio. To see this, note that the debt-GDP ratio evolves according to the following relationship:

$$\Delta b_t = \rho_t b_{t-1} - s_t \quad (2)$$

where  $b_t$  is the debt-GDP ratio at the end of year  $t$ ,  $\Delta b_t$  equals the debt-GDP ratio change  $b_t - b_{t-1}$ ,  $\rho_t \equiv \frac{r_t - g_t}{1 + g_t}$  equals the excess interest rate (Yagan 2024) where  $r_t$  is the nominal interest rate in year  $t$  and  $g_t$  is the nominal GDP growth rate in year  $t$ , and  $s_t$  is the primary surplus in year  $t$ .<sup>6</sup> If the primary surplus is zero, the debt-GDP ratio grows by the excess interest rate, which equals the amount by which the interest rate raises the debt-ratio in excess of the amount by which GDP growth shrinks the debt-ratio.

Clearly, if there are shocks that reduce the primary surplus, these will lead to a more rapid increase in the debt ratio. However, even if the government is running primary deficits, the debt-GDP ratio will not grow if excess interest is sufficiently negative. If excess interest is not sufficiently negative, then the growth of  $b$  will be exacerbated if  $r$  increases with  $b$ , as increases in the debt-GDP ratio feed back into the rate at which the debt-GDP ratio increases. To assess the likelihood that the United States will reach a debt-GDP ratio that threatens fiscal stability, we use empirical evidence regarding these factors.

#### 3.1 Excess Interest Rate

Over the past many years, the average interest rate on government debt  $r$  has remained below the GDP growth rate  $g$ . Based on the most recent CBO projections, this will remain so until 2041 (Auerbach and Gale (2024)). If the excess interest rate  $\rho_t$  remains at some constant negative value  $\rho < 0$  forever, and primary deficits remain constant as a share of GDP, then debt as a share of GDP will stabilize and the government’s intertemporal budget constraint will hold, as emphasized by Blanchard (2023). That is, setting  $\Delta b$  equal to zero in equation 2 and letting  $-s$  be the constant primary deficit, the long-run debt-GDP ratio will equal  $\frac{s}{\rho}$ . However, the excess interest rate could turn positive, for example because of secular drivers of global savings and investment (Blanchard 2019), because rising debt leads to rising interest rates (Gamber and Seliski 2019; Mian, Straub, and Sufi 2024), or because population or technology growth disappoints.

We begin our assessment of fiscal risk by examining the historical variance of the excess interest rate  $\rho_t$ , in the spirit of Ball, Elmendorf, and Mankiw (1998) but with more years of data. We study

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<sup>6</sup>This formula abstracts from what CBO calls “Other means of financing”, which is usually minor. Other means of financing includes changes to loan present values under the Federal Credit Reform Act of 1990 as well as changes to Treasury’s cash balances such as during and after “extraordinary measures” to avoid debt ceiling default.



realized values of the excess interest rate, which correspond to the actual evolution of the debt ratio. For example, unexpected inflation yields a lower excess interest rate than was expected *ex ante*.

Historical data on the primary surplus, net interest payments, and the nominal level of public debt held by the public derive from two sources. Data 1962-2023 come from CBO’s historical data series (CBO 2024a). For years 1790-1961, CBO data are not available, so we supplement with the historical series compiled by Wallis (2000). We supplement those data with nominal GDP from the Bureau of Economic Analysis. To estimate the average nominal interest rate on government debt  $b_t$ , we follow Auerbach and Gale (2024) by dividing the current year’s net interest by the prior year’s debt minus half of the current year’s primary surplus, which approximately accounts for interest saved by or paid on the current year’s primary surplus.

Figure 3a plots rolling averages of the excess interest rate in the United States since its founding. Annual values fluctuate greatly, in particular because of recessions. Long-term means of the excess interest rate matter most for debt sustainability. The graph plots the excess interest rate over rolling periods of five, thirty, fifty, and one hundred years.

Over five year periods, the excess interest rate fluctuated greatly. For example, it rose dramatically in the Great Depression, fell dramatically after World War II, and rose again during the Volcker disinflation (Hall and Sargent 2011). The five-year series shows that the variance in the excess interest rate declined dramatically in recent decades, perhaps because of Federal Reserve independence, abandonment of the gold standard, and rule-following. The excess interest rate has exhibited less variance over longer intervals. However, even the fifty-year rolling average has fluctuated by multiple percentage points.

Table 3 plots quantiles of the excess interest rate distribution over different rolling time horizons. Panel A uses all data since 1790 while Panel B uses data only since 1900. The variance is substantial at all horizons. For example, since the country’s founding, the mean value of the excess interest rate across all thirty-year rolling averages has been  $-0.004\%$ , the median has been  $0.0\%$ , the 5th percentile has been  $-4.0\%$ , and the 95th percentile has been  $2.8\%$ . In summary, while the excess interest rate has been negative on average over long periods, its distribution even over long periods includes positive values that could contribute to adverse debt dynamics. Moreover, the historical period over which these distributions have been estimated did not include debt-GDP ratios such as those being projected to occur in the near future, and therefore may not reflect the possibly higher values of interest rates that could result.

### 3.2 Budget Shocks

Current forecasts of the federal budget outlook (e.g., CBO (2024c) suggest relatively stable primary surpluses as a share of GDP and a smoothly rising debt-GDP ratio. While one may argue that these projections incorporate overly optimistic assumptions regarding spending and revenues (e.g., Auerbach and Gale (2024)), alternative assumptions would still result in a relatively smooth path for the debt-GDP ratio, albeit one with a steeper slope. However, the debt-GDP ratio over the past two decades has behaved quite differently, with periods of relative stability punctuated by very sharp increases.

Figure 3b plots the debt-GDP ratio since 2000. The series exhibits relative stability, except during two crises: first during the Great Recession, when the debt-GDP ratio doubled, from 35% to 70% between 2007 and 2012, and then during the COVID-19 pandemic and its aftermath, with the debt-

GDP ratio rising by 20 percentage points between 2019 and 2020. These jumps reflect the combination of automatic stabilizers and discretionary fiscal actions, but the observed pattern suggests that one can think of the shocks to the budget as taking the form of large, infrequent jumps that are asymmetric in nature. That is, during this period, there were no offsetting declines in the debt-GDP ratio outside of the episodes when the debt-GDP ratio jumped.

While this may partially reflect the underlying upward trend in the debt-GDP ratio (i.e., a period of relative stability of the debt-GDP ratio represents a favorable outcome relative to trend), the upward jumps are still of a much greater magnitude relative to any plausible forecast trend.<sup>7</sup>

This pattern suggests that treating budget forecasts as representing the central tendency of the distribution of outcomes may provide a distorted and overly optimistic picture of the fiscal outlook. In our simulations below, we incorporate budget shocks that result in infrequent but sharp increases in the debt-GDP ratio, along with shocks to the gap between interest rates and growth rates, as sources of uncertainty in the fiscal path.

### 3.3 The Prospect of Sudden Fiscal Consolidations

Even without gradual legislative feedback as observed for 1984-2003 in Auerbach (2003), and with the additional risks posed by shocks to interest rates and the budget itself, the government could satisfy its intertemporal budget constraint if it responds suddenly and sufficiently strongly in particularly adverse fiscal scenarios. As an extreme example, a government that permanently increases its surplus by 10% of GDP when the debt-GDP ratio reaches 150% of GDP would likely weather any fiscal storm. In our simulations below, we therefore consider not only how likely the United States is on an explosive fiscal trajectory, but also the extent to which a plausible fiscal consolidation could materially change the outcome.

How large a permanent deficit reduction would the United States be politically and economically able to implement in an adverse fiscal scenario? Guidance could in principle be gained from the recent experience of other advanced nations. Alesina et al. (2018) update and refine the compilation of fiscal consolidations across the Organisation for Economic Co-operation and Development (OECD) 1978-2014. Their goal is to identify legislation motivated by deficit reduction rather than future economic conditions.

While those data have proven useful in other empirical contexts, we worry that other legislation may have undone some of those consolidations and therefore overstate the magnitude of feasible fiscal consolidations for our purpose. For example, the Alesina et al. (2018) data list the United States as having reduced the deficit by 4.4% of GDP cumulatively 1990-1998 via legislation enacted in 1990 and 1993 for the purposes of deficit reduction. However, the CBO-based measure of legislated surplus changes that we constructed in Section 2 identify only 1.4% in cumulative deficit reduction on net across all legislation enacted 1990-1998.<sup>8</sup>

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<sup>7</sup>If one looks back further, an additional large jump in the debt-GDP ratio occurred during the Great Depression; however, this jump is much less apparent when one measures debt relative to potential GDP. Another episode of a sharp increase in the debt-GDP ratio occurred during World War II, as the debt-GDP ratio jumped to its historical high of greater than 100%. But this was followed by a period of rapid decline in the debt-GDP ratio, due in part to a policy of financial repression. See Hall and Sargent (2011). Thus, the jumps in the debt-GDP ratio associated with the past two recessions are the only “clean” episodes of this type of outcome in the past century. They are also the only two to have occurred during the “modern” period in which a substantial share of government spending is accounted for by social insurance.

<sup>8</sup>Note that these figures are not exactly comparable as their timing definitions differ.

In the CBO data 1984-2023, we search for the maximum deficit reduction that was enacted over any contiguous length of time less than or equal to three years. We find the maximum between the first period of 1986 and the first period of 1988. During that time, the United States enacted legislation that CBO estimated would cumulatively reduce the deficit by 2.0% of GDP.<sup>9</sup> Moreover, that deficit reduction was not undone by new legislation over the subsequent decade.<sup>10</sup> Hence, deficit reduction equal to 2% of GDP was historically feasible in the United States. We use this finding in the simulations below.

## 4 Modeling the U.S. Fiscal Trajectory

In this section, we develop a model to simulate the distribution of paths for the debt-GDP ratio, taking into account the factors discussed in the previous section, as well as the potential stabilizing effects of fiscal feedback, either continual or sudden. Our aim is to determine how likely US fiscal policy is to be on an explosive path, which we define as reaching a very high debt-GDP ratio within a certain period of time.

### 4.1 The Model

The debt-GDP ratio  $b$  evolves according to the expression

$$b_t = (1 + \rho_t)b_{t-1} - s_t + e_{st} \quad (3)$$

where  $\rho_t = \frac{r_t - g_t}{1 + g_t}$  is the excess interest rate defined in the previous section and  $e_s$  is a Poisson shock to the debt-GDP ratio, meant to represent the occurrence of a rare event that causes a jump in the debt-GDP ratio. This expression is the same as the standard law of motion for the debt-GDP ratio given in equation 2, but for convenience we have broken the primary surplus down into two components: its “normal” value  $s$  and the additional component arising when there are one-time shocks to the budget.

We parameterize the Poisson shock  $e_s$  to have an expected frequency  $\lambda$  of 2 shocks per 100 years. We choose 2 to correspond to those shocks during the past century during which the debt-GDP ratio (and debt-potential GDP ratio) rose substantially and then remained at a higher level: the Great Recession, and the COVID-19 recession. As to the magnitude of the shock,  $K_s$ , we set it equal to the average increase in the debt-GDP ratio during these two historical episodes:

$$K_s = \frac{1}{2} \{ [b_{2014} - b_{2007}] + [b_{2021} - b_{2019}] \}. \quad (4)$$

The resulting value is 0.25, which we use in our simulations below.<sup>11</sup> That is, our simulations assume that on average there are two times per century when the debt-GDP ratio rises by 25 percentage

<sup>9</sup>The largest component of deficit reduction in this time range occurred in the first period of the 1986 fiscal year, during which the Gramm-Rudman-Hollings Balanced Budget and Emergency Deficit Control Act of 1985 was enacted and imposed binding discretionary spending caps. In contrast, the Tax Reform Act of 1986 was largely revenue neutral.

<sup>10</sup>Though the Budget Enforcement Act of 1990 replaced Gramm-Rudman-Hollings’ spending caps with an alternative pay-as-you-go system, CBO’s estimates of the net effects of new legislation both in the 1991 fiscal year and over years 1988-1997 were net increases in the surplus.

<sup>11</sup>We also obtain 0.25 when de-trending, i.e., when we compute the average increase net of the increase that would have occurred had the annual changes in the debt-GDP ratio during the shock period equaled its value in the year immediately prior to the shock.

points.

For the variable  $\rho_t$ , we find using various statistical tests that an AR(1) process is generally preferred to other ARMA specifications, and an augmented Dickey-Fuller test rejects the presence of a unit root in the process. To reflect existing recent estimates indicating the presence of positive feedback of the debt-GDP ratio on interest rates, we add to our specification the lagged debt-GDP ratio. That is, the term  $\rho$  evolves according to the relationship:

$$\rho_t = \beta_0 + \beta_1 \rho_{t-1} + \beta_2 b_{t-1} + e_{ut} \quad (5)$$

The results for different sample periods are shown in Table 4. The estimated value of  $\beta_1$  in the first column of the table, for the sample since the end of the gold standard is 0.576 (with standard error 0.114), which we use as the main assumption in our simulations. For reference, the results for the full sample available to us, beginning in 1792, since 1900, and during the period since the Volcker disinflation (post-1985) are shown in the remaining columns of the table. For the stochastic term  $e_u$ , we assume normality with zero mean and standard deviation equal to the standard error of residuals from the same regression specification. Here, the choice of sample period is very important. We scale the stochastic shocks using the residuals from our baseline specification in column 1. Had we worked with one of the longer samples, the implied standard deviation of our stochastic element would have been nearly three times as large.

Estimates in Table 4 of  $\beta_0$  and  $\beta_2$  are far less precise than those for  $\beta_1$ , so we choose values to provide a simulation path that conforms to CBO’s recent analyses. We set  $\beta_2$  equal to 0.004 and choose  $\beta_0$  so that the initial value of  $\rho$  equals -.005. We discuss these choices further below.

The remaining equation needed to complete our model involves the evolution of the primary surplus (as discussed above, excluding the Poisson debt shock). This is, in a sense, the central equation of the model, in that large primary deficits make it very hard to achieve a sustainable fiscal path, even with favorable realizations of  $\rho_t$  and good luck in avoiding large recession-induced budget shocks. We specify this equation to include two possible versions of a fiscal feedback rule: one responding to status-quo values of the budget surplus as in Auerbach (2003), and one responding to the lagged debt-GDP ratio as in Bohn (1998). With these potential feedback rules included, the evolution of the primary surplus follows the following equation:

$$s_t = \theta s_{t-1} + (1 - \theta)a_s + c[\rho_t b_{t-1} - \theta s_{t-1} - (1 - \theta)a_s] + d[b_{t-1} - a_b] \quad (6)$$

where  $c$  is the strength of the feedback in response to the status-quo budget surplus (“gradual deficit-driven feedback”) and  $d$  is the strength of the response to the lagged debt-GDP ratio (“gradual debt-driven feedback”). The term  $a_s$  represents the initial value of the primary surplus relative to GDP, and also the value that would hold in the absence of any fiscal feedback (i.e., for  $c = d = 0$ ). That is, we assume that the underlying fiscal policy of the government, absent any fiscal feedback, involves a constant primary surplus as a share of GDP. This is consistent with the most recent CBO projections (CBO (2024c)) that show relatively stable primary surpluses over the coming years and, indeed, come in an environment in which, as discussed above, fiscal feedback has been essentially absent.

When there is fiscal feedback, the parameter  $\theta$  represents how “sticky” that feedback is, in terms of the permanence of legislative changes. For example, when feedback results in an increase in the

primary surplus, say through a tax increase, how permanent is that tax increase? Estimates of the parameter  $c$  in Table 2 are based on data incorporating policy changes that vary in permanence, and it clearly makes a difference how long these changes last.<sup>12</sup> For our base where adjustment is based on the parameter  $c$ , we assume that all such changes are permanent ( $\theta = 1$ ). For the case in which adjustment is based on the parameter  $d$ , we assume that  $\theta = 0$ . We do so because this corresponds to the way the parameter  $d$  has been estimated in Bohn (1998), relating the primary budget surplus to the lagged debt-GDP ratio.<sup>13</sup>

Gradual deficit-driven feedback is based on what the current surplus would be if there were no fiscal feedback in the current period. Specifically, the gradual deficit-driven feedback parameter  $c$  multiplies the status-quo change in the debt-GDP ratio, equal to excess interest  $\rho_t b_{t-1}$  minus the status-quo surplus if there were no fiscal feedback  $\theta s_{t-1} - (1 - \theta)a_s$ .<sup>14</sup> Gradual debt-driven feedback includes an intercept term,  $a_b$ , assumed to be constant. The purpose of this intercept term is to scale the feedback so that it is positive if and only if debt exceeds some level. Otherwise, there would be a higher primary surplus even in response to a very low positive debt-GDP ratio, which seems highly unrealistic. We set  $a_b = 1$ , assuming that fiscal tightening for this specification occurs when the debt-GDP ratio exceeds roughly its current level. For simulations where  $c$  is nonzero, we use  $c = 0.30$ , consistent with estimates for the period through 2003 in column (1) of Table 2a. (We use a value for  $c$  approximately double that in the table because those estimates are for the semiannual frequency, i.e., there are two such feedback responses at the annual frequency.). When  $d$  is nonzero, we use a value of  $d = 0.05$ , consistent with estimates in Bohn (1998).

Before continuing, it is worth discussing the relationship between debt-based and deficit-based fiscal feedback. Under our assumptions about the parameter  $\theta$  for the two cases, deficit-based fiscal feedback is described by the expression:

$$s_t = s_{t-1} + c[\rho_t b_{t-1} - s_{t-1}] \quad (7)$$

so that the change in the primary surplus between periods  $t - 1$  and  $t$  is:

$$s_t - s_{t-1} = c[\rho_t b_{t-1} - s_{t-1}] \quad (8)$$

For debt-based feedback, the primary surplus follows the expression:

$$s_t = a_s + d[b_{t-1} - a_b] \quad (9)$$

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<sup>12</sup>In particular, the feedback estimates based on CBO data discussed above reflect legislative changes in the primary surplus over a five-year horizon, but some of these changes were explicitly temporary in the legislation. Examples include the Bush tax cuts in 2001 and the Trump tax cuts in 2017, both of which largely phased out at the end of a 10-year budget window and required additional legislation to be extended, which would also be counted as policy responses.

<sup>13</sup>In such a specification, there is no “memory” incorporating previous legislation in the dependent variable. Each year’s primary surplus is related to the level of debt. Our estimates in Table 2 that include the level of debt (either lagged or projected) as an explanatory variable, which would correspond to a higher value of  $\theta$ , are lower than the value estimated by Bohn (1998). However, given that these parameters are estimated over a much shorter sample period and not significant when the projected surplus is included as an explanatory variable, we rely on the estimates and specification in the existing literature.

<sup>14</sup>Note that, for simplicity, this varies slightly from the specification discussed in Section 2, which related policy responses for a five-year window to projected surpluses over a five-year window. However, given that  $a_s$  is assumed constant and that Poisson budget shocks are not included in  $s$ , the differences should be minor. Note also that our main estimates in Section 2 used weighted projected surpluses as an explanatory variable, whereas in our model we use  $\rho_t$  rather than  $r_t$  in calculating debt service.

so that the change in the primary surplus between periods  $t - 1$  and  $t$  is:

$$s_t - s_{t-1} = d[b_{t-1} - b_{t-2}] \quad (10)$$

The term in brackets in equation 10 is just the period- $t - 1$  deficit, adjusted for growth, while the term in brackets in equation 8 is a combination of the growth-adjusted deficits in periods  $t$  and  $t - 1$ , including the debt service from year  $t$  and the primary deficit from year  $t - 1$ . Thus, for equal values of  $c$  and  $d$ , we would expect very similar evolution of the primary surplus for the two cases, assuming the same initial primary surplus.<sup>15</sup> One exception, and it is an important one for our modeling, involves the reaction to the Poisson shocks in the debt-GDP ratio. Because we exclude these from our measure of the primary surplus (they are treated as simply causing a jump in the debt itself), there is no direct response to them in the deficit-based feedback described by equation 7; the jump in debt only affects fiscal feedback through its impact on debt service. Because the debt-based feedback in equation 9 relates directly to changes in the debt-GDP ratio, this type of feedback will react directly to jumps in debt.

Finally, we also consider a third type of fiscal feedback, to which we refer as “sudden feedback.” In this version of the model, the gradual feedback parameters  $c$  and  $d$  equal zero, and government undertakes a large fiscal consolidation periodically when the debt-GDP ratio reaches a certain level. We choose a consolidation size of 1.5% of GDP, based on our previous discussion of empirical evidence on fiscal consolidations, which suggest that a consolidation of this size is historically large but possible. We further assume that consolidations may occur once every  $T$  years and that they are triggered when, following Furman and Summers (2020), real debt service is projected to average at least 2% of GDP over the next ten years and to be at least 2% in tenth year.<sup>16</sup> So, for example, when real debt service initially breaches this ceiling, a 1.5% consolidation will occur. The next consolidation of 1.5% will occur  $T$  years later if the same condition is met at that time, or in the first year beyond the  $T$ -year horizon that the condition is met. The effectiveness of such an approach to fiscal control depends on how realistic it is. Unlike for the parameters  $c$  and  $d$ , we cannot cite historical evidence that such a pattern of consolidations is politically optimistic or pessimistic. Instead, we simply choose a value of  $T$  for our base case that results in stabilization of the debt-GDP ratio after 100 years that is roughly in line with the outcomes for the two types of gradual fiscal stabilization. This value is  $T = 30$ , meaning that we are assuming that sudden fiscal consolidation can occur roughly once a generation. Note that the success of sudden stabilization also depends critically on how durable the consolidations are – in our terminology, how close  $\theta$  is to 1. Consolidations that lack durability will be of little help in improving the fiscal path, under our assumption that they cannot occur more than once every  $T$  years. For our simulations, we assume that  $\theta = 1$ , but this may be very optimistic.

Note that our model does not specify the nature of fiscal adjustments; it does not distinguish between taxes and spending. Our estimates for the period 1983-2003 discussed above indicated that roughly 40% of fiscal adjustments took the form of taxes and 60% took the form of spending, but we make no such assumption in our model. We therefore do not delve into the potentially different

<sup>15</sup>While  $\rho$  is endogenous, depending on the debt-GDP ratio  $b$ , the near equality of  $b$  in the two cases implies a near equality of  $\rho$  as well.

<sup>16</sup>Because the term  $\rho$  in our model incorporates both the nominal interest rate and the nominal GDP growth rate, we need assumptions about the GDP growth rate and the inflation rate to solve for the real interest rate. That is, as  $\rho_t \equiv \frac{r_t - g_t}{1 + g_t}$ , the real interest rate is  $(1 + g)\rho + g - \pi$ , where  $\pi$  is the inflation rate. For this calculation, we assume that the inflation rate is 2% and the real growth rate,  $g - \pi$ , is 1.5%.

macroeconomic effects of tax-based vs. spending-based fiscal consolidations, as considered by Alesina, Favero, and Giavazzi (2015). Note also that we do not consider the political difficulty of making different types of adjustments, which may be relevant given the shift over time in spending away from discretionary spending, which is subject to an annual appropriations process, toward old-age entitlements, which, absent new legislation, follow existing rules for determining benefits. Auerbach (2006) estimated that, for the period 1963-2004, U.S. federal nondefense discretionary spending responded significantly in a fiscally stabilizing manner to the budget surplus, while total spending on the major entitlement programs, Social Security, Medicare, and Medicaid, did not (having an insignificant coefficient of the wrong sign).<sup>17</sup> This may be one factor in the general decline in fiscal responsiveness to the budget in the last two decades, although it fails to explain the lack of responsiveness of revenues as well. However, it is a point worth keeping in mind as we analyze the effects of a return to the fiscal responsiveness of an earlier period, as it suggests that such a return may face an additional hurdle beyond the current political climate.

The only other parameters that must be specified to carry out the simulations are the “underlying” primary surplus variable  $a_s$ , the initial  $b_0$  and intercept  $a_b$  value of the debt-GDP ratio, and the initial value for excess interest  $\rho_t$ . For these, we set  $a_s = -0.025$ , equal to the average ratio of the primary surplus to GDP over the next five fiscal years projected by CBO (2024c).<sup>18</sup> We set the initial  $b_0$  and intercept debt-GDP ratio  $a_b$  equal to 1, roughly its current value, and set the initial excess interest rate value  $\rho_1$  equal to  $-0.005$ , roughly its average value over the next five fiscal years.<sup>19</sup>

All of the parameter values used in the simulations are collected in Table 5.

## 5 Simulation Results

### 5.1 Results without Fiscal Shocks

In order to help understand the properties of the model under different assumptions about fiscal feedback, we begin with a discussion of results for the case in which there are no fiscal shocks. In particular, the shock  $e_u$  to the process governing the excess interest rate equals zero so that the excess interest rate changes only because of changes in the debt-GDP ratio, and the Poisson shock equals zero as well.

Figure 4a shows the paths of the debt-GDP ratio under this assumption. Also displayed in the figure is the 30-year path of the debt-GDP ratio projected by CBO (2024b). The red dashed line, labeled “no feedback,” is our baseline projection. By construction, this projection follows the CBO projection closely over the next 30 years.<sup>20</sup> In particular, the debt-GDP ratios at the end of the 30-year period are close and, importantly for our simulations, the growth rates of the excess interest

<sup>17</sup>Although the sample is very short, the results were similar for the period 1993-2004, suggesting that the main result is not due to the unimportance of Medicare and Medicaid early in the sample period.

<sup>18</sup>Note that this value of the primary surplus is likely to be an optimistic characterization of current policy because it is based on the assumption that the Trump 2017 tax cuts are allowed to expire in full and that discretionary spending grows very slowly. Under alternative “current policy” assumptions, the primary deficit would average just over 3.5% of GDP over the next five years, rather than 2.5% (Auerbach and Gale 2024). We consider the larger primary deficit in an alternative specification below.

<sup>19</sup>CBO’s five-year average value of  $\rho_t$  is slightly higher (less negative) than  $-0.005$ , but the average debt-GDP ratio over this period is also slightly higher than 1.0. Given our assumed feedback of the debt-GDP ratio onto  $\rho$ , our assumed initial value of  $\rho$  is consistent with our assumed initial debt-GDP ratio.

<sup>20</sup>As CBO’s projections do not forecast recessions or other economic shocks, they provide a good benchmark for our simulations that exclude shocks.



rate over the last ten years of the overlapping sample period are roughly the same. Indeed, our choice of the sensitivity  $\beta_2$  of the excess interest rate with respect to the interest rate is made to satisfy these conditions, reflecting the simple relationship between changes in debt and changes in the excess interest rate in the CBO projections, shown in Figure 3c, and taking account of the AR(1) structure of the evolution of  $\rho$ . Beyond 30 years, the no-feedback simulation shows a steadily growing debt-GDP ratio, consistent with the fact that the primary deficit overwhelms the initially slightly negative value of excess interest in determining the path.

The remaining series in Figure 4a show the impact of various feedback policies on the debt-GDP ratio. Both types of gradual feedback sharply reduce the growth of debt, with its value barely rising above 1 for the deficit-driven feedback case ( $c > 0$ ). For the debt-driven feedback case ( $d > 0$ ), the debt-GDP ratio rises gradually, approaching 1.5 by the end of the 100-year period. Under the sudden feedback scenario, the debt-GDP ratio rises as under the no-feedback case until the real debt service condition is breached after nearly 20 years and at a debt-GDP ratio around 1.4, after which the 1.5% fiscal consolidation causes the debt-GDP ratio to rise less rapidly, until a second fiscal consolidation after another 30 years causes the debt-GDP ratio to decline steadily, starting from around 1.6. There is then a third fiscal consolidation after another 30 years, when the debt-GDP ratio is around 1.5. With the initial primary deficit of 2.5% of GDP, the three consolidations result in an annual primary surplus of 2.0% of GDP, which even with initially elevated values of the debt-GDP ratio and hence the excess interest rate is sufficient to eventually induce a sharp decline in the debt-GDP ratio, which accelerates as the debt-GDP ratio and hence the excess interest rate fall.<sup>21</sup>

The primary surpluses associated with these debt trajectories are shown in Figure 4b. With gradual deficit-driven feedback, the primary deficit falls quickly to around 0.5% of GDP, causing the debt-GDP ratio to stabilize. Feedback based on the debt-GDP ratio takes effect more gradually, because the response is to the debt-GDP ratio rather than the large deficits. Only as the debt-GDP ratio rises higher does the debt-based feedback strengthen, finally exceeding in the strength the deficit-based feedback after about 50 years. The three steps in the sudden feedback series simply reflect the constraints assumed for the policy. While all of these policies succeed in bringing the debt-GDP ratio under control, the sudden feedback policy does so with a significant lag. Finally, note how different all of these policies are from the CBO baseline, which shows very little movement in the primary surplus as a share of GDP.

Figure 4c shows the trajectories of the excess interest rate  $\rho_t$ . As noted above, with no feedback the excess interest rate grows at roughly the same pace as under the CBO projections toward the end of the 30-year CBO projection period, although its level is somewhat lower, suggesting that our simulations may be a little optimistic concerning the subsequent path of  $\rho_t$ . The rapid consolidations under deficit-based gradual feedback head off any significant increase in  $\rho_t$ , while this stabilization is delayed under gradual debt-based feedback and especially on the sudden feedback trajectory.

All of the results so far are for specific values of the feedback rules. But how much do the feedback parameters matter with respect to the government's success in stabilizing the debt-GDP ratio under certainty? Figures 5a-5b consider this by displaying the debt-GDP ratio after 100 years for variations in the key feedback parameters. Figure 5a, for the cases in which  $c > 0$  and  $d > 0$ , shows the impact of varying  $c$  and  $d$ . Under certainty, the two types of gradual feedback lead to essentially the same

<sup>21</sup>One might argue from this pattern for an additional set of conditions for sudden consolidation to occur, including that the debt-GDP ratio is not falling on its own; adding this condition would eliminate the third consolidation in this case.



terminal debt values for a given parameter value. (As discussed in the previous section, these two feedback mechanisms are very closely related in the absence of stochastic shocks to the debt-GDP ratio.) For values of  $c$  or  $d$  above 0.2, there is little impact of variations in the feedback parameters. However, as  $c$  or  $d$  falls below 0.2, the outcome deteriorates increasingly rapidly, exploding at values below 0.05.

Figure 5b shows the terminal debt-GDP ratio for different values of the minimum duration between sudden consolidations,  $T$ . It is a piece-wise linear relationship, with a downward jump at the 29-year frequency. The intuition for this pattern is that, for a given number of sudden feedback episodes, the relationship is linear – waiting longer between episodes increasing the terminal level of debt. However, as the frequency of episodes declines, moving to the right in the figure, there is also a change in the number of sudden feedback episodes, as waiting longer for the second adjustment results in there being an additional adjustment necessary. This causes a downward jump in the terminal debt-GDP ratio. Once this jump happens, further increases in the minimum duration between adjustments continues to increase the terminal debt-GDP ratio. Eventually, the duration between shocks increases to the point that the number of sudden consolidations falls again, and the terminal debt-GDP ratio resumes its original linear increase with respect to the minimum time between sudden fiscal adjustments.

Even with relatively infrequent consolidations being feasible, it is still possible to keep the debt-GDP ratio under control, given our assumption that each consolidation is permanent, keeping a lower primary deficit until the next consolidation takes place.

These results suggest that fiscal feedback can have a significant impact on the trajectory of the debt-GDP ratio if it is of sufficient size, emphasizing the importance of the disappearance of fiscal feedback from the U.S. federal budget process over the past two decades. However, they may overstate the potential of any particular feedback rule to induce fiscal stability, as they do not account for the shocks to the fiscal process, to the excess interest rate  $\rho_t$ , and to the budget itself via the assumed Poisson shock process. The latter shock is asymmetric, so omitting it improves the fiscal picture. But even the former shock, assumed to be symmetric, could make the fiscal situation worse because it introduces the possibility of unfavorable stochastic outcomes that can induce explosive debt dynamics. We now turn to analysis of the full stochastic model.

## 5.2 Results with Fiscal Shocks

Under certainty, fiscal feedback can stabilize the debt-GDP ratio. But how likely is a given strength of feedback still to work once shocks are present?

### 5.2.1 Baseline Results

Figures 6a-c provide some initial answers to this question, with the three panels showing median outcomes over the 100-year horizon for the four types of fiscal feedback (deficit, debt, sudden, and no feedback) as well as for the certainty case with no feedback, repeated here for the purpose of comparison. Each plotted value is the median across all 1000 simulations for the given outcome, feedback series, and year. As Figure 6a shows, the median debt-GDP ratio with no feedback diverges from the certainty case, as shocks increase the likelihood of a bad outcome.

As to the median trajectories for the different types of feedback, there are interesting differences among the three types. With gradual debt-driven feedback, there is little difference between the

median outcome under uncertainty and the outcome under certainty (shown in Figure 4a). The intuition is that, although shocks may initially drive debt higher than under certainty, the feedback response of an increased primary surplus offsets this fairly sharply.

But the outcomes under uncertainty are quite different, and less favorable, for the other two types of feedback. For gradual deficit-driven feedback, there is no direct mechanism for offsetting sudden jumps in debt due to Poisson shocks. The higher debt-GDP ratio generates an increase in the primary surplus only through the reaction to debt-service being higher, which is much weaker than a response to the level of debt itself in the previous case. Thus, the median debt-GDP ratio rises steadily, reaching roughly the same value as under debt-based gradual feedback after 100 years.

Under the case of sudden feedback, and unlike in the certainty case, the median trajectory continues to rise through most of the projection period, leveling off near the end and turning slightly negative. Even with multiple increases in the primary surplus, the higher debt-GDP ratio under many trajectories resulting from adverse shocks makes the median value continue to creep upward as the next fiscal consolidation is awaited. As a consequence, the median outcome trajectory for the case of sudden fiscal feedback now shows a higher debt-GDP ratio for the entire projection period than for the case of feedback based on the budget surplus, although the values become closer toward the end of the period.

The corresponding median primary surpluses under uncertainty are shown in Figure 6b. With greater uncertainty, both types of gradual fiscal feedback show higher median values than under certainty, reflecting the less favorable debt-GDP trajectories in Figure 6a. But the stronger feedback is more evident under gradual debt-driven feedback. By contrast, gradual deficit-driven feedback does strengthen over time, but does so very mildly. As already discussed, this is because the feedback only responds weakly to a jump in the debt-GDP ratio itself. For the sudden feedback case, the median value of the primary surplus still shows the jumps that occur under certainty, with the size of the jumps unchanged, by assumption.

Figure 6c shows the median trajectories for the excess interest rate  $\rho_t$  for each of the feedback scenarios. These differ from those under certainty in Figure 4c for two reasons. First, the median debt-GDP paths are different. Second, there are now shocks to the process for  $\rho$ , conditional on the debt-GDP ratio. The combined effects of these two factors are most easily seen in the no-feedback scenario. Compared to the comparable scenario without risk, the median path, while noisier, initially deviates relatively little from the certainty case. However, after about 20 years, when the median debt-GDP ratio diverges significantly from the certainty case, the median excess interest rate diverges as well. The trajectory for the excess interest rate is much flatter for the gradual feedback trajectories, and somewhat less so for the sudden feedback case, reflecting the higher associated debt-GDP ratios.

### 5.2.2 Sensitivity Analysis

How sensitive are the foregoing results to differences in parameter assumptions?

Figures 7a-b show the impact under uncertainty of variations in assumptions about various parameters on the 100-year median trajectory of the debt-GDP ratio. The two panels show the results under deficit-based gradual fiscal feedback and debt-based gradual fiscal feedback.

For gradual deficit-driven feedback (panel a), perhaps the most striking result involves the impact of the frequency of debt shocks,  $\lambda$ . Eliminating these shocks entirely ( $\lambda = 0$ ) causes the median debt-GDP trajectory to be close to flat, similar to what we saw under certainty in Figure 4a. On the

other hand, doubling the frequency of these shocks ( $\lambda = 4$ ) causes a sharp upward tilt in the debt trajectory, with the median debt-GDP ratio exceeding 200% at the end of the projection period.

This finding that eliminating the debt shock results in a trajectory similar to that under full certainty indicates that the stochastic behavior in the “ $r$  minus  $g$ ” term  $\rho$ , on its own, has a negligible impact; it is the large, asymmetric shocks to the budget that have a big impact. This lack of impact of fluctuations in  $\rho$  is also evident by comparing the baseline trajectory with that for a much higher assumed standard deviation for the stochastic term in the expression for  $\rho$ , taken from the value for this term for the full-sample (1792-2023) estimation period in the second column of Table 4. This large increase in the size of the shocks to  $\rho$  has a small impact on the debt trajectory.

Also having very little impact on the trajectory is the size of the parameter governing the impact of debt on interest rates,  $\phi$ . Doubling it ( $\phi = .008$ ) or eliminating it ( $\phi = 0$ ) leaves the debt trajectory very close to the baseline. The intuition for this result is that the feedback process is successful at keeping the debt-GDP ratio from rising very high. As a result, the feedback of debt into interest rates never has the chance to become very significant.

The underlying fiscal situation, as characterized by the initial primary surplus  $a_s$ , has a somewhat larger impact, at least given the chosen parameter variation. Increasing or decreasing the initial primary surplus by 1.5% of GDP (to  $-4\%$  or  $-1\%$ ), moves the debt path in a predictable direction, although still much less than variation in the frequency of debt shocks.

The last series in Figure 7a is for the case in which fiscal feedback adjustments decay, where the parameter  $\theta$  is less than 1. Setting  $\theta = 0.9$ , meaning that about 35% of any fiscal change remains after 10 years, raises the trajectory considerably, almost as much as doubling the frequency of large budget shocks. This highlights the importance of the durability of fiscal adjustments to the feedback process.

Finally, Figure 5a shows the impact of variations in the feedback parameter itself on the terminal debt-GDP ratio in the presence of risk. Notably, the trade-off is considerably worse in the presence of risk than in its absence, and we may infer, based on the results just discussed, that this is largely due to the debt shocks that are now present.

Turning now to the effects of parameter variation under gradual debt-based fiscal adjustment, in Figure 7b, we observe interesting differences from the deficit-based feedback case that highlight differences in the two feedback mechanisms. For instance, variation in the debt-shock parameter,  $\lambda$ , has a much smaller impact under debt-based adjustment than under deficit-based adjustment. This is because shocks that go directly into the debt-GDP ratio immediately result in increased feedback under the debt-adjustment process. By contrast, jumps in debt are more weakly offset by deficit-based adjustment, which reacts only indirectly, via the increase in the debt-service component of the deficit. This difference can also be seen in Figure 5a, where, unlike for the case of deficit-based adjustment, there is a relatively small rise in the curve that relates the terminal debt-GDP ratio to the debt-adjustment parameter.

On the other hand, differences in the underlying fiscal situation, as represented by the initial primary surplus, have a much larger impact in the case of debt-based adjustment, because these differences only gradually translate into differences in the level of debt itself, whereas the deficit-based adjustment process reacts to such differences in deficits immediately. The same explanation applies to the larger impact of variations in the sensitivity of interest rates to the level of debt,  $\phi$ . Variations in the sensitivity of interest rates to debt show up in debt service, to which deficit-based

adjustment reacts directly, thereby limiting the effects; for debt-based adjustment, the response occurs only through the resulting debt increases themselves. This difference also explains why increasing the magnitude of shocks to  $\rho$  has a bigger impact under debt-based adjustment. Finally, setting the policy permanence parameter  $\phi$  equal to 0.9 makes debt-based fiscal feedback much more effective, because in our baseline this parameter equals 0. As discussed above, this is consistent with the form of the equation from which our assumed value of  $d$  is drawn, but the variation simply confirms, again, the importance of policy permanence, *ceteris paribus*.

Finally, Figure 5b shows the median terminal debt-GDP ratio in the presence of risk for different assumptions about the frequency of sudden fiscal adjustments. The general relationship is now nearly linear, as the abrupt changes in the case of certainty are smoothed by the variation in when adjustments take place. Except at very high frequencies of adjustment, though, the median terminal debt-GDP ratio is shifted upward.

## 6 How Strong Does Fiscal Feedback Need to Be?

### 6.1 How Would Continued Fiscal Feedback Have Changed Our Current Situation?

This section assesses the strength of fiscal feedback necessary to achieve various debt-ratio objectives over the coming century. As a prelude, we look backward to quantify how different our current fiscal situation would be had the gradual fiscal feedback observed in the past persisted so far this century, rather than vanishing. To implement this experiment, we apply the above feedback rules to the actual path of primary surpluses 2001-2023, except during crises. Real net interest was modest over this period, so sudden feedback would not have been triggered and we omit sudden feedback from the results.

For both deficit-based feedback and debt-based feedback, each year's counterfactual primary surplus  $s_t$  equals the actual primary surplus in CBO data  $s_t^{\text{CBO}}$  in year  $t$  during crises years 2008-2014 and 2020 but applies fiscal feedback during all other years. The choice to assume no feedback during crises corresponds to our simulation model above in which Poisson shocks like the Great Recession and COVID-19 increase the debt ratio with no immediate deficit reduction. Colloquially, the government does not reduce the deficit during a crisis but then after a crisis “fixes the roof while the sun is shining.”

During non-crisis years, the counterfactual primary surplus under deficit-based feedback equals the actual primary surplus plus two adjustment terms:

$$s_t = s_t^{\text{CBO}} + \Delta s_t + \sum_{t'=2001}^{t-1} \Delta s_{t'-1} \quad (11)$$

where  $\Delta s_t$  denotes the deficit-based feedback rule's year- $t$  adjustment to  $s_t^{\text{CBO}}$ :

$$\Delta s_t = c \left[ \rho_t^{\text{CBO}} b_{t-1} - \left( s_t^{\text{CBO}} + \sum_{t'=2001}^{t-1} \Delta s_{t'-1} \right) \right] \quad (12)$$

where  $\rho_t^{\text{CBO}}$  equals the actual excess interest rate in year- $t$  and where the summation term equals the inherited persistence of past adjustments under  $\theta = 1$  and ensures that deficit-based feedback in each

year applies to the primary surplus that would prevail with no year- $t$  adjustment.<sup>22</sup>

The debt-based feedback equation utilizes no persistence ( $\theta=0$ ) and thus inherits no past adjustments and thus requires no summation term. However, we make one important amendment to the debt-based feedback considered above: we set  $a_b = b_{1999} = 0.383$  as the neutral debt-GDP ratio:

$$s_t = s_t^{\text{CBO}} + \Delta s_t \quad (13)$$

$$\Delta s_t = d[b_{t-1} - b_{1999}] \quad (14)$$

We make this choice in order to illustrate counterfactual behavior of a government that seeks to constrain deficits going forward (here, as of 2001). Were we to continue to use  $a_b = 1$ , the government under debt-based feedback before the COVID-19 pandemic would have increased the deficit in order to reach its neutral debt-ratio value of 1 faster. This exercise highlights the importance of the choice of the neutral debt ratio value  $a_b$  in debt-based feedback.

Figure 9 presents the results of this counterfactual exercise, showing the actual evolution of the debt-GDP ratio since 2000 along with two alternative trajectories, corresponding to continued deficit-based fiscal feedback (with  $c = 0.3$ ) and continued debt-based fiscal feedback (with  $d = .05$ ). Under either alternative path, the current debt-GDP ratio would have been noticeably lower. This is especially true for debt-based feedback, which in response to the debt shocks experienced during the Great Recession and the COVID-19 pandemic would have substantially reduced the primary deficit. This exercise highlights how deficit reduction under debt-based feedback ratchets up directly in relation to the debt-ratio level, whereas deficit reduction under deficit-based feedback ratchets up only indirectly the debt-ratio level via excess interest.

## 6.2 Avoiding 100-Year Failure

We now use the modeling of the previous section to ask: how strong does fiscal feedback need to be in order to avoid fiscal failure? An earlier literature has studied conditions under which debt feedback is sufficient for the government's infinite-horizon budget constraint to hold, finding that any feedback  $d > 0$  is sufficient (Canzoneri, Cumby, and Diba 2001; Bohn 2008). However, those analyses can involve paths for the debt-GDP ratio that rise to arbitrarily high levels.

We take an alternative approach. We assume that there is a threshold level of the debt-GDP ratio that is not plausibly sustainable. That is, we assume that if the United States crosses a very high debt-GDP threshold within the next 100 years, the debt sensitivity of the interest rate on government debt would rise due to especially high default risk, further compounding explosive debt dynamics and leading to default. Employing this assumption requires great humility. We, like earlier papers, have no special knowledge on where such a threshold lies. For example, Ball, Elmendorf, and Mankiw (1998) wrote during the 1990s when the U.S. debt-GDP ratio was below 0.5, and they considered failure definitions of the debt-GDP ratio crossing thresholds of 1 and 1.5. As we write this paper, the debt-GDP ratio is nearly 1 and projected to rise, yet the excess interest rate is currently and is projected to remain for the next decade lower than it was in the 1990s (Yagan 2024).

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<sup>22</sup>Our assumption of a fixed excess interest rate rules out a feedback rule reducing the excess interest rate by reducing the debt-GDP ratio, which overstates the magnitude of the primary surplus under feedback rules.

As a start to this analysis, before settling on a particular criterion for assessing success, we consider how likely the debt-GDP ratio is to remain under any particular value after 100 years, for different values of the gradual feedback parameters  $c$  and  $d$ .

Figure 8a shows the likelihood of the debt-GDP ratio staying below values ranging from 1 to 5 after 100 years for values of the deficit feedback parameter  $c$  ranging from 0 (no feedback) to 0.5, much stronger than our baseline assumption of 0.3. The various curves slope upward, reflecting the fact that meeting the target becomes more likely as the debt ceiling rises. Perhaps surprisingly, the figure shows that even modest gradual adjustment, relative to historical behavior, substantially improves the odds of success.<sup>23</sup>

Figure 8b addresses the same question for debt-based gradual feedback, for the feedback parameter  $d$  ranging from 0 (no feedback) to 0.1, double the value assumed for our baseline simulations. Unlike the case of deficit-based feedback, the improvement as  $d$  increases is more gradual. However, the odds of success for our two base cases,  $c = .30$  and  $d = .05$  are similar, indicating that not only the median outcomes are similar after 100 years – as already shown in Figure 6a; the distributions of outcomes after 100 years are similar as well.

The analogous results for sudden feedback, shown in Figure 8c, follow the same general pattern. However, to achieve success similar to that of the gradual adjustment approaches requires being able to undertake fiscal adjustments at a very high frequency, i.e., once every 10 years.

Table 6 considers alternative failure thresholds: the debt-GDP ratio exceeding 150%, 200%, 250%, or 500% of GDP 100 years from now. The values in Panel A report the minimum feedback necessary to prevent failure without fiscal shocks. We find that relatively weak magnitudes of gradual feedback are sufficient to prevent failure. For example, in order to keep the debt-GDP ratio below 250% of GDP, deficit feedback of magnitude  $c = .02$  is sufficient, while debt feedback of magnitude  $d = .02$  is sufficient.<sup>24</sup> Both values are considerably smaller than the empirical values estimated on twentieth century data (Auerbach 2003; Bohn 1998). When considering sudden feedback, our assumed baseline assumption of a fiscal consolidation as frequent as every  $T = 30$  years is sufficient to ensure success in the case of certainty: the minimum frequency needed to achieve a terminal debt-GDP ratio of even 150% is lower than every 30 years.

However, the necessary feedback responsiveness is considerably greater, accounting for fiscal shocks, as reported in Panel B. Akin to the 95% statistical inference convention, we find the minimum feedback values necessary to prevent failure in at least 95% of the time. We find that no amount of gradual deficit feedback  $c \in [0, 1]$  prevents failure 95% of the time when defining failure as keeping the terminal debt-GDP ratio below 200% of GDP. When using the 250% (500%) debt-GDP threshold, deficit feedback equal to  $c = 0.15$  (0.05) is sufficient. Recall that  $c = 0.3$  is approximately the empirical value found 1984-2003, so that this historical degree of deficit-based feedback would achieve successful fiscal stability based on a debt threshold of 250% of GDP, but not 200%. For the debt-based gradual feedback, success is possible even at lower target debt-GDP ratios, but only for values of  $d$  above the historical estimate of .05 in Bohn (1998). However, this value (just) suffices for target debt-GDP

<sup>23</sup>The increasing lack of smoothness in the figure as  $c$  increases reflects the fact that, with strong deficit-based fiscal feedback, the only things causing failure are the large debt shocks, to which, as discussed, deficit-based feedback does not directly react. The upward “steps” in the series for  $c = .50$  represent improvement in outcomes as debt levels move above those associated with a particular number of debt shocks, each of which, by assumption, increases the debt-GDP ratio by 0.25.

<sup>24</sup>The grid over which we search for values of  $c$  and  $d$ , by steps of .01, is too fine to distinguish the results for the two types of gradual adjustment. As discussed earlier, under certainty, the debt trajectories are very similar for these two types of adjustment when  $c = d$ .

ratios of 250% and above.

We further find that the minimum frequencies of sudden feedback needed to prevent failure 95% of the time are very large, as one would predict based on the results in Figure 8. To prevent the debt-GDP ratio from rising to 250% of GDP, the government needs to be able to implement sudden fiscal consolidation at least as frequently as every 11 years. The necessary frequency varies little with the failure threshold considered, which reflects explosive debt dynamics: given the possibility of several negative fiscal shocks during the 100-year period, long delays in fiscal consolidation can result in a trajectory on which debt grows very rapidly. Note the contrast between this finding about the upper tail of the distribution of outcomes under sudden fiscal adjustment and the median outcome pictured above in Figure 6a. This highlights the advantage of gradual feedback: as things begin to get out of control, being able to act immediately provides greater insurance against bad outcomes than waiting to make larger adjustments. It also begs the question of whether our conception of the sudden adjustment regime as a “wait-and-see” approach is really consistent with being able to take action as frequently as would be necessary to meet any of the terminal debt-GDP targets in Table 6b.

### 6.3 Implications for the Next Ten Years

Table 7 uses values from Table 6 to compute how different the ten-year budget outlook would be if government were to be on course to avoid failure 95% of the time. For Table 7, we define failure as the year-100 debt exceeding 250% of GDP.

The first row of Panel A lists the CBO June 2024 baseline projection for the primary surplus, reproduced from CBO Table 1-1 (CBO 2024c). The primary surplus oscillates between  $-2.2\%$  and  $-3.1\%$  of GDP over the years 2025-2034. Each subsequent row applies a gradual feedback rule to those years’ baseline primary surpluses. For those subsequent rows, we apply equations 11-14, except  $s_t^{\text{CBO}}$  denotes the CBO baseline projected primary surplus, the first year of feedback is 2025 instead of 2001, and the neutral debt-ratio level  $a_b$  equals the 2023 debt ratio  $b_{2023} = 0.973$ .

The second and fourth rows of Table 7 consider the modest feedback needed to keep the debt-GDP ratio below 2.5 in one hundred years with no fiscal shocks, as listed in Table 6. The implied deficit reduction is correspondingly modest. The required deficit reduction is too small to appear to two significant digits in 2025 but grows over time, as deficit feedback adjustments compound via the  $\sum_{t'=2025}^{t-1} \Delta s_{t-1}$  term in equation 12 and as debt feedback grows via the debt ratio further deviating from  $b_{2023}$ . Deficit feedback of magnitude  $c = 0.02$  implies an average primary deficit that is 0.2% of GDP smaller over the decade and 0.4% of GDP smaller in 2034. Debt feedback of magnitude  $d = 0.02$  implies the same deficit reductions. Panel B shows corresponding reductions in the 2034 debt-GDP ratio of 2.2% and 2.3% of GDP, respectively.

The third and fifth rows of Table 7 consider the stronger feedback needed to keep the debt-GDP ratio below 2.5 with a 95% probability in one hundred years with fiscal shocks, as listed in Table 6. The implied deficit reduction is correspondingly larger. Deficit feedback of magnitude  $c = 0.15$  implies an average primary deficit that is 1.2% of GDP smaller over the decade and 1.9% of GDP smaller in 2034. Debt feedback of magnitude  $d = 0.05$  implies an average primary deficit that is 0.5% of GDP smaller over the decade and 0.9% of GDP smaller in 2034. Panel B shows corresponding reductions in the 2034 debt-GDP ratio of 11.7% and 5.2% of GDP, respectively.

As for the sudden-feedback scenario, there are no changes from the CBO baseline. As is the nature of this scenario, nothing will happen until fiscal conditions reach a more dire state than is projected



to occur through 2034.

## 7 Conclusion

This paper has studied Congress' legislative surplus response to projected budget deficits, as well as the magnitude of response required to prevent large future debt-GDP ratios under cases of certainty and fiscal shocks. We conclude by noting that other policies affect the government budget. Our paper concerned explicit taxes and spending. The government can also assess implicit taxes through the use of financial repression and unexpected inflation (Hall and Sargent 2011). We leave full analysis of explicit and implicit tools to future work.

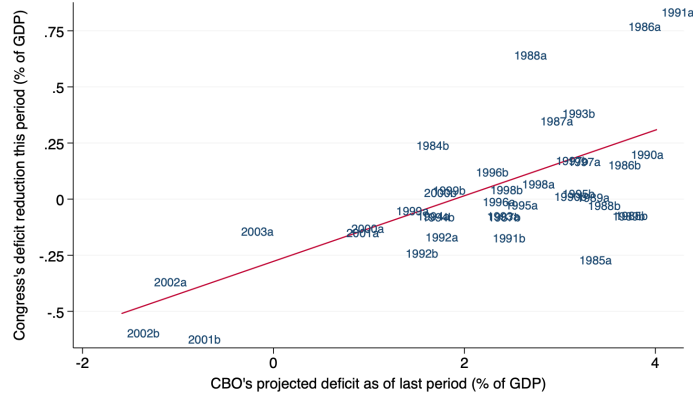


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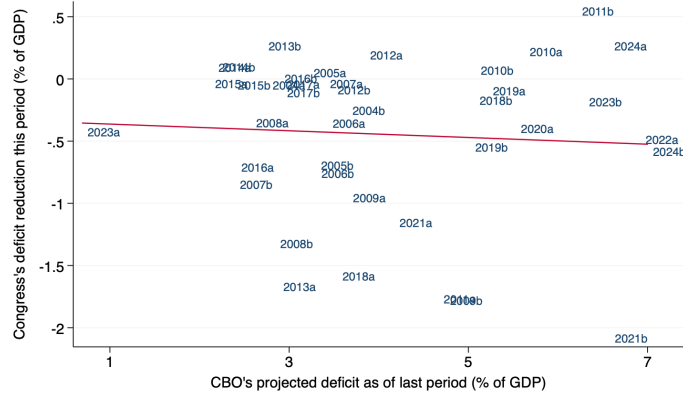
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Figure 1: Congress No Longer Reduces the Deficit when Projected Deficits Rise

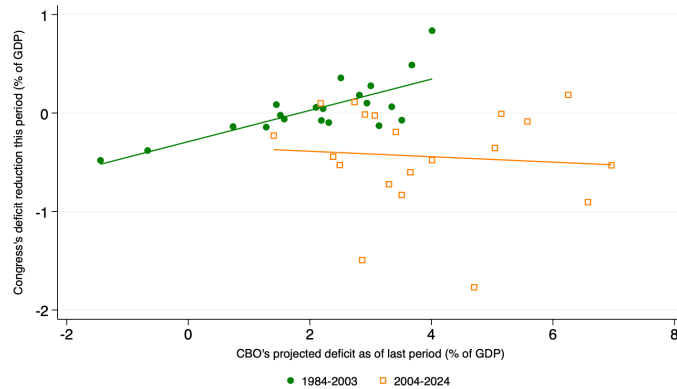
(a) 1984-2003 original Auerbach (2003) sample



(b) 2004-2024 sample



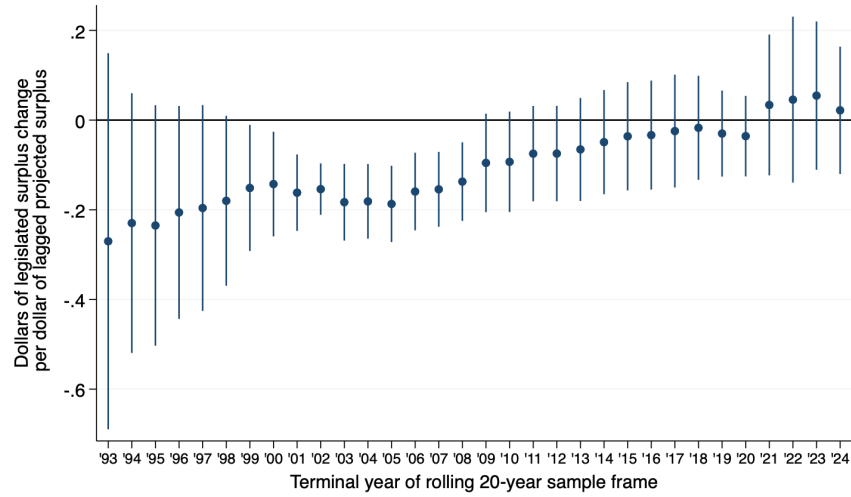
(c) Both samples



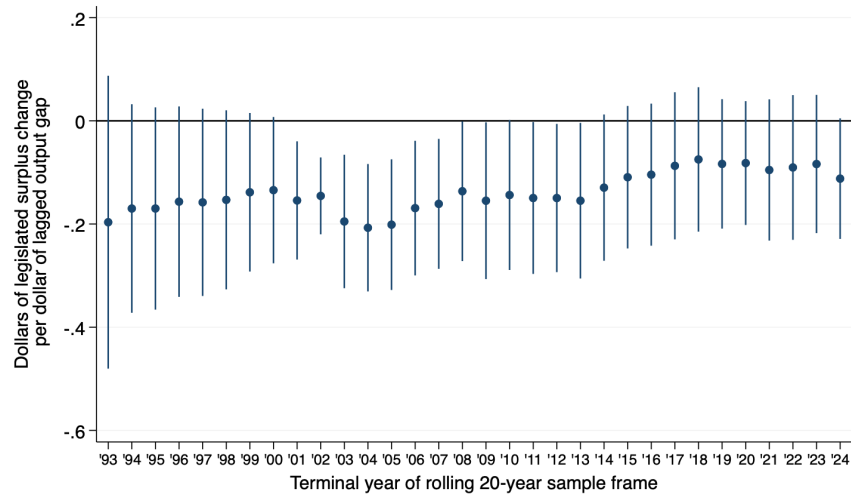
Notes: The figures plot nonparametric binscatter plots of the relationship between enacted deficit reduction (y-axis) and the lagged projected deficit, controlling linearly for the lagged output gap. Panel (a) plots this relationship for the original Auerbach (2003) sample. Panel (b) plots this relationship for the period 2004-2023; it excludes the 2020b observation (second report of year 2020), which is an outlier in our sample and makes the relationship more negative when included. The slopes of the best-fit lines in panels (a) and (b) equal the negative of the coefficients on projected surplus in Table 2 column 1. Panel (c) plots both of the above panels' relationships on the same graph, binning each series's observations into vingtiles (approximately two underlying observations per bin) and plotting the mean enacted deficit reduction within each series; the best-fit lines are identical to those above.

Figure 2: Congressional Response by 20-year Rolling Sample

(a) Effect of CBO's Lagged Projected Surplus on Legislated Surplus Change



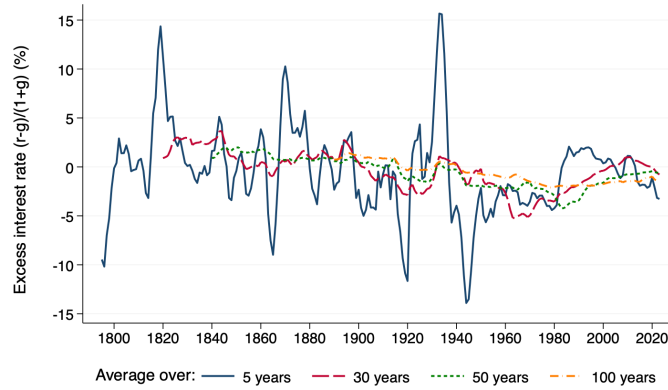
(b) Effect of CBO's Lagged Output Gap on Legislated Surplus Change



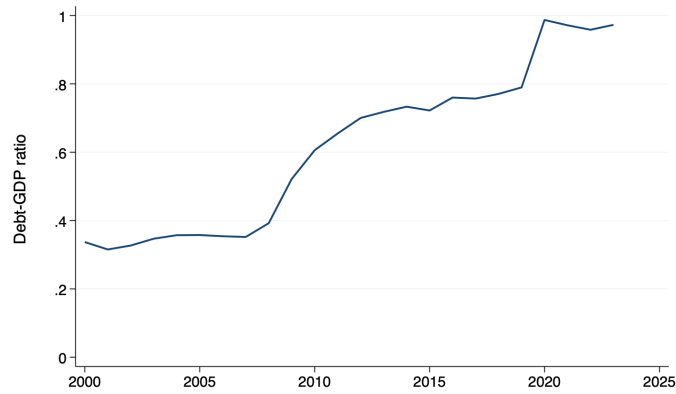
Notes: This figure plots the dynamics of our coefficients on projected surplus and the output gap using a 20-year rolling sample. It excludes the 2020b observation (second report of year 2020), which is an outlier in our sample.

Figure 3: Excess Interest Rate and Debt-GDP Ratio over Time

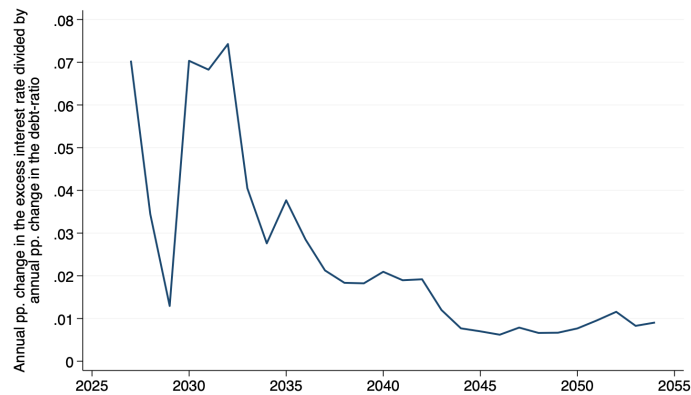
(a) Evolution of Excess Interest Rate  $(r-g)/(1+g)$  over Time



(b) Recent Stability of the Debt-GDP Ratio Except for Crises



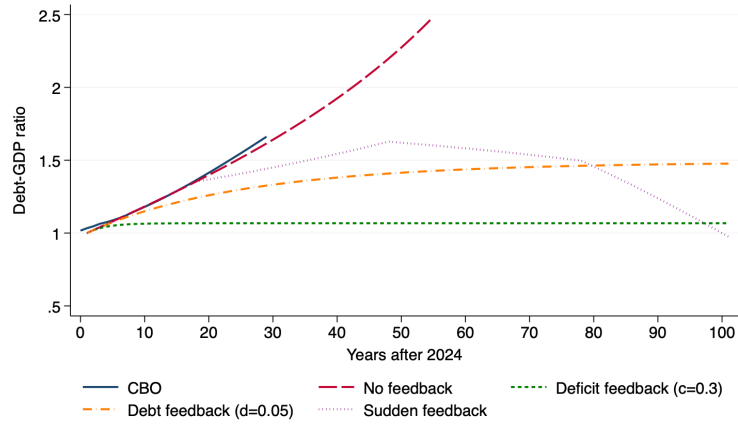
(c) CBO Implied Feedback of Debt into the Excess Interest Rate



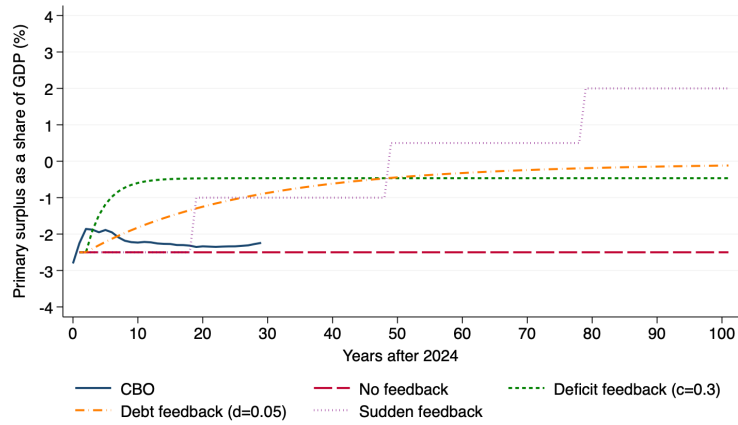
Notes: Panel (a) plots the evolution of mean  $(r - g)/(1+g)$  over time using different time horizons for computing the mean. Panel (b) plots the evolution of the debt-GDP ratio over time. Panel (c) plots feedback of debt into the excess interest rate implicit in CBO's long-term budget outlook.

Figure 4: Fiscal Paths under Certainty

(a) Debt-GDP Ratio



(b) Primary Surplus



(c) Excess Interest Rate

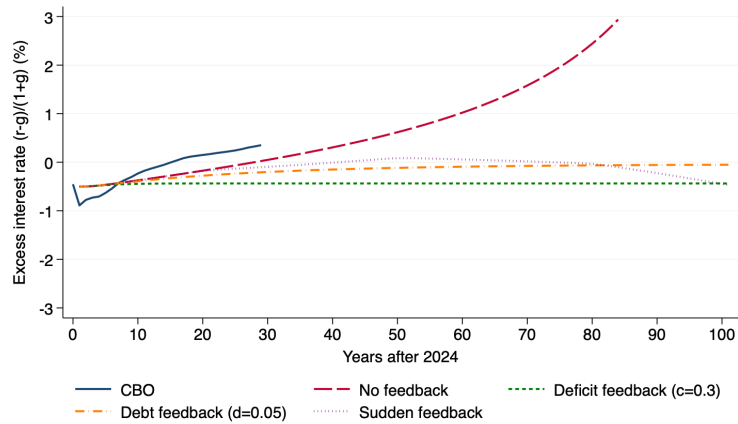
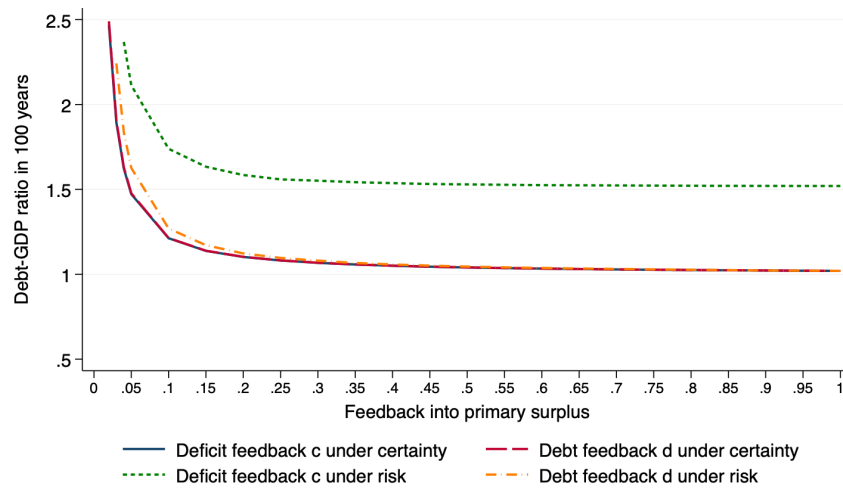


Figure 5: Feedback Sensitivity of Fiscal Paths

(a) Deficit and Debt Feedback



(b) Sudden Feedback

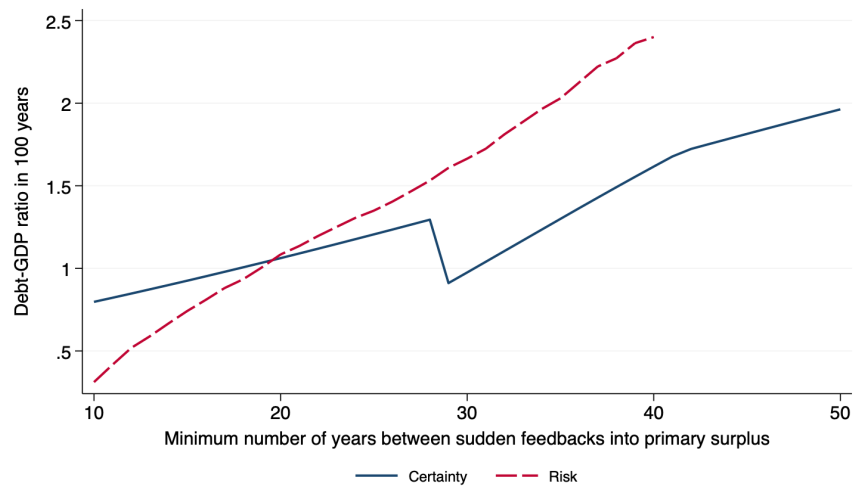
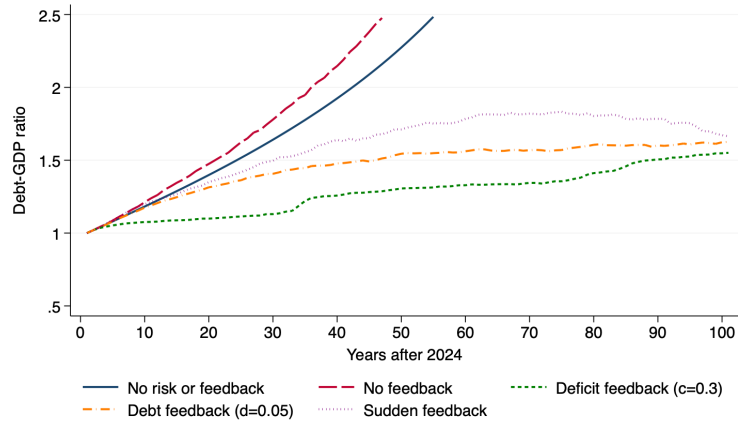
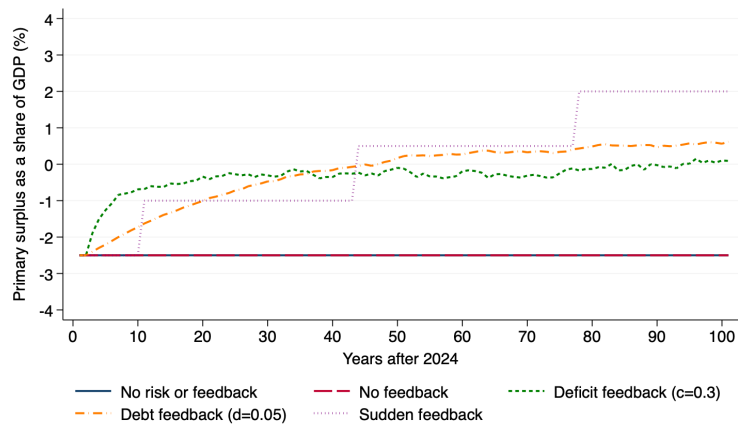


Figure 6: Fiscal Paths under Risk

(a) Debt-GDP Ratio



(b) Primary Surplus



(c) Excess Interest Rate

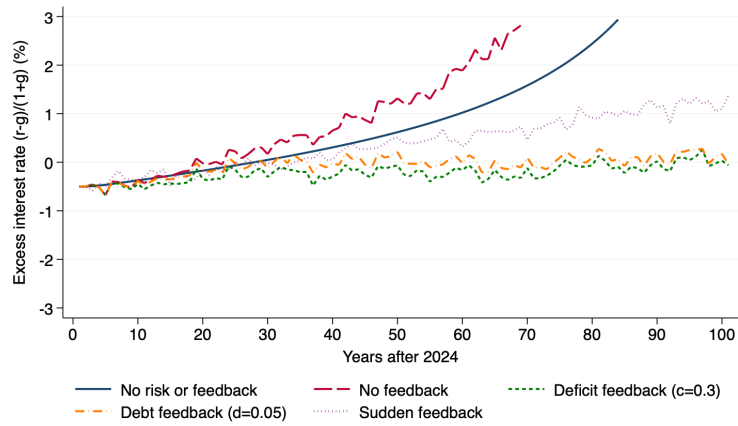
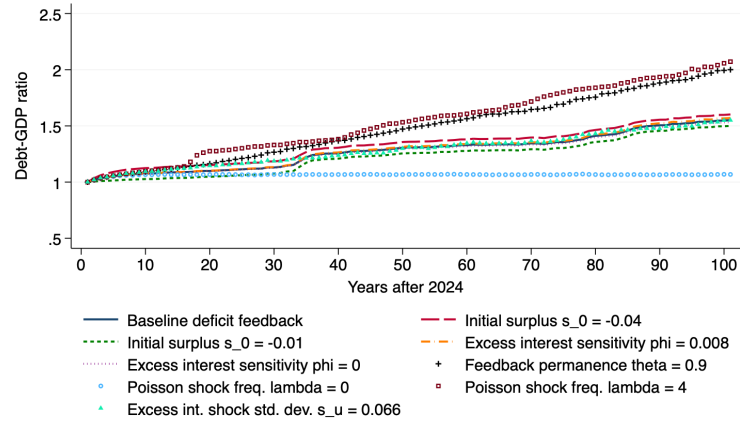


Figure 7: Sensitivity of Fiscal Paths under Risk

(a) Deficit Feedback



(b) Debt Feedback

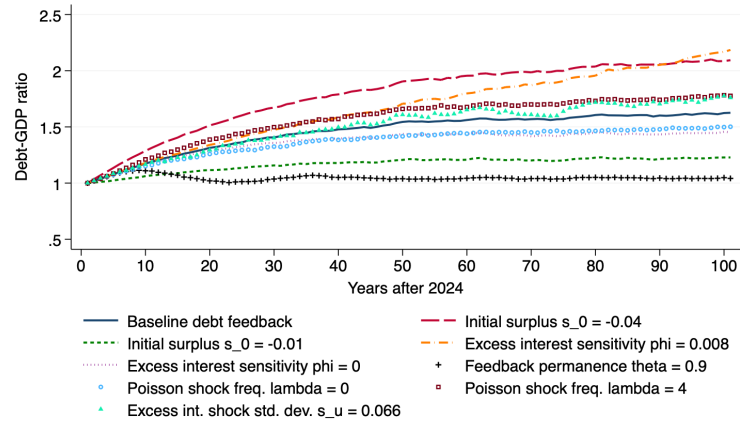
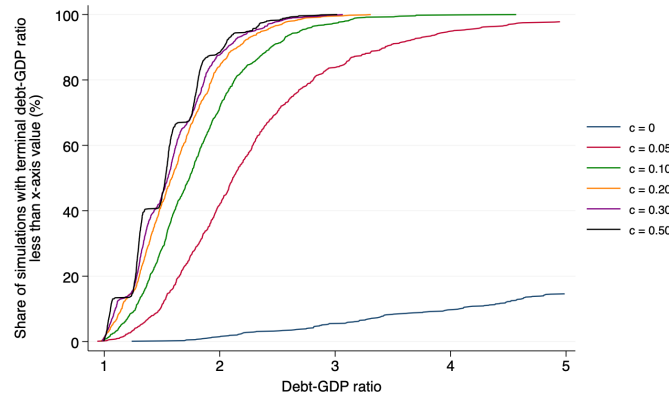


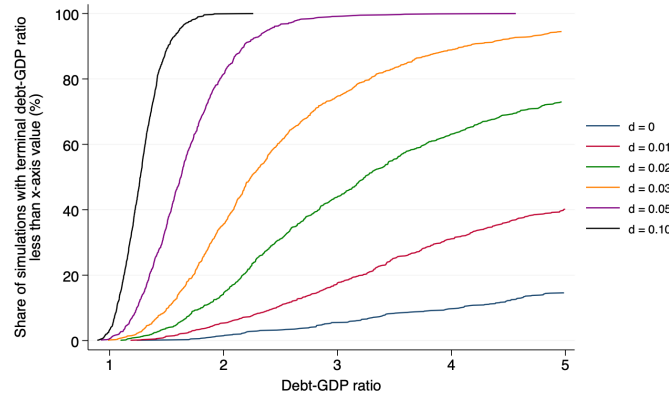


Figure 8: How Strong Does Fiscal Feedback Need to Be?

(a) Deficit Feedback



(b) Debt Feedback



(c) Sudden Feedback

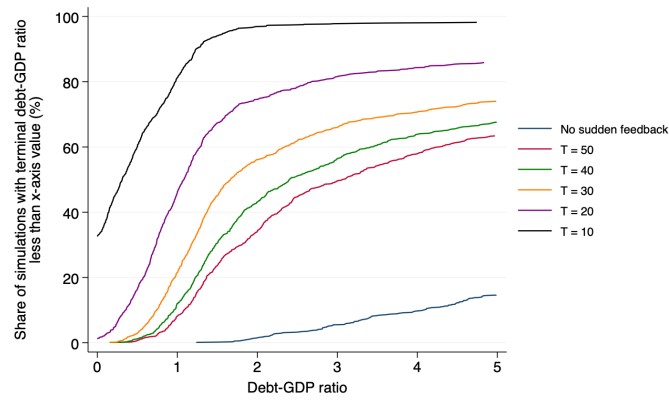


Figure 9: Recent Debt-Ratio Path under Counterfactual Fiscal Feedback

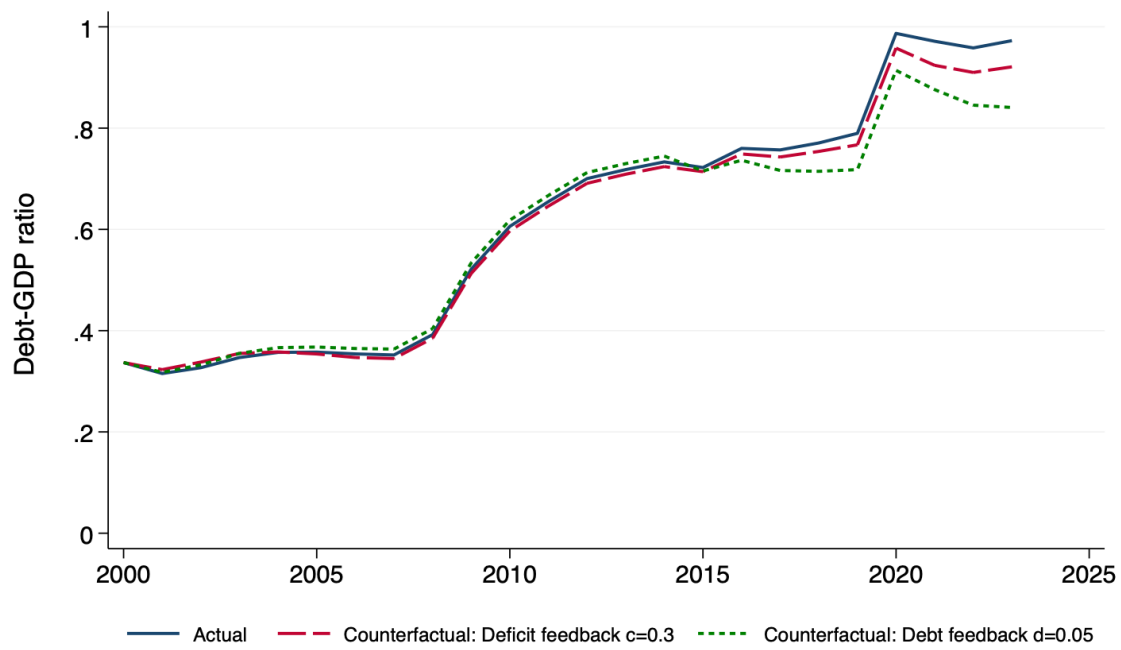


Table 1: Summary statistics for feedback regressions

## (a) Full sample

	Mean	p10	p50	p90
Legislated change to primary surplus	-0.003	-0.010	-0.001	0.003
Legislated change to revenues	-0.001	-0.004	-0.000	0.000
Legislated change to primary outlays	0.002	-0.002	0.000	0.005
Projected surplus	-0.030	-0.057	-0.030	0.000
Projected debt-GDP ratio	0.540	0.283	0.463	0.793
Projected debt-GDP ratio change	0.003	-0.019	0.004	0.022
Lagged debt-GDP ratio	0.527	0.337	0.446	0.790
Lagged output gap	0.011	-0.011	0.008	0.034

## (b) 1984-2003 original Auerbach (2003) sample

	Mean	p10	p50	p90
Legislated change to primary surplus	0.000	-0.002	-0.000	0.004
Legislated change to revenues	0.000	-0.000	0.000	0.002
Legislated change to primary outlays	-0.000	-0.002	0.000	0.002
Projected surplus	-0.021	-0.046	-0.025	0.017
Projected debt-GDP ratio	0.386	0.209	0.408	0.500
Projected debt-GDP ratio change	-0.004	-0.035	0.000	0.017
Lagged debt-GDP ratio	0.405	0.327	0.399	0.478
Lagged output gap	0.005	-0.016	0.005	0.024

## (c) 2004-2024 sample

	Mean	p10	p50	p90
Legislated change to primary surplus	-0.004	-0.019	-0.002	0.001
Legislated change to revenues	-0.002	-0.005	-0.000	0.000
Legislated change to primary outlays	0.002	-0.002	0.001	0.006
Projected surplus	-0.039	-0.069	-0.033	-0.016
Projected debt-GDP ratio	0.684	0.378	0.738	0.989
Projected debt-GDP ratio change	0.008	-0.003	0.006	0.025
Lagged debt-GDP ratio	0.645	0.353	0.709	0.972
Lagged output gap	0.015	-0.009	0.012	0.038

Notes: This table shows summary statistics for key variables used in our feedback regressions using different time horizons. The full sample comprises all observations between the second period of 1984 and the second period of 2024. The original Auerbach (2003) sample comprises all observations between the second period of 1984 and first period of 2003. The 2004-2024 sample comprises all observations between the first period of 2004 and the second period of 2024, except for the second period of 2020 which included legislation in response to the COVID-19 pandemic.

Table 2: Fiscal Feedback in Practice

(a) Years 1984 through 2003 (original Auerbach 2003 period)

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	-0.146 (0.028)	-0.060 (0.023)	0.086 (0.021)				-0.203 (0.051)
Projected debt-GDP ratio change				0.116 (0.053)			
Projected debt-GDP ratio					0.016 (0.006)		-0.013 (0.008)
Lagged debt-GDP ratio						0.011 (0.009)	
Lagged output gap	-0.133 (0.035)	-0.053 (0.026)	0.081 (0.021)	-0.084 (0.058)	-0.046 (0.045)	0.036 (0.027)	-0.132 (0.033)
Constant	-0.002 (0.000)	-0.001 (0.000)	0.001 (0.000)	0.001 (0.001)	-0.006 (0.002)	-0.005 (0.004)	0.002 (0.002)
N	38	38	38	38	38	38	38
r2	0.47	0.33	0.36	0.18	0.19	0.07	0.51

(b) Years 2004 through 2024

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	0.027 (0.069)	-0.015 (0.028)	-0.042 (0.061)				0.024 (0.075)
Projected debt-GDP ratio change				-0.097 (0.129)			
Projected debt-GDP ratio					-0.001 (0.004)		-0.000 (0.004)
Lagged debt-GDP ratio						0.000 (0.005)	
Lagged output gap	-0.108 (0.057)	-0.045 (0.033)	0.063 (0.057)	-0.114 (0.060)	-0.121 (0.052)	-0.124 (0.052)	-0.109 (0.057)
Constant	-0.002 (0.002)	-0.002 (0.001)	-0.000 (0.002)	-0.002 (0.001)	-0.002 (0.003)	-0.003 (0.003)	-0.001 (0.003)
N	40	40	40	40	40	40	40
r2	0.15	0.04	0.14	0.17	0.15	0.14	0.15

Notes: Panel (b) excludes the observation for the second period of 2020, which included legislation in response to the COVID-19 pandemic. Including that observation strengthens the finding of Congressional behavior reversal, as shown in Appendix Table A1.

Table 3: Distribution of the Excess Interest Rate over Different Time Horizons

	Horizon in years							
	1	5	10	20	30	50	75	100
Mean	-0.5	-0.5	-0.4	-0.3	-0.4	-0.6	-0.7	-0.6
<i>Percentile</i>								
1 <sup>th</sup>	-19.6	-11.6	-8.6	-6.2	-5.1	-4.2	-2.5	-2.1
5 <sup>th</sup>	-13.0	-7.2	-6.3	-4.4	-4.0	-3.4	-2.4	-2.0
10 <sup>th</sup>	-7.6	-5.0	-4.0	-3.4	-3.2	-2.3	-2.3	-1.9
25 <sup>th</sup>	-4.3	-2.9	-2.6	-2.0	-1.8	-1.9	-1.9	-1.6
50 <sup>th</sup>	-1.4	-0.4	-0.2	-0.0	0.0	-0.6	-0.9	-0.8
75 <sup>th</sup>	2.2	1.6	1.2	1.2	0.9	0.7	0.4	0.3
90 <sup>th</sup>	8.0	4.3	3.9	2.9	2.4	1.5	1.5	0.9
95 <sup>th</sup>	12.2	7.2	5.9	3.7	2.8	1.7	1.6	1.2
99 <sup>th</sup>	24.2	14.4	8.5	4.2	3.0	2.0	1.8	1.3

Notes: This table shows the distribution of the excess interest rate  $\rho = (r - g)/(1 + g)$  (in percentage points) using different time horizons.

Table 4: Autoregressivity of the Excess Interest Rate

	(1)	(2)	(3)	(4)
	1972-2023	1792-2023	1900-2023	1985-2023
Lagged excess interest rate	0.576 (0.114)	0.437 (0.060)	0.482 (0.079)	0.264 (0.137)
Lagged debt/GDP	-0.025 (0.016)	-0.029 (0.019)	-0.022 (0.023)	-0.072 (0.017)
Constant	0.008 (0.008)	0.005 (0.007)	-0.000 (0.010)	0.037 (0.009)
N	52	227	124	39
Std. dev. of residuals	0.023	0.066	0.062	0.018

Notes: Dependent variable is the excess interest rate  $\rho = (r - g)/(1 + g)$ .

Table 5: Parameter Values and Descriptions

Parameter	Value	Description
$\beta_0$	-.0061	Intercept in equation for $\rho$
$\beta_1$	0.576	AR(1) estimate in equation for $\rho$
$\beta_2$	0.004	Debt sensitivity of $\rho$
$s_u$	0.023	Standard deviation of error in equation for $\rho$
$a_b$	1	Government debt target in debt fiscal feedback rule
$a_s$	-0.025	Underlying primary surplus-GDP ratio
$\rho_0$ and $\rho_1$	-0.005	Initial value of $\rho$
$b_0$	1	Initial value of debt-GDP ratio
$\lambda$	2	Expected Poisson shock frequency per 100 years
$K_s$	0.25	Size of Poisson shock
$\theta$	0, 1	“Stickiness” of fiscal feedback
$c$	0.3	Degree of surplus fiscal feedback
$d$	0.05	Degree of debt fiscal feedback
$T$	30	Minimum number of years between sudden feedbacks

Table 6: How Strong Does Fiscal Feedback Need to Be?

(a) Certainty

Success defined as year-100 debt less than	Deficit feedback (1)	Debt feedback (2)	Sudden feedback (3)
150% of GDP	0.05	0.05	38
200% of GDP	0.03	0.03	51
250% of GDP	0.02	0.02	71
500% of GDP	0.01	0.01	100

(b) Risk

Success defined as at least 95% of simulations with year-100 debt less than	Deficit feedback (1)	Debt feedback (2)	Sudden feedback (3)
150% of GDP	NA	0.15	9
200% of GDP	NA	0.10	10
250% of GDP	0.15	0.05	11
500% of GDP	0.05	0.05	13

Notes: Each cell represents the minimum feedback strength needed to keep terminal debt (i.e., debt in year 100) below the column's critical value. For deficit and debt feedback, the lowest value of  $c$  or  $d$  from the domains  $\{0, 0.01, \dots, 0.05\}$  and  $\{0.1, \dots, 1\}$  is chosen. For sudden feedback, the highest value of  $T$  from the domain  $\{5, 6, \dots, 100\}$  is chosen. An "NA" value indicates that no value from the domain achieves success.

Table 7: What Does Feedback Imply for Ten-Year Policy?

As a Percentage of Gross Domestic Product											Average	
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2025– 2029	2025– 2034
<i>A. Primary surplus</i>												
CBO baseline	-3.1	-2.6	-2.1	-2.4	-2.2	-2.6	-2.5	-2.6	-3.1	-2.8	-2.5	-2.6
Deficit feedback (c=0.02)	-3.1	-2.5	-2.0	-2.3	-2.0	-2.3	-2.2	-2.3	-2.7	-2.4	-2.4	-2.4
Deficit feedback (c=0.15)	-2.7	-1.9	-1.3	-1.4	-1.0	-1.3	-1.1	-1.1	-1.4	-0.9	-1.7	-1.4
Debt feedback (d=0.02)	-3.1	-2.5	-2.0	-2.3	-2.0	-2.3	-2.2	-2.3	-2.7	-2.4	-2.3	-2.4
Debt feedback (d=0.05)	-3.0	-2.3	-1.8	-2.0	-1.7	-2.0	-1.8	-1.9	-2.3	-1.9	-2.2	-2.1
Sudden feedback	-3.1	-2.6	-2.1	-2.4	-2.2	-2.6	-2.5	-2.6	-3.1	-2.8	-2.5	-2.6
<i>B. Debt</i>												
CBO baseline	101.6	104.1	106.2	108.6	110.5	112.7	114.8	117.1	119.9	122.4		
Deficit feedback (c=0.02)	101.6	103.9	105.9	108.2	109.9	111.9	113.7	115.7	118.1	120.2		
Deficit feedback (c=0.15)	101.2	103.1	104.4	105.8	106.6	107.5	108.2	109.0	110.0	110.7		
Debt feedback (d=0.02)	101.6	104.0	105.9	108.2	109.9	111.9	113.7	115.6	118.0	120.1		
Debt feedback (d=0.05)	101.5	103.8	105.6	107.6	109.0	110.6	112.0	113.6	115.6	117.2		
Sudden feedback	101.6	104.1	106.2	108.6	110.5	112.7	114.8	117.1	119.9	122.4		

Notes: The first row of each panel re-prints the CBO's June 2024 baseline budget outlook for the primary surplus and debt held by the public, respectively, as a percentage of GDP. The remaining rows apply different fiscal feedback rules to the CBO baseline. For example, a government implementing deficit feedback with c=0.02 would run an average primary surplus 2025-2034 equal to -2.4% of GDP instead of the CBO's baseline of -2.6%, yielding a 2034 debt equal to 120.2% of GDP instead of 122.4%.



# Appendix

Table A-1: Fiscal Feedback in Practice

(a) Years 2004 through 2024 (including 202002)

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	0.115 (0.111)	0.006 (0.035)	-0.109 (0.089)				0.081 (0.093)
Projected debt-GDP ratio change				-0.243 (0.182)			
Projected debt-GDP ratio					-0.008 (0.008)		-0.005 (0.007)
Lagged debt-GDP ratio						-0.005 (0.007)	
Lagged output gap	-0.000 (0.123)	-0.020 (0.040)	-0.020 (0.102)	-0.044 (0.106)	-0.046 (0.092)	-0.056 (0.088)	-0.007 (0.118)
Constant	-0.001 (0.002)	-0.002 (0.001)	-0.001 (0.002)	-0.003 (0.001)	0.001 (0.004)	-0.002 (0.003)	0.001 (0.004)
N	41	41	41	41	41	41	41
r2	0.05	0.01	0.07	0.10	0.05	0.03	0.06

(b) Years 1984 through 2024

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	-0.040 (0.040)	-0.024 (0.015)	0.016 (0.034)				-0.103 (0.047)
Projected debt-GDP ratio change				0.021 (0.061)			
Projected debt-GDP ratio					-0.004 (0.003)		-0.009 (0.004)
Lagged debt-GDP ratio						-0.005 (0.004)	
Lagged output gap	-0.137 (0.051)	-0.055 (0.025)	0.082 (0.050)	-0.114 (0.052)	-0.085 (0.044)	-0.091 (0.040)	-0.144 (0.051)
Constant	-0.002 (0.001)	-0.001 (0.000)	0.001 (0.001)	-0.001 (0.001)	0.001 (0.002)	0.001 (0.002)	0.001 (0.001)
N	79	79	79	79	79	79	79
r2	0.12	0.06	0.10	0.11	0.13	0.14	0.18

Table A-1: Fiscal Feedback in Practice (continued)

(c) Years 1984 through 2024 (including 202002)

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	0.027 (0.075)	-0.008 (0.022)	-0.035 (0.058)				-0.075 (0.060)
Projected debt-GDP ratio change				-0.069 (0.107)			
Projected debt-GDP ratio					-0.010 (0.007)		-0.013 (0.006)
Lagged debt-GDP ratio						-0.009 (0.006)	
Lagged output gap	-0.051 (0.099)	-0.034 (0.031)	0.016 (0.082)	-0.042 (0.098)	-0.025 (0.074)	-0.048 (0.059)	-0.068 (0.092)
Constant	-0.002 (0.001)	-0.001 (0.000)	0.001 (0.001)	-0.002 (0.001)	0.003 (0.003)	0.003 (0.002)	0.003 (0.003)
N	80	80	80	80	80	80	80
r2	0.03	0.02	0.03	0.05	0.10	0.09	0.12

Table A-2: Summary of CBO reports

Year	Month	Note	Year	Month	Note
1981	7	Baseline only	2004	1	
1983	3		2004	3	
1984	1		2004	9	3rd report
1984	2	“early” second report	2005	1	
1984	8	3rd report	2005	3	
1985	2		2005	8	3rd report
1985	8		2006	1	
1986	2		2006	3	
1986	8		2006	8	3rd report
1987	2		2007	1	
1987	3		2007	3	
1987	8	3rd report	2007	8	3rd report
1988	2		2008	1	
1988	3		2008	3	
1988	8	3rd report	2008	8	3rd report
1989	1		2009	1	
1989	2	“early” second report, 3-report year	2009	3	
1989	8	3rd report	2009	8	3rd report
1990	1		2010	1	
1990	2	“early” second report, 3-report year	2010	3	
1990	6	3rd report	2010	8	3rd report
1991	1		2011	1	
1991	2	“early” second report, 3-report year	2011	3	
1991	8	3rd report	2011	8	3rd report
1992	1		2012	1	
1992	3		2012	3	
1992	8	3rd report	2012	8	3rd report
1993	1		2013	2	
1993	3		2013	5	
1993	9	3rd report	2014	2	
1994	1		2014	4	
1994	3		2014	8	3rd report
1994	8	3rd report	2015	1	
1995	1		2015	3	
1995	4		2015	8	3rd report
1995	8	3rd report	2016	1	
1995	12	First report of 1996	2016	3	
1996	4		2016	8	3rd report
1997	1		2017	1	
1997	3		2017	6	
1997	9	3rd report	2018	4	“late” first report
1998	1		2018	5	
1998	3		2019	1	
1998	8	3rd report	2019	5	
1999	1		2019	8	3rd report
1999	3		2020	1	
1999	7	3rd report	2020	3	omitted
2000	1		2020	9	omitted, 3rd report
2000	4		2021	2	
2000	7	3rd report	2021	7	
2001	1		2022	5	“late” first report
2001	5		2023	2	
2001	8	3rd report	2023	5	
2002	1		2024	2	
2002	3		2024	6	
2002	8	3rd report			
2003	1				
2003	3				
2003	8	3rd report			

Table A-3: Sources of Variables Using CBO Data

Report	Source(s) of legislated surplus change	Source of projected surplus	Report	Source(s) of legislated surplus change	Source of projected surplus
1981a*	Jul-81	-	2013a	Feb-13	Aug-12
1983a*	Mar-83	Jul-81	2013b	May-13	Feb-13
1984a	Jan-84	Mar-83	2014a	Feb-14	May-13
1984b	Feb 1984, Aug 1984	Jan-84	2014b	Apr 2014, Aug 2014	Feb-14
1985a	Feb-85	Aug-84	2015a	Jan-15	Aug-14
1985b	Aug-85	Feb-85	2015b	Mar 2015, Aug 2015	Jan-15
1986a	Feb-86	Aug-85	2016a	Jan-16	Aug-15
1986b	Aug-86	Feb-86	2016b	Mar 2016, Aug 2016	Jan-16
1987a	Feb-87	Aug-86	2017a	Jan-17	Aug-16
1987b	Mar 1987, Aug 1987	Feb-87	2017b	Jun-17	Jan-17
1988a	Feb-88	Aug-87	2018a	Apr-18	Jun-17
1988b	Mar 1988, Aug 1988	Feb-88	2018b	May-18	Apr-18
1989a	Jan-89	Aug-88	2019a	Jan-19	May-18
1989b	Feb 1989, Aug 1989	Jan-89	2019b	May 2019, Aug 2019	Jan-19
1990a	Jan-90	Aug-89	2020a	Jan-20	Aug-19
1990b	Feb 1990, Jun 1990	Jan-90	2020b*	Mar 2020, Sep 2020	Jan-20
1991a	Jan-91	Jun-90	2021a	Feb-21	Sep-20
1991b	Feb 1991, Aug 1991	Jan-91	2021b	Jul-21	Feb-21
1992a	Jan-92	Aug-91	2022a	May-22	Jul-21
1992b	Mar 1992, Aug 1992	Jan-92	2023a	Feb-23	May-22
1993a	Jan-93	Aug-92	2023b	May-23	Feb-23
1993b	Mar 1993, Sep 1993	Jan-93	2024a	Feb-24	May-23
1994a	Jan-94	Sep-93	2024b	Jun-24	Feb-24
1994b	Mar 1994, Aug 1994	Jan-94			
1995a	Jan-95	Aug-94			
1995b	Apr 1995, Aug 1995	Jan-95			
1996a	Dec-95	Dec-95			
1996b	Apr-96	Dec-96			
1997a	Jan-97	Apr-96			
1997b	Mar 1997, Sep 1997	Jan-97			
1998a	Jan-98	Sep-97			
1998b	Mar 1998, Aug 1998	Jan-98			
1999a	Jan-99	Aug-98			
1999b	Mar 1999, Jul 1999	Jan-99			
2000a	Jan-00	Jul-99			
2000b	Apr 2000, Jul 2000	Jan-00			
2001a	Jan-01	Jul-00			
2001b	May 2001, Aug 2001	Jan-01			
2002a	Jan-02	Aug-01			
2002b	Mar 2002, Aug 2002	Jan-02			
2003a	Jan-03	Aug-02			
2003b	Mar 2003, Aug 2003	Jan-03			
2004a	Jan-04	Aug-03			
2004b	Mar 2004, Sep 2004	Jan-04			
2005a	Jan-05	Sep-04			
2005b	Mar 2005, Aug 2005	Jan-05			
2006a	Jan-06	Aug-05			
2006b	Mar 2006, Aug 2006	Jan-06			
2007a	Jan-07	Aug-06			
2007b	Mar 2007, Aug 2007	Jan-07			
2008a	Jan-08	Aug-07			
2008b	Mar 2008, Aug 2008	Jan-08			
2009a	Jan-09	Aug-08			
2009b	Mar 2009, Aug 2009	Jan-09			
2010a	Jan-10	Aug-09			
2010b	Mar 2010, Aug 2010	Jan-10			
2011a	Jan-11	Aug-10			
2011b	Mar 2011, Aug 2011	Jan-11			
2012a	Jan-12	Aug-11			
2012b	Mar 2012, Aug 2012	Jan-12			

Notes: \* denotes reports that are omitted.