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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%-1.1% 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 thirteen-year periods, suggesting that a “wait-and-see” approach to successful deficit reduction sometimes allows little waiting.

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1 Introduction

America's fiscal path is likely unsustainable: the Congressional Budget Office (CBO) routinely projects that debt as a share of GDP under current law will explode to infinity. How much deficit reduction is enough? Fiscal gap analysis provides a standard answer. For example, Auerbach and Gale (2024) estimate that an immediate reduction in the federal budget deficit equal to approximately 2.5% of GDP would stabilize the debt-GDP ratio over the next 30 years under current law.

However, there are limitations to standard fiscal gap analysis. Economically, such analyses typically assume certainty. Under risk, stability requires an ongoing data-dependent fiscal rule. Empirically, historical Congressional behavior involved making year-to-year data-dependent adjustments in response to fiscal conditions (Auerbach 2003). Politically, an immediate 2.5% of GDP deficit reduction appears extremely unlikely. The most ambitious proposals typically seek less deficit reduction, such as the 0.9% of GDP deficit reduction over ten years proposed in the most recent President's Budget (OMB 2024). What data-dependent fiscal rules robustly stabilize the debt-GDP ratio under risk, and what do such rules imply for necessary deficit reduction over the short and long run?

We begin our analysis by revisiting earlier empirical work on actual Congressional behavior. Using CBO data on legislated changes to the deficit, we replicate earlier findings that fiscal feedback prevailed in the 1984-2003 period, the first twenty years of available data (Auerbach 2003). When CBO projected a 1% of GDP higher deficit and conditional on the lagged output gap, Congress enacted deficit reduction equal to 0.15% of GDP with a robust t-statistic of 5. We provide new evidence that the relationship during that period is quite robust. While Congress's behavior is consistent with deficit reduction when the debt-ratio was high, as in Bohn (1998), the projected deficit more strongly predicts Congressional behavior than the lagged or projected debt-GDP ratio.

We then rerun the analysis for the 2004-2024 period. We find that Congress's gradual year-to-year fiscal feedback has disappeared. Congress during the 2004-2024 period on average increased the deficit, and those deficit increases did not fall when projected deficits rose. When CBO projected a 1% of GDP higher deficit and conditional on the lagged output gap, Congress during the 2004-2024 period enacted deficit reduction equal to -0.03% of GDP (i.e., insignificantly increased the deficit), with a 95% confidence interval that rejects the 1984-2003 estimate. The change in Congressional behavior is strikingly evident in scatterplots and is robust across alternative specifications.

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 quantify our answers using a simple model of the U.S. fiscal trajectory. Absent changes in fiscal policy and economic shocks, the model closely matches the CBO long-term budget outlook. However, we allow for two types of shocks: large transitory deficit shocks like the COVID-19 pandemic and persistent excess interest rate ("r-g") shocks. Moreover, we allow the government to reduce the deficit in response to fiscal conditions. Importantly, we do not model the excess interest as being determined by optimizing agents; instead, the excess interest rate is determined by exogenous shocks and by CBO's implied sensitivity of the excess interest rate to the debt-GDP ratio. We make this choice in order to focus on the government's reaction function within CBO conventions.

We find that deficit-based 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 interest payments exceed 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 twelve 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.

Our paper contributes to three literatures. First, an influential literature finds that the U.S. government satisfies its intertemporal budget constraint by reducing the deficit when either the debt-GDP ratio (Bohn 1998, 2008) or the deficit (Auerbach 2003) rises. We solidify evidence of such historical fiscal feedback and provide new evidence of statistically zero fiscal feedback in recent decades. Our approach of relying on empirical evidence regarding the tendency of Congress to react to fiscal conditions, rather than on the text of budget rules that can be repealed or superseded, aligns with recent work finding that budget rules that seek to contain fiscal policy lack credibility and enforcement (Potrafke 2023). Examples include the European Union's Stability and Growth Pact (Blanchard, Leandro, and Zettelmeyer 2021; Buti, Friis, and Torre 2022) and the U.S.'s 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).

Second, government entities routinely estimate the long-term fiscal trajectory of the United States under certainty (e.g., CBO 2024b, OMB 2024), and economists have modeled the trajectory under excess interest rate risk (e.g., Ball, Elmendorf, and Mankiw 1998, Blanchard 2019, Mehrotra and Sergeyev 2021). We augment these approaches with a key empirical feature of the last twenty years: the risk of transitory shocks to the deficit, such as the Great Recession and the COVID-19 pandemic. We find that the mean frequency of such deficit disasters is a quantitatively important determinant of the U.S. fiscal path, which can improve the stochastic debt sustainability analyses urged by Blanchard, Leandro, and Zettelmeyer (2021) and Blanchard (2023).

Third, a large literature studies optimal debt accumulation and sustainability (e.g. Lucas and Stokey 1983, Aiyagari and McGrattan 1998, Cochrane 2001, Blanchard 2019, Kocherlakota 2023, Angeletos, Lian, and Wolf 2024, Mian, Straub, and Sufi 2024). We provide guidance to policymakers seeking a fiscal rule to keep the debt-GDP ratio below extreme levels with high probability. For example, we find that a deficit-based fiscal rule half as strong as actually estimated in the 1984-2003 period would be sufficient to meet our stability criterion. We further find that the sufficient debt-based and deficit-based fiscal rules that we consider would imply between 0.5% and 1.1% of GDP deficit reduction on average over the coming decade, which can be used to assess the fiscal responsibility of ten-year budget proposals while clarifying the additional deficit reduction required over time and under adverse shocks.

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-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 fiscal 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

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

where t denotes a semi-annual period, $\mathbb{E}\left[s_{t-1}\right]$ 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, Δs_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.[1]

Table 1 presents summary statistics.[2] 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.[3] 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 explantory variable) on the lagged output gap, having added back the respective mean to each. We denote a year's first 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

[1] 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.

[2] The construction of the observations themselves is described in the Appendix, in Table A-2.

[3] Results deviate slightly due to using an updated potential GDP series.

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.[4]

Also new in this paper, the remaining columns of Table 2a supplement Auerbach (2003) with new specification robustness tests with respect to projected fiscal conditions and the debt-GDP ratio. Columns 4-6 replace projected surpluses with the projected change in the debt-GDP ratio between t and $t+4$, the projected $t+4$ debt-GDP ratio, and the lagged debt-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 the projected debt-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.

Table 3a column 1 reproduces the key Table 2a column 1 result that the projected surplus predicts legislated surplus changes and then presents additional robustness checks that are also new in this paper. Column 2 controls for a quartic in the lagged output gap, allowing for nonlinearity in Congress's reaction function. The coefficient on the projected surplus barely changes.

Surpluses are serially correlated, so it is possible that Congress responds more strongly to past surpluses than to future surpluses. Columns 3, 5, 7, and 9 test whether the lagged surplus, lagged primary surplus, lagged net interest, or lagged real net interest, respectively, as a share of lagged potential GDP predicts legislated surplus changes. Lagged refers to the fiscal year prior to the fiscal year of the observation. Lagged real interest equals lagged net interest minus the GDP price index inflation rate times the prior fiscal year's terminal debt (Furman and Summers 2020). In all cases, we find that the given lagged measure significantly predicts legislated surplus changes and with the appropriate sign, consistent with Congress reacting to lagged conditions. However, columns 4, 6, 8, and 10 find that when both the projected surplus and the given lagged measure are included as covariates, the coefficient on the given lagged measure attenuates toward zero while the coefficient on the projected surplus remains close to its column 1 value. Hence, Congress appears to react most to the projected surplus.[5]

[4] These particular relationships also hold after residualizing with the lagged output gap, as shown in Figure 1a's 1991a and 2001b data points.

[5] The original CBO data contain the data necessary to test how well the projected primary surplus, projected interest, or projected real interest predict legislated surplus changes. However, those data were not digitized by Auerbach (2003),

Finally, the lagged output gap may not perfectly absorb Congressional stabilization action. For example, the relationship between the lagged output gap and the future output gap may vary predictably across recessions. Therefore, column 10 supplements the column 2 analysis by excluding observations from any fiscal year with a month during which the United States was in recession during the 1984-2003 period: 1990, 1991, and 2001. The coefficient on the projected surplus attenuates only slightly. All told, the projected surplus robustly predicted legislated surplus changes in the 1984-2003 period.

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.[6] 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.

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 of Table 2b confirm no statistically significant relationship remains. The additional robustness checks in Table 3b confirm the same. One feature of the 2004-2024 period is that the United States experienced more severe recessions. However, Columns 2 and 11 find that controlling for a quartic in the lagged output gap and dropping recession years, respectively, do not alter the null result. Going even further, Column 12 excludes all observations from years 2008-2014 and 2020-2021, which amounts to dropping nearly half the sample. Though the sign on the projected surplus changes, the coefficient remains statistically insignificant and the 95% confidence interval continues to reject the 1984-2003 estimate.

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

have not been digitized by CBO as of this writing, and were not otherwise available to us in time for such tests.

[6] Results for the full sample period 1984-2024 are shown in the Appendix, in Tables A-1b and A-1c.

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.

Investigating the cause of Congress's behavior change would be valuable but is beyond the scope of this paper.[7] One potential cause is that voters may have stopped rewarding politicians for reducing the deficit. Cox, Epp, and Shapiro (2022) compile data on public poll responses over time to the question of what is the most important problem facing the United States. They find that the share of respondents listing the budget deficit as the most important problem reached a zenith in the 1980s, remained substantial until the late 1990s, and was low 2000-2020 except for a spike during the first Obama administration. We leave testing this and other hypotheses and their underlying causes to future work.

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:

[7] We thank our discussant Bill Gale for emphasizing its value.

$$\Delta b_t = \rho_t b_{t-1} - s_t \tag{2}$$

where b_t is the debt-GDP ratio at the end of year t, Δb_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.[8] 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 ρ_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 Δb 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 ρ_t, in the spirit of Ball, Elmendorf, and Mankiw (1998) but with more years of data. We study 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 1792-1961, 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.

[8] 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.

Annual values fluctuate greatly, in particular becuase 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 4 plots quantiles of the excess interest rate distribution over different rolling time horizons using all years 1791-2023. 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% (i.e., -0.4 percentage points), 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.[9]

[9] 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

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.[10]

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.[11] Moreover, that deficit reduction was not undone by new legislation over the subsequent decade.[12] Hence, deficit reduction equal to 2% of GDP was historically feasible in the United States. We use this finding in the simulations below.

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.

[10] Note that these figures are not exactly comparable as their timing definitions differ.

[11] 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.

[12] 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.

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

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

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 λ 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:

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

The resulting value is 0.25, which we use in our simulations below.[13] That is, our simulations assume that on average there are two times per century when the debt-GDP ratio rises by 25 percentage points.

For the variable ρ_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 ρ evolves according to the relationship:

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

The results for different sample periods are shown in Table 5. The estimated value of β_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

[13] 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.

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 5 of β_0 and β_2 are far less precise than those for β_1, so we choose values to provide a simulation path that conforms to CBO's recent analyses. We set β_2 equal to 0.004 and choose β_0 so that the initial value of ρ 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 ρ_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:

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

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 θ 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.[14] 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.[15]

[14] 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.

[15] 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

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 $\theta s_{t-1} - (1-\theta)a_s$.[16] 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 θ for the two cases, deficit-based fiscal feedback is described by the expression:

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

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

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

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

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

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

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

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.[17] 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

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.

[16] 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 ρ_t rather than r_t in calculating debt service.

[17] While ρ is endogenous, depending on the debt-GDP ratio b, the near equality of b in the two cases implies a near equality of ρ as well.

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. That is, we replace equation 6 with the following rule: the surplus remains unchanged

$$s_t = s_{t-1} \tag{11}$$

unless a fiscal consolidation occurs, in which case the surplus is increased by a fiscal consolidation value S

$$s_t = s_{t-1} + S \tag{12}$$

We choose a consolidation size S 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.[18] 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.[19]

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 θ 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 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

[18] Because the term ρ 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 π 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%.

[19] Mehrotra and Sergeyev (2021) also consider a nonlinear fiscal feedback rule, though with less extreme nonlinearity.

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).[20] 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. Finally, as our emphasis here is on longer-term fiscal trajectories, we do not account for the effects of fiscal actions on cyclical fluctuations in GDP.

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 ρ_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).[21] 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 ρ_1 equal to $-.005$, roughly its average value over the next five fiscal years.[22]

All of the parameter values used in the simulations are collected in Table 6.

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.[23] 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 rate over the last ten years of the overlapping sample period are roughly the same. Indeed, our choice of the sensitivity β_2 of the excess interest rate with respect to the interest rate is made to satisfy

[20] 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.

[21] 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.

[22] CBO's five-year average value of ρ_t is slightly higher (less negative) than -.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 ρ, our assumed initial value of ρ is consistent with our assumed initial debt-GDP ratio.

[23] As CBO's projections do not forecast recessions or other economic shocks, they provide a good benchmark for our simulations that exclude shocks.

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 ρ.[24] 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.[25]

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 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 ρ_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 ρ_t. The rapid consolidations under deficit-based gradual feedback head off any significant increase in ρ_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

[24] Note that to the extent that other factors, such as labor force growth, contribute to a downward trend in ρ, our simple method of choosing β_2 will understate the sensitivity of ρ to the debt-GDP ratio and understate the severity of fiscal imbalances.

[25] 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 ρ_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 ρ_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 ρ, 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-c show the impact under uncertainty of variations in assumptions about various parameters on the 100-year median trajectory of the debt-GDP ratio. The three panels show the results under deficit-based gradual fiscal feedback, debt-based gradual fiscal feedback, and sudden fiscal feedback, respectively.

For gradual deficit-driven feedback (panel a), perhaps the most striking result involves the impact of the frequency of debt shocks, λ. 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 ρ, 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 ρ is also evident by comparing the baseline trajectory with that for a much higher assumed standard deviation for the the stochastic term in the expression for ρ, taken from the value for this term for the full-sample (1792-2023) estimation period in the second column of Table 5. This large increase in the size of the shocks to ρ 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, ϕ. 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 θ 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, λ, 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, ϕ.

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 ρ has a bigger impact under debt-based adjustment. Finally, setting the policy permanence parameter ϕ 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, looking again at Figure 5a, we see that the presence of risk has relatively little impact on the relationship between the terminal debt-GDP ratio and the feedback parameter for the debt-adjustment case, because in this case, unlike in the deficit feedback case, policy responds directly and immediately to debt shocks, which are the main added source of upward pressure on the terminal debt-GDP ratio in the presence of risk.

Figure 7c displays the sensitivity analysis for the case of sudden fiscal feedback. Before considering specific parameter variations, a couple of general observations are worth making. First, the variation in trajectories is wider under this type of adjustment than for the two gradual types of adjustment, reflecting the fact that the sudden adjustment process is less flexible in its ability to deal with different challenges. Indeed, for several of the alternative parameter assumptions, the median debt-GDP ratio explodes past 2.5, the highest value represented in the figure.

Second, some of the results may initially appear counterintuitive, but these are again traceable to the nature of the assumed sudden adjustment process. Smaller increases in the debt-GDP ratio and associated debt service delay the adoption of fiscal adjustments and may also reduce their frequency, which can actually lead to higher terminal values of the debt-GDP ratio, given the size and assumed permanence of these large fiscal adjustments. This is the case for the excess interest sensitivity parameter, ϕ, for which the height of the trajectory is nonmonotonic with respect to parameter variation, being higher for lower and higher values than for the midrange baseline parameter value. Note, though, for the lower value, $\phi = 0$, the trajectory converges on that for the baseline value of $\phi = .04$, whereas the trajectory for $\phi = .08$ explodes.

Among the other parameter variations, we can see further evidence of the inflexibility associated with sudden feedback. In particular, for the case of feedback permanence parameter $\theta = 0.9$, the outcome is far worse than in the deficit-based feedback case, which also sets $\theta = 1$ in the baseline scenario. Whereas this reduced permanence of adjustments can be partially offset by stronger adjustments in the deficit feedback case, the scope for stronger reaction is much more limited in the sudden feedback case, where by assumption the size and frequency of adjustments are fixed.

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^{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:

$$s_t = s_t^{\text{CBO}} + \Delta s_t + \sum_{t'=2001}^{t-1} \Delta s_{t'-1} \tag{13}$$

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

$$\Delta s_t = c\left[\rho_t^{\text{CBO}} b_{t-1} - \left(s_t^{\text{CBO}} + \sum_{t'=2001}^{t-1} \Delta s_{t'-1}\right)\right] \tag{14}$$

where ρ_t^{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.[26]

The debt-based feedback equation utilizes no persistence (θ=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:

$$s_t = s_t^{\text{CBO}} + \Delta s_t \tag{15}$$

$$\Delta s_t = d[b_{t-1} - b_{1999}] \tag{16}$$

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

[26] 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.

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).

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.[27]

Figure 8b addresses the same question for debt-based gradual feedback, for the feedback parameter

[27]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.

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 7 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.[28] 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 $c = 0.14$ (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 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 12 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

[28]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 $c = d$.

action as frequently as would be necessary to meet any of the terminal debt-GDP targets in Table 7b.

6.3 Implications for the Next Ten Years

Table 8 uses values from Table 7 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 8, 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 13-16, except s_t^{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 8 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 7. 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 14 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 8 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 7. The implied deficit reduction is correspondingly larger. Deficit feedback of magnitude $c = 0.14$ implies an average primary deficit that is 1.1% 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 11.2% 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

Any fiscal path is sustainable if future fiscal policy responds sufficiently to high deficits. This paper solidified the previous finding that Congress in the 1984-2003 period reduced the deficit when projected deficits rose (Auerbach 2003). We further found that this year-to-year feedback has disappeared: Congress on average during 2004-2024 did not respond to the projected deficits. In a model with large transitory deficit shocks and persistent excess interest rate shocks, we found that deficit-based fiscal feedback half as strong as estimated in the 1984-2003 period is sufficient to keep the debt-GDP ratio below 250% in one hundred years with 95% probability. Debt-based feedback as strong as previously estimated in the 1916-1995 period (Bohn 1998) is also sufficient. These sufficiently strong fiscal rules imply 0.5%-1.1% of GDP deficit reduction over the next ten years, with more required in subsequent years and after adverse shocks. Finally, we found that a sufficient “wait-and-see” approach sometimes allows little waiting, as it requires Congress to enact two 1.5%-of-GDP deficit reductions within thirteen years of each other in adverse states of the world.

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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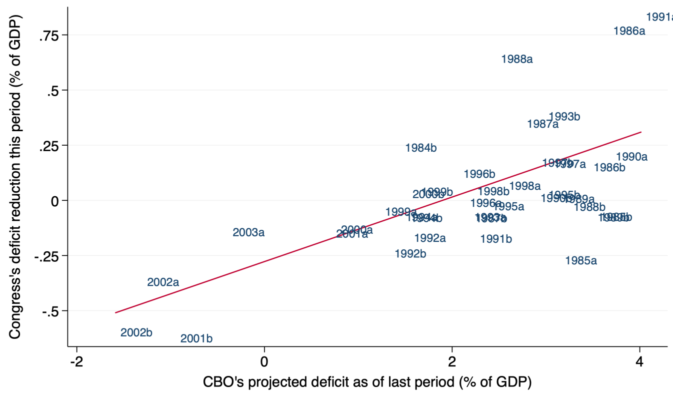
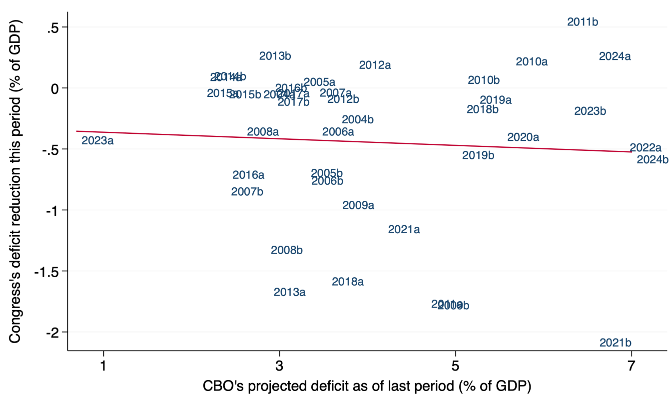
Figure 1: Congress Stopped Reducing the Deficit when Projected Deficits Rise

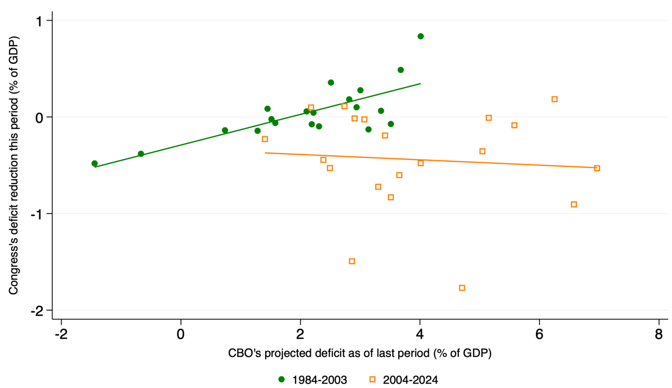
(a) 1984-2003 original Auerbach (2003) sample



(b) 2004-2024 sample



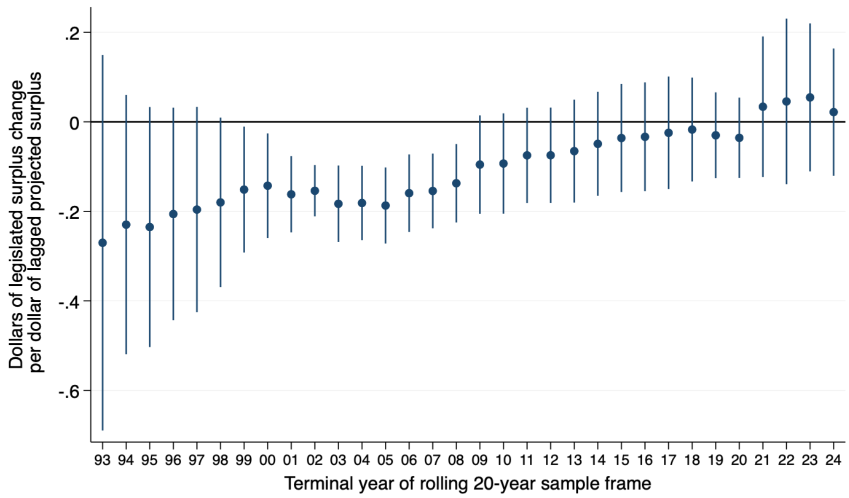
(c) Both samples



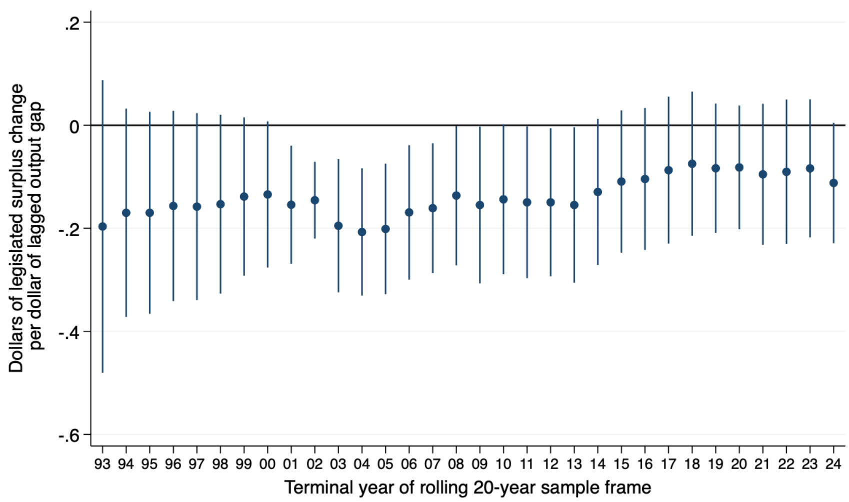
Notes: The figure plots the relationship between legislated deficit reduction (y-axis) and the lagged projected deficit (x-axis), controlling linearly for the lagged output gap. Specifically, each panel plots residuals from a regression of the legislated primary deficit reduction on the lagged output gap during the specified time period, versus residuals from a regression of the lagged projected deficit on the lagged output gap during the same time period, having added back the respective mean to each. The data point suffixes "a" and "b" denote the first and second observations of a fiscal year, respectively. Panel (a) plots the residualized data points for the original Auerbach (2003) sample. Panel (b) plots the residualized data points for the 2004-2024 period, excluding the 2020b observation 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 legislated deficit reduction within each bin; 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



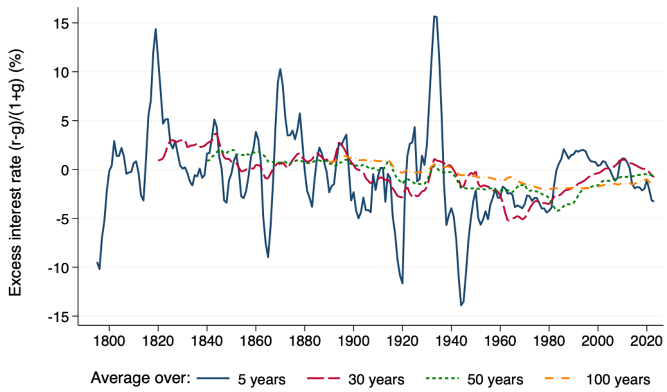
(b) Effect of CBO's Lagged Output Gap on Legislated Surplus Change



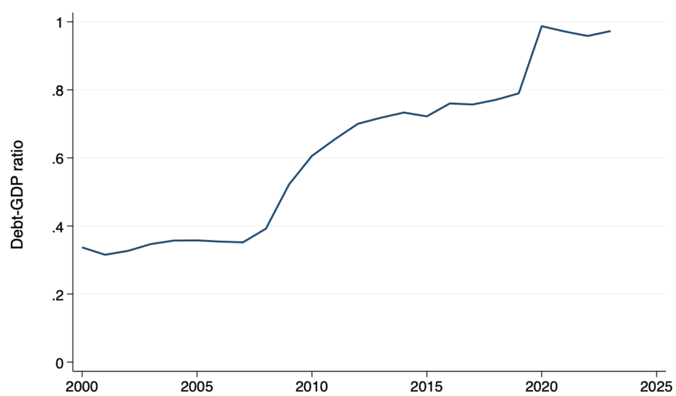
Notes: This figure repeats the Table 2 column 1 specification for different rolling time periods of up to 20 years. Specifically, the 2003 value plots the point estimate and 95% confidence interval from the first period of 1984 through the second period of 2003, nearly equaling the Table 2a column 1 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. 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.

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

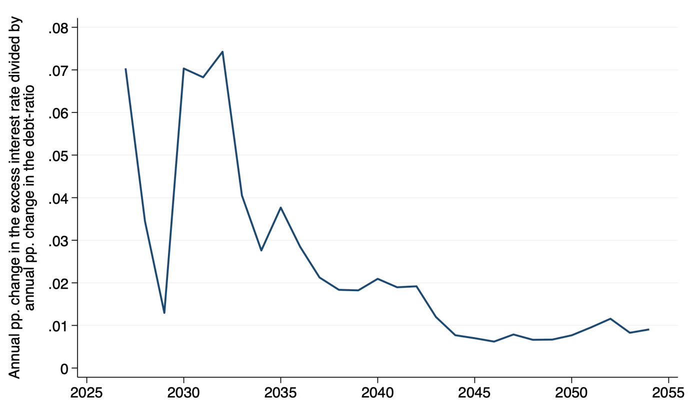
(a) Evolution of Excess Interest Rate (r-g)/(1+g)



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



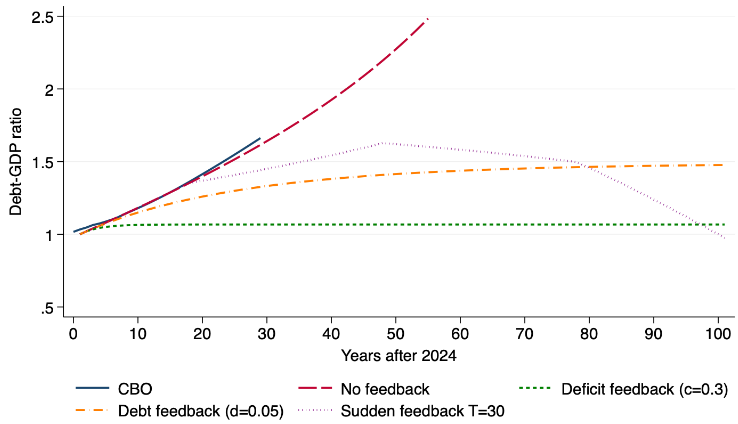
(c) CBO Implied Feedback of Debt into the Excess Interest Rate



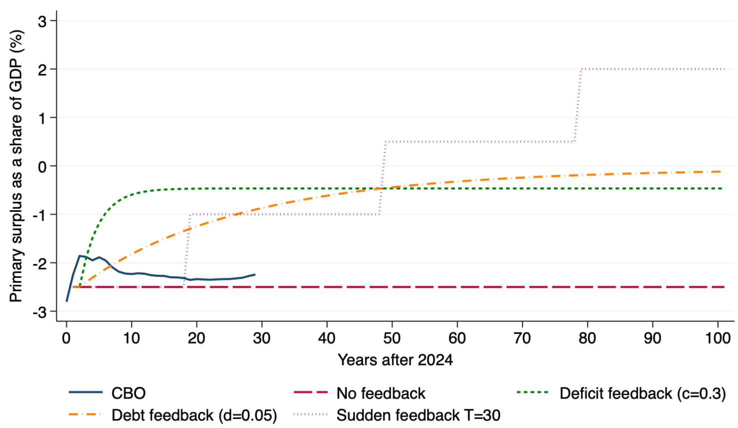
Notes: Panel (a) plots various rolling averages of the excess interest rate $(r_t - g_t)/(1+g_t)$ 1792-2023, where g_t is nominal GDP growth in year t and r_t is the average nominal interest rate on government debt in year t. The year t value for the N-year average equals the mean of the excess interest rate over years $[t-N+1, t]$. Panel (b) plots the debt-GDP ratio over time. Panel (c) plots the implied feedback of the debt-GDP ratio into the excess interest rate in CBO's 2024 long-term budget outlook. Each year t's value equals the difference in CBO's projected excess interest rate between t and $t-1$, divided by the difference in CBO's projected debt-GDP ratio between $t-1$ and $t-2$.

Figure 4: Fiscal Paths under Certainty

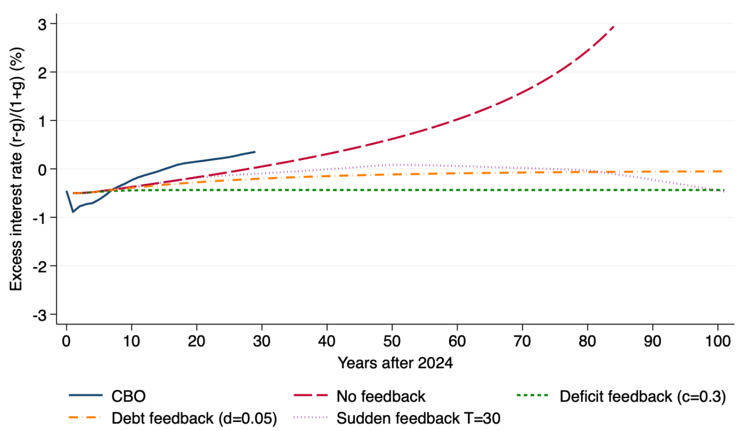
(a) Debt-GDP Ratio



(b) Primary Surplus



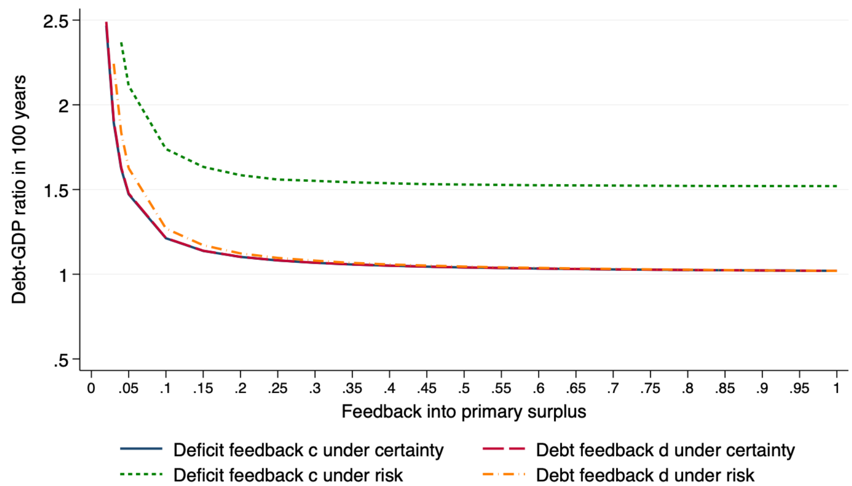
(c) Excess Interest Rate



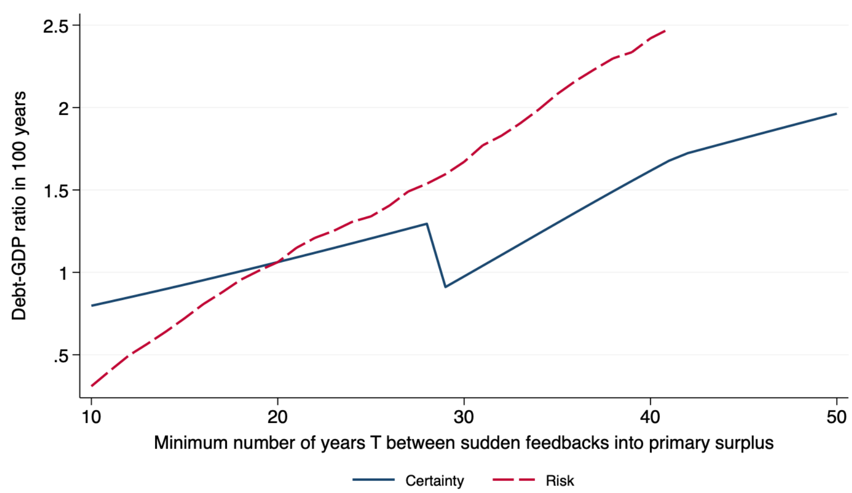
Notes: This figure assumes no shocks to the primary deficit or the excess interest and plots fiscal path variables over the coming 100 years under different assumptions about fiscal feedback. The CBO series is CBO's 2024 long-term budget outlook. The No feedback series is our model (equations 3, 5, and 6) with no shocks ($e_{st} = e_{ut} = 0$) and no fiscal feedback ($c = d = 0$). The Deficit feedback model equals the No feedback model except with $c = 0.3$. The Debt feedback model equals the No feedback model except with $d = 0.05$. The Sudden feedback series replaces equation 6 with equations 11-12.

Figure 5: Feedback Sensitivity of Fiscal Paths

(a) Deficit and Debt Feedback



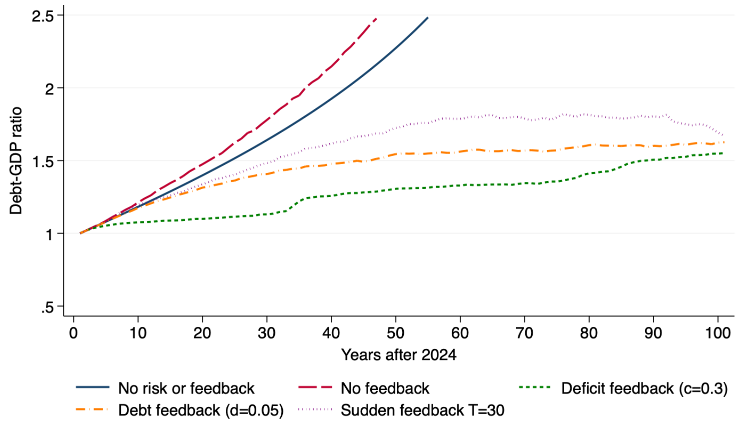
(b) Sudden Feedback



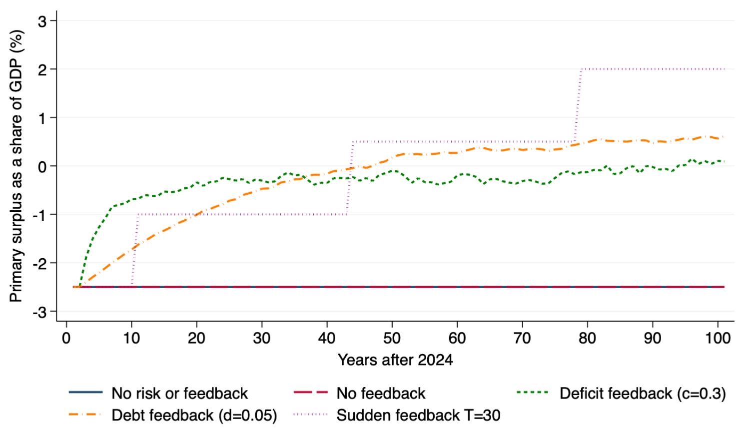
Notes: This figure plots the year-100 debt-GDP ratio values plotted in Figures 4a (certainty) and 6a (risk), under various values of deficit feedback strength c, debt feedback strength d, or sudden feedback minimum interval T. See the notes to those figures for details.

Figure 6: Fiscal Paths under Risk

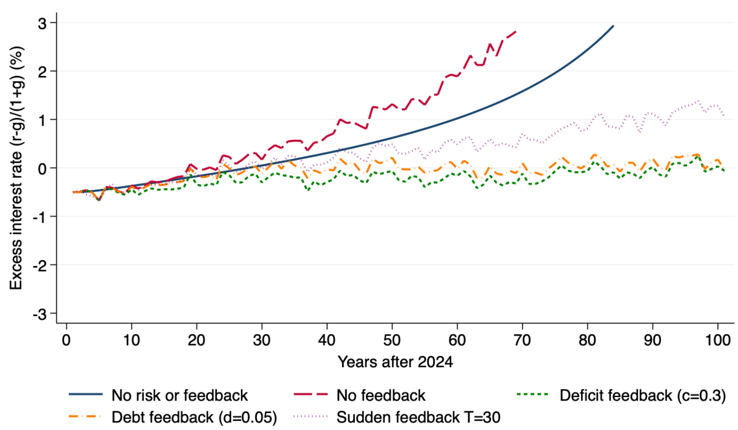
(a) Debt-GDP Ratio



(b) Primary Surplus



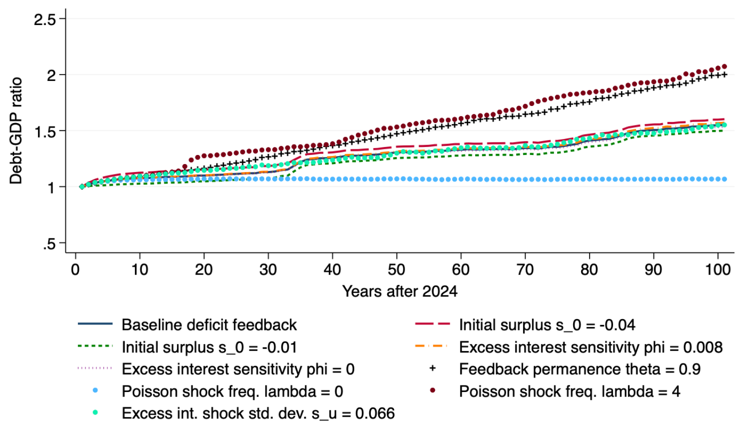
(c) Excess Interest Rate



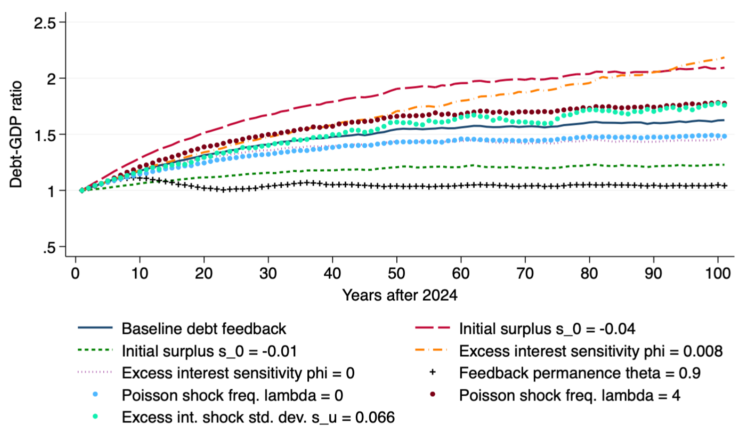
Notes: This figure replicates Figure 4 except for the following changes. This figure's No risk or feedback series equal Figure 4's No feedback series. The models underlying all other series have non-zero shocks e_{st} and e_{ut}. The value plotted in each panel in each year is the median in that year of the given outcome across the 1000 simulations.

Figure 7: Sensitivity of Fiscal Paths under Risk

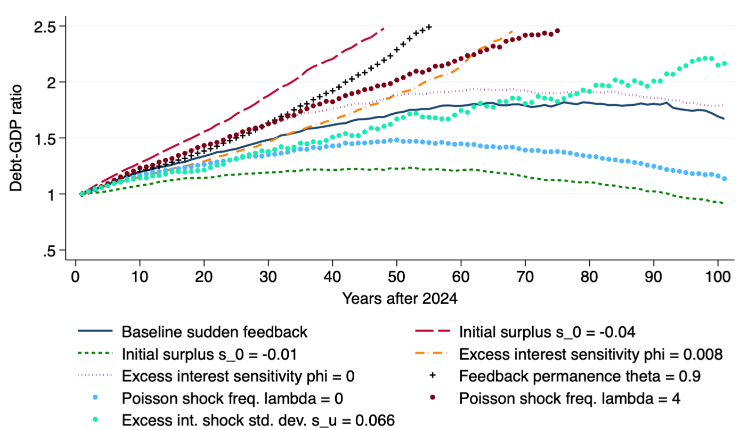
(a) Deficit Feedback



(b) Debt Feedback



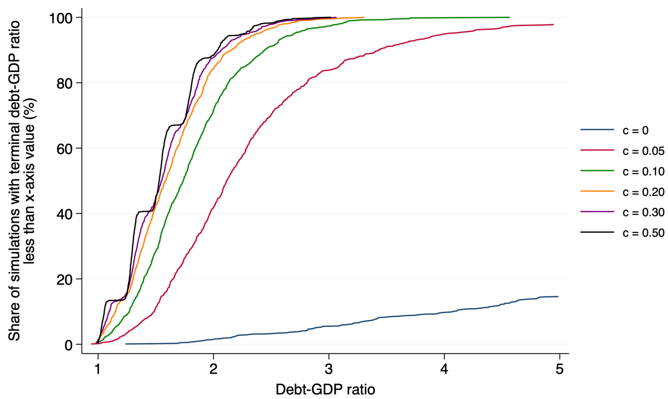
(c) Sudden Feedback



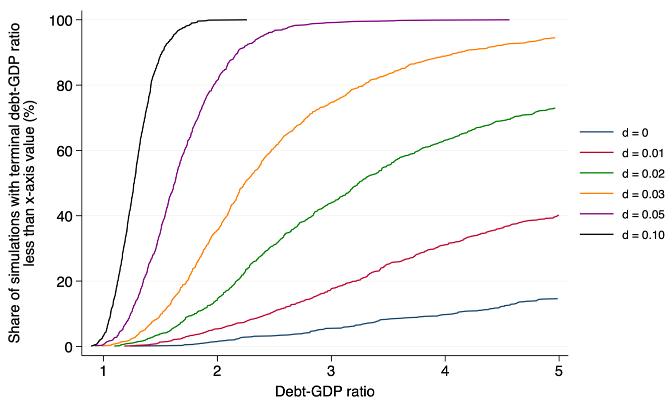
Notes: This figure replicates Figure 6a except for the following changes. This figure's Baseline deficit feedback, Baseline debt feedback, and Baseline sudden feedback series equal Figure 6a's deficit feedback, debt feedback, and sudden feedback series, respectively. Each of the remaining series replicates the panel's baseline series except that the underlying model uses the one alternative assumption listed in the series name.

Figure 8: Cumulative Distributions of the Year-100 Debt-GDP Ratio under Risk

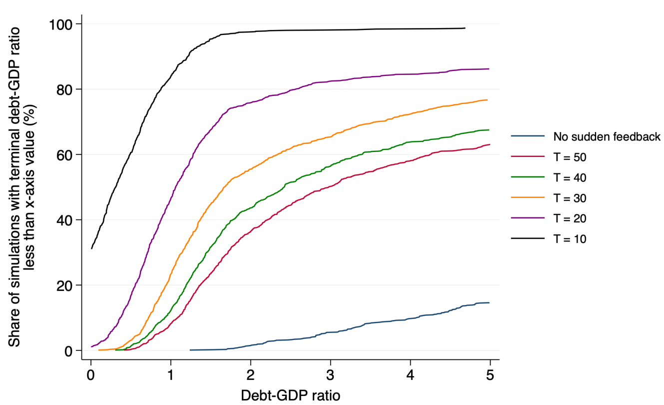
(a) Deficit Feedback



(b) Debt Feedback

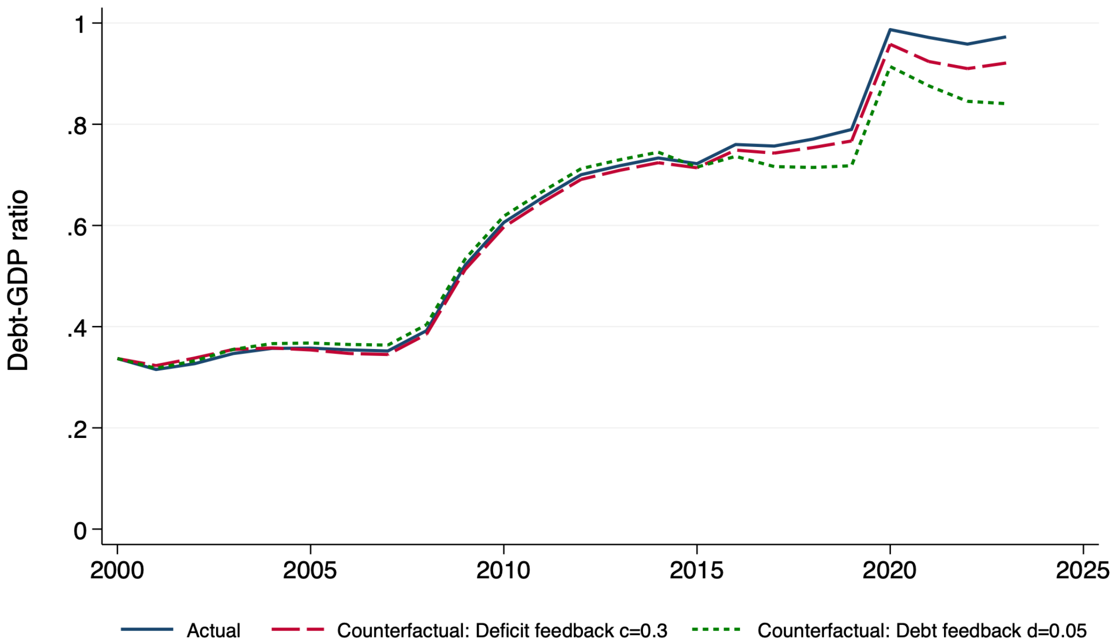


(c) Sudden Feedback



Notes: This figure plots the cumulative distribution function of year-100 debt-GDP ratios under various feedback parameters. The $c = 0.3$ series of panel (a), the $d = 0.05$ series of panel (b), and the $T = 30$ series of panel (c) use the same debt-GDP values underlying median debt-GDP values plotted in Figure 6a.

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



Notes: This figure plots the debt-GDP ratio in actuality 2000-2023 and under counterfactual deficit feedback (equations 13-14) and debt feedback (equastions 15-16). The counterfactuals apply the given feedback rule beginning in 2001 except during the "crisis" years 2008-2014 and 2020, when no fiscal feedback is applied. Counterfactual debt-feedback uses neutral debt ratio $a_b = b_{1999} = 0.383$. We apply each given feedback rule to the actual fiscal path, implicitly assuming that Congress in actuality did not employ fiscal feedback during this period, consistent with the Table 2 results over most of this period.

Table 1: Summary Statistics for Fiscal Feedback Regressions

(a) Full sample

	Mean	p10	p50	p90	St. Dev.
Legislated change to primary surplus	-0.003	-0.010	-0.001	0.003	0.008
Legislated change to revenues	-0.001	-0.004	-0.000	0.000	0.003
Legislated change to primary outlays	0.002	-0.002	0.000	0.005	0.006
Projected surplus	-0.030	-0.057	-0.030	0.000	0.023
Projected debt-GDP ratio	0.540	0.283	0.462	0.793	0.228
Projected debt-GDP ratio change	0.003	-0.022	0.004	0.022	0.017
Lagged debt-GDP ratio	0.527	0.337	0.446	0.790	0.203
Lagged surplus	-0.037	-0.081	-0.034	-0.003	0.031
Lagged primary surplus	-0.016	-0.067	-0.014	0.027	0.034
Lagged interest	0.021	0.013	0.019	0.031	0.007
Lagged real interest	0.010	-0.000	0.011	0.022	0.013
Lagged output gap	0.011	-0.011	0.008	0.034	0.020

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

	Mean	p10	p50	p90	St. Dev.
Legislated change to primary surplus	0.000	-0.002	-0.000	0.004	0.003
Legislated change to revenues	0.000	-0.000	0.000	0.002	0.002
Legislated change to primary outlays	-0.000	-0.002	0.000	0.002	0.002
Projected surplus	-0.021	-0.046	-0.025	0.017	0.022
Projected debt-GDP ratio	0.386	0.209	0.405	0.499	0.111
Projected debt-GDP ratio change	-0.004	-0.035	0.000	0.021	0.019
Lagged debt-GDP ratio	0.405	0.327	0.399	0.478	0.055
Lagged surplus	-0.023	-0.048	-0.029	0.013	0.023
Lagged primary surplus	0.005	-0.019	-0.000	0.038	0.021
Lagged interest	0.028	0.022	0.029	0.031	0.004
Lagged real interest	0.020	0.014	0.020	0.024	0.004
Lagged output gap	0.005	-0.016	0.005	0.024	0.015

(c) 2004-2024 sample

	Mean	p10	p50	p90	St. Dev.
Legislated change to primary surplus	-0.004	-0.019	-0.002	0.001	0.007
Legislated change to revenues	-0.002	-0.005	-0.000	0.000	0.004
Legislated change to primary outlays	0.002	-0.002	0.001	0.006	0.005
Projected surplus	-0.039	-0.069	-0.033	-0.016	0.020
Projected debt-GDP ratio	0.684	0.378	0.738	0.989	0.215
Projected debt-GDP ratio change	0.008	-0.003	0.006	0.025	0.011
Lagged debt-GDP ratio	0.645	0.353	0.709	0.972	0.221
Lagged surplus	-0.051	-0.093	-0.036	-0.021	0.033
Lagged primary surplus	-0.036	-0.081	-0.022	-0.006	0.033
Lagged interest	0.015	0.012	0.014	0.018	0.003
Lagged real interest	0.001	-0.017	0.004	0.011	0.013
Lagged output gap	0.015	-0.009	0.012	0.038	0.022

Notes: This table shows summary statistics over different time horizons for variables used in our fiscal feedback regressions. All values are expressed as a share of GDP. Each observation derives from a Congressional Budget Office (CBO) update to its budget outlook, of which there are approximately two per fiscal year. 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. Primary surplus equals revenues minus primary (i.e., non-interest) outlays (i.e., spending). Surplus equals primary surplus minus interest. A legislated change value equals CBO's estimated impact of legislation enacted since its previous update, on average over the succeeding five fiscal years divided by potential GDP and with declining weights reflecting a discount factor of 0.5. Projected values are similarly weighted but use data from the preceding period. The lagged variables equal the previous fiscal year's actual value divided by potential GDP, except for the lagged debt-GDP ratio which divides debt by actual GDP as in Bohn (1998) and except for the lagged output gap (defined to be positive when output is below potential) which equals the difference between CBO's estimate of actual and potential GDP as a share of potential GDP in the last full quarter preceding the period. Real interest equals interest minus the inflation rate times the prior year's debt.

Table 2: Fiscal Feedback in Practice

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

	Primary surplus	Revenues	Primary outlays	Primary surplus	Primary surplus	Primary surplus	Primary surplus
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Projected surplus	-0.146	-0.060	0.086				-0.205
	(0.028)	(0.023)	(0.021)				(0.050)
Projected debt-GDP ratio change				0.111			
				(0.055)			
Projected debt-GDP ratio					0.015		-0.014
					(0.006)		(0.008)
Lagged debt-GDP ratio						0.011	
						(0.009)	
Lagged output gap	-0.133	-0.053	0.081	-0.083	-0.046	0.036	-0.128
	(0.035)	(0.026)	(0.021)	(0.063)	(0.047)	(0.027)	(0.033)
Constant	-0.002	-0.001	0.001	0.001	-0.005	-0.005	0.002
	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.004)	(0.002)
N	38	38	38	38	38	38	38
r2	0.47	0.33	0.36	0.16	0.18	0.07	0.51

(b) Years 2004 through 2024

	Primary surplus	Revenues	Primary outlays	Primary surplus	Primary surplus	Primary surplus	Primary surplus
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Projected surplus	0.027	-0.015	-0.042				0.024
	(0.069)	(0.028)	(0.061)				(0.075)
Projected debt-GDP ratio change				-0.097			
				(0.129)			
Projected debt-GDP ratio					-0.001		-0.000
					(0.004)		(0.004)
Lagged debt-GDP ratio						0.000	
						(0.005)	
Lagged output gap	-0.108	-0.045	0.063	-0.114	-0.121	-0.124	-0.109
	(0.057)	(0.033)	(0.057)	(0.060)	(0.052)	(0.052)	(0.057)
Constant	-0.002	-0.002	-0.000	-0.002	-0.002	-0.003	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.003)	(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: This table reports coefficients from linear regressions of the column's listed outcome on the covariates with coefficients listed, with robust standard errors reported in parentheses. See the notes to Table 1 for variable definitions. 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: Additional Robustness of Fiscal Feedback in Practice Results

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

	Primary surplus											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Projected surplus	-0.146	-0.147		-0.114		-0.113		-0.173		-0.129	-0.120	-0.120
	(0.028)	(0.028)		(0.075)		(0.049)		(0.054)		(0.043)	(0.030)	(0.030)
Lagged surplus			-0.127	-0.031								
			(0.023)	(0.060)								
Lagged primary surplus					-0.146	-0.040						
					(0.029)	(0.049)						
Lagged interest							0.386	-0.121				
							(0.131)	(0.156)				
Lagged real interest									0.431	0.099		
									(0.114)	(0.139)		
Control for lagged output gap	X		X	X	X	X	X	X	X	X	X	X
Control for lagged output gap quartic		X										
Exclude recession years											X	
Exclude expanded recession years												X
N	38	38	38	38	38	38	38	38	38	38	32	32
r2	0.47	0.48	0.44	0.47	0.42	0.48	0.26	0.48	0.29	0.48	0.36	0.36

(b) Years 2004 through 2024

	Primary surplus											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Projected surplus	0.027	0.063		-0.063		-0.054		0.003		0.036	0.029	-0.054
	(0.069)	(0.089)		(0.116)		(0.114)		(0.078)		(0.074)	(0.073)	(0.043)
Lagged surplus			0.049	0.076								
			(0.052)	(0.086)								
Lagged primary surplus					0.050	0.073						
					(0.056)	(0.091)						
Lagged interest							-0.312	-0.303				
							(0.406)	(0.447)				
Lagged real interest									-0.071	-0.078		
									(0.049)	(0.063)		
Control for lagged output gap	X		X	X	X	X	X	X	X	X	X	X
Control for lagged output gap quartic		X										
Exclude recession years											X	
Exclude expanded recession years												X
N	40	40	40	40	40	40	40	40	40	40	35	23
r2	0.15	0.24	0.18	0.19	0.18	0.18	0.16	0.16	0.16	0.17	0.17	0.05

Notes: This table adds or removes covariates from, or applies sample restrictions to, the specification underlying Table 2 column 1, reprinted here in column 1. Column 2 controls for a quartic in the lagged output gap. Columns 3, 5, 7, and 9 remove the projected surplus covariate and add lagged annual surplus, primary surplus, interest, and real interest as a share of potential GDP, respectively. Real interest equals interest minus the inflation rate times the prior year's debt. Columns 4, 6, 8, and 10 repeat columns 3, 5, 7, and 9 with the projected surplus covariate. Column 11 excludes observations from any fiscal year with a month during which the United States was in recession: 1990-1991, 2001, 2008-2009, and 2020. Column 12 additionally excludes observations from the 2010-2014 and 2021 fiscal years.

Table 4: 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
Percentile								
1^{th}	-19.6	-11.6	-8.6	-6.2	-5.1	-4.2	-2.5	-2.1
5^{th}	-13.0	-7.2	-6.3	-4.4	-4.0	-3.4	-2.4	-2.0
10^{th}	-7.6	-5.0	-4.0	-3.4	-3.2	-2.3	-2.3	-1.9
25^{th}	-4.3	-2.9	-2.6	-2.0	-1.8	-1.9	-1.9	-1.6
50^{th}	-1.4	-0.4	-0.2	-0.0	0.0	-0.6	-0.9	-0.8
75^{th}	2.2	1.6	1.2	1.2	0.9	0.7	0.4	0.3
90^{th}	8.0	4.3	3.9	2.9	2.4	1.5	1.5	0.9
95^{th}	12.2	7.2	5.9	3.7	2.8	1.7	1.6	1.2
99^{th}	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 $\rho_t = (r_t - g_t)/(1 + g_t)$ in percentage points using different time horizons over years 1792-2023. g_t denotes the nominal GDP growth rate in year t while r_t denotes the average nominal interest on government debt in year t. For each time horizon N, each underlying observation equals the mean of ρ_t over years $[t - N + 1, t]$, for all years t such that $(t - N + 1), t \in [1792, 2023]$. For example, the earliest value underlying the final column equals the mean of ρ_t over years [1791,1890] and the latest value equals the mean of ρ_t over years [1924,2023].

Table 5: Autoregressivity of the Excess Interest Rate

	(1) 1972-2023	(2) 1793-2023	(3) 1900-2023	(4) 1985-2023
Lagged excess interest rate	0.576	0.437	0.482	0.264
	(0.121)	(0.077)	(0.127)	(0.149)
Lagged debt/GDP	-0.025	-0.029	-0.022	-0.072
	(0.020)	(0.015)	(0.023)	(0.022)
Constant	0.008	0.005	-0.000	0.037
	(0.010)	(0.007)	(0.013)	(0.011)
N	52	227	124	39
Std. dev. of residuals	0.023	0.066	0.062	0.018

Notes: This table reports coefficients and robust standard errors from regressing the excess interest rate $\rho_t = (r_t - g_t)/(1+g_t)$ on its lagged value, the lagged debt-GDP ratio, and a constant over different sample horizons. See the notes to Table 4 for further details on the excess interest rate.

Table 6: Parameter Values and Descriptions

Parameter	Value	Description
β_0	-.0061	Intercept in excess interest rate equation
β_1	0.576	AR(1) estimate in excess interest rate equation
β_2	0.004	Debt sensitivity in excess interest rate equation
s_u	0.023	Standard deviation of error e_{ut} in excess interest rate equation
a_b	1	Government debt-GDP ratio target in debt-based feedback rule
a_s	-0.025	Underlying ratio of the primary surplus to GDP
ρ_0 and ρ_1	-0.005	Initial value of the excess interest rate
b_0	1	Initial value of debt-GDP ratio
λ	2	Expected number of transitory deficit Poisson shocks e_{st} per 100 years
K_s	0.25	Size of transitory deficit Poisson shock e_{st} as a share of GDP
θ	1, 0	Persistence of fiscal feedback (1 for deficit-based, sudden; 0 for debt-based)
c	0.3	Strength of deficit-based feedback
d	0.05	Strength of debt-based feedback
T	30	Minimum number of years between sudden feedbacks
S	0.015	Change in primary surplus-GDP ratio under sudden feedback

Notes: This table lists parameters of our model, as defined in equations 3-6 and 11-12.

Table 7: 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	0.13	10
200% of GDP	NA	0.07	12
250% of GDP	0.14	0.05	12
500% of GDP	0.05	0.04	13

Notes: Each cell represents the minimum feedback strength needed to keep the debt-GDP ratio below the column's critical value, either under certainty (panel a) or under risk for 95% of simulations (panel b). For deficit-based and debt-based feedback, respectively, the lowest value of c or d in the domain $\{0, 0.01, ..., 1\}$ is chosen. For sudden feedback, the highest value of T from the domain $\{0, 1, ..., 100\}$ is chosen. An "NA" value indicates that no value from the domain achieves success.

Table 8: What Does Fiscal 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
A. Primary surplus												
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=0.14)	-2.8	-2.0	-1.3	-1.5	-1.1	-1.3	-1.1	-1.1	-1.4	-1.0	-1.7	-1.5
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
B. Debt												
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=0.14)	101.3	103.2	104.5	105.9	106.8	107.8	108.5	109.4	110.5	111.2		
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 reprints 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-based 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 – Alternative Samples

(a) Years 2004 through 2024 (including the second period of 2020)

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	0.115	0.006	-0.109				0.081
	(0.111)	(0.035)	(0.089)				(0.093)
Projected debt-GDP ratio change				-0.243			
				(0.182)			
Projected debt-GDP ratio					-0.008		-0.005
					(0.008)		(0.007)
Lagged debt-GDP ratio						-0.005	
						(0.007)	
Lagged output gap	-0.000	-0.020	-0.020	-0.044	-0.046	-0.056	-0.007
	(0.123)	(0.040)	(0.102)	(0.106)	(0.092)	(0.088)	(0.118)
Constant	-0.001	-0.002	-0.001	-0.003	0.001	-0.002	0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.004)	(0.003)	(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 (excluding the second period of 2020)

	Primary surplus (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (7)
Projected surplus	-0.040	-0.024	0.016				-0.102
	(0.040)	(0.015)	(0.034)				(0.047)
Projected debt-GDP ratio change				0.022			
				(0.060)			
Projected debt-GDP ratio					-0.004		-0.009
					(0.003)		(0.004)
Lagged debt-GDP ratio						-0.005	
						(0.004)	
Lagged output gap	-0.137	-0.055	0.082	-0.114	-0.084	-0.091	-0.144
	(0.051)	(0.025)	(0.050)	(0.052)	(0.044)	(0.040)	(0.051)
Constant	-0.002	-0.001	0.001	-0.001	0.001	0.001	0.001
	(0.001)	(0.000)	(0.001)	(0.001)	(0.002)	(0.002)	(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 the second period of 2020)

	Primary surplus	Revenues	Primary outlays	Primary surplus	Primary surplus	Primary surplus	Primary surplus
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Projected surplus	0.027	-0.008	-0.035				-0.075
	(0.075)	(0.022)	(0.058)				(0.060)
Projected debt-GDP ratio change				-0.067			
				(0.106)			
Projected debt-GDP ratio					-0.010		-0.013
					(0.007)		(0.006)
Lagged debt-GDP ratio						-0.009	
						(0.006)	
Lagged output gap	-0.051	-0.034	0.016	-0.042	-0.025	-0.048	-0.067
	(0.099)	(0.031)	(0.082)	(0.099)	(0.074)	(0.059)	(0.092)
Constant	-0.002	-0.001	0.001	-0.002	0.003	0.003	0.003
	(0.001)	(0.000)	(0.001)	(0.001)	(0.003)	(0.002)	(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

Notes: This table replicates Table 2a, except that each panel varies the sample as specified in the panel title.

Table A-2: Underlying CBO Sources for Each Fiscal Feedback Observation

Observation	Source(s) of legislated surplus change	Source of projected surplus
1981a	Jul 1981	
1983a	Mar 1983	Jul 1981
1984a	Jan 1984	Mar 1983
1984b	Feb 1984, Aug 1984	Jan 1984
1985a	Feb 1985	Aug 1984
1985b	Aug 1985	Feb 1985
1986a	Feb 1986	Aug 1985
1986b	Aug 1986	Feb 1986
1987a	Feb 1987	Aug 1986
1987b	Mar 1987, Aug 1987	Feb 1987
1988a	Feb 1988	Aug 1987
1988b	Mar 1988, Aug 1988	Feb 1988
1989a	Jan 1989	Aug 1988
1989b	Feb 1989, Aug 1989	Jan 1989
1990a	Jan 1990	Aug 1989
1990b	Feb 1990, Jun 1990	Jan 1990
1991a	Jan 1991	Jun 1990
1991b	Feb 1991, Aug 1991	Jan 1991
1992a	Jan 1992	Aug 1991
1992b	Mar 1992, Aug 1992	Jan 1992
1993a	Jan 1993	Aug 1992
1993b	Mar 1993, Sep 1993	Jan 1993
1994a	Jan 1994	Sep 1993
1994b	Mar 1994, Aug 1994	Jan 1994
1995a	Jan 1995	Aug 1994
1995b	Apr 1995, Aug 1995	Jan 1995
1996a	Dec 1995	Dec 1995
1996b	Apr 1996	Dec 1996
1997a	Jan 1997	Apr 1996
1997b	Mar 1997, Sep 1997	Jan 1997
1998a	Jan 1998	Sep 1997
1998b	Mar 1998, Aug 1998	Jan 1998
1999a	Jan 1999	Aug 1998
1999b	Mar 1999, Jul 1999	Jan 1999
2000a	Jan 2000	Jul 1999
2000b	Apr 2000, Jul 2000	Jan 2000
2001a	Jan 2001	Jul 2000
2001b	May 2001, Aug 2001	Jan 2001
2002a	Jan 2002	Aug 2001
2002b	Mar 2002, Aug 2002	Jan 2002
2003a	Jan 2003	Aug 2002
2003b	Mar 2003, Aug 2003	Jan 2003
2004a	Jan 2004	Aug 2003
2004b	Mar 2004, Sep 2004	Jan 2004
2005a	Jan 2005	Sep 2004
2005b	Mar 2005, Aug 2005	Jan 2005
2006a	Jan 2006	Aug 2005
2006b	Mar 2006, Aug 2006	Jan 2006
2007a	Jan 2007	Aug 2006
2007b	Mar 2007, Aug 2007	Jan 2007
2008a	Jan 2008	Aug 2007
2008b	Mar 2008, Aug 2008	Jan 2008
2009a	Jan 2009	Aug 2008
2009b	Mar 2009, Aug 2009	Jan 2009
2010a	Jan 2010	Aug 2009
2010b	Mar 2010, Aug 2010	Jan 2010
2011a	Jan 2011	Aug 2010
2011b	Mar 2011, Aug 2011	Jan 2011
2012a	Jan 2012	Aug 2011
2012b	Mar 2012, Aug 2012	Jan 2012
2013a	Feb 2013	Aug 2012
2013b	May 2013	Feb 2013
2014a	Feb 2014	May 2013
2014b	Apr 2014, Aug 2014	Feb 2014
2015a	Jan 2015	Aug 2014
2015b	Mar 2015, Aug 2015	Jan 2015
2016a	Jan 2016	Aug 2015
2016b	Mar 2016, Aug 2016	Jan 2016
2017a	Jan 2017	Aug 2016
2017b	Jun 2017	Jan 2017
2018a	Apr 2018	Jun 2017
2018b	May 2018	Apr 2018
2019a	Jan 2019	May 2018
2019b	May 2019, Aug 2019	Jan 2019
2020a	Jan 2020	Aug 2019
2020b	Mar 2020, Sep 2020	Jan 2020
2021a	Feb 2021	Sep 2020
2021b	Jul 2021	Feb 2021
2022a	May 2022	Jul 2021
2023a	Feb 2023	May 2022
2023b	May 2023	Feb 2023
2024a	Feb 2024	May 2023
2024b	Jun 2024	Feb 2024

Notes: This table documents the CBO sources underlying each observation in the fiscal feedback used in Tables 1-3. The suffix "a" denotes a fiscal year's first period observation while the suffix "b" denotes a second period observation. CBO sometimes updates its budget outlook three times per year rather than two. In such cases, we sum the legislated surplus changes across two reports, as specified in the second column. We follow Auerbach (2003) in not using the observations preceding 1984b.