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Robust Fiscal Stabilization

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-to-GDP ratio below 250 percent 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 percent of GDP. When considering large transitory deficit shocks like the COVID-19 pandemic and persistent interest rate shocks, keeping the debt ratio below 250 percent with 95 percent probability requires stronger gradual feedback—0.5–1.1 percent 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 percent 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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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 percent of GDP would stabilize the debt-to-GDP ratio over the next thirty 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 percent of GDP deficit reduction appears extremely unlikely. The most ambitious proposals typically seek less deficit reduction, such as the 0.9 percent 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-to-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 the 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 percent of GDP higher deficit conditional on the lagged output gap, Congress enacted deficit reduction equal to 0.15 percent 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-to-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 percent of GDP higher deficit conditional on the lagged output gap, Congress during the 2004–2024 period enacted deficit reduction equal to –0.03 percent of GDP (i.e., insignificantly increased the deficit), with a 95 percent 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-to-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—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 US 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 rate 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-to-GDP ratio. We make this choice in order to focus on the government's reaction function within the 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 percent 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 percent stability criterion. Translating our findings into current policy, we consider what the ten-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 ten 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 percent of GDP) when real interest payments exceed 2 percent 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 areas in the literature. First, an influential body of literature finds that the US government satisfies its intertemporal budget constraint by reducing the deficit when either the debt-to-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; Friis, Torre, and Buti 2022) and the United States' Gramm-Rudman-Hollings deficit targets of the mid-1980s and targets for discretionary spending and so-called pay-as-you-go (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 2024a; 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 US fiscal path, which can improve the stochastic debt sustainability analyses urged by Blanchard, Leandro, and Zettelmeyer (2021) and Blanchard (2023).

Third, a large body of 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-to-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 percent and 1.1 percent 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.

I. Gradual Fiscal Feedback Has Disappeared

I.A. Design and Data

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

A problem with many estimates of the responsiveness of fiscal policy to the government's fiscal situation is that changes in primary balances do not necessarily reflect active government policy decisions. For example, automatic stabilizers could account for large fluctuations in primary surpluses. For some purposes, such passive fiscal policy reactions should also be taken into account. However, even controlling for the state of the economy—for example, 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 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

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

where t denotes a semiannual period, $\mathbb{E}[s_{t-1}]$ denotes CBO's forecast as of period $t-1$ of the average surplus scaled by potential GDP over the coming five years beginning with period t, Δs_t denotes CBO's estimate at the end of period t of the impact of legislation 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-19 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 percent of GDP over the coming five years.

I.B. 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

1. For observations ending in the winter, the weights used for changes in year $t, t+1, \ldots, t+4$ 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 online appendix, table A-2.

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

Table 1. Summary Statistics for Fiscal Feedback Regressions

	Mean	*p10*	*p50*	*p90*	*Std. dev.*
Panel A. Full sample					
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-to-GDP ratio	0.540	0.283	0.462	0.793	0.228
Projected debt-to-GDP ratio change	0.003	−0.022	0.004	0.022	0.017
Lagged debt-to-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
Panel B. 1984–2003 (original Auerbach 2003 sample)					
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-to-GDP ratio	0.386	0.209	0.405	0.499	0.111
Projected debt-to-GDP ratio change	−0.004	−0.035	0.000	0.021	0.019
Lagged debt-to-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
Panel C. 2004–2024 sample					
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-to-GDP ratio	0.684	0.378	0.738	0.989	0.215
Projected debt-to-GDP ratio change	0.008	−0.003	0.006	0.025	0.011
Lagged debt-to-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

Source: Auerbach (2003) and authors' calculations using the CBO data.

Note: 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 potential GDP. Each observation derives from a 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., noninterest) 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-to-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

	Primary surplus (1)	*Revenues (2)*	*Primary outlays (3)*	*Primary surplus (4)*	*Primary surplus (5)*	*Primary surplus (6)*	*Primary surplus (7)*
Panel A. Years 1984 through 2003 (original Auerbach 2003 period)							
Projected surplus	−0.146	−0.060	0.086				−0.205
	(0.028)	(0.023)	(0.021)				(0.050)
Projected debt-to-GDP ratio change				0.111			
				(0.055)			
Projected debt-to-GDP ratio					0.015		−0.014
					(0.006)		(0.008)
Lagged debt-to-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
r^2	0.47	0.33	0.36	0.16	0.18	0.07	0.51
Panel B. Years 2004 through 2024							
Projected surplus	0.027	−0.015	−0.042				0.024
	(0.069)	(0.028)	(0.061)				(0.075)
Projected debt-to-GDP ratio change				−0.097			
				(0.129)			
Projected debt-to-GDP ratio					−0.001		−0.000
					(0.004)		(0.004)
Lagged debt-to-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
r^2	0.15	0.04	0.14	0.17	0.15	0.14	0.15

Source: Auerbach (2003) and authors' calculations using the CBO data.

Note: 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 online appendix, table A-1.

the key fiscal feedback result: When the projected average surplus over the coming five years rose by 1 percent of GDP, Congress enacted legislation to reduce the average surplus over the coming five years by 0.15 percent of GDP. Given that our observations are semiannual, this indicates that legislation offsets 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 percent of the legislated surplus response derives from a reduction in revenue while 60 percent 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 the results in table 2, panel A, column 1. We use deficit terminology rather than surplus terminology in order to be maximally familiar to readers. Figure 1, panel A, plots residuals from a regression of the legislated primary deficit reduction (i.e., our primary surplus increase dependent variable) on the lagged output gap, versus residuals from a regression of the projected deficit (i.e., the negative of our projected surplus explanatory variable) on the lagged output gap, having added back the respective mean to each. We denote a year's first 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 the –0.15 coefficient in table 2, panel A. The nonparametric relationship appears linear, supporting the assumed linear relationship in equation (1). Moreover, the scatterplot 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 percent of potential GDP, and Congress enacted legislation including outlay reductions and tax increases of similar magnitudes that cumulatively increased the weighted surplus over the five-year window by 0.8 percent of GDP. In the second period of 2001, the projected surplus averaged 2.8 percent 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 percent of GDP.[4]

Also new in this paper, the remaining columns of table 2, panel A, supplement Auerbach (2003) with new specification robustness tests with respect

4. These particular relationships also hold after residualizing with the lagged output gap, as shown in the 1991a and 2001b data points in figure 1, panel A.

Figure 1. Congress Stopped Reducing the Deficit When Projected Deficits Rise

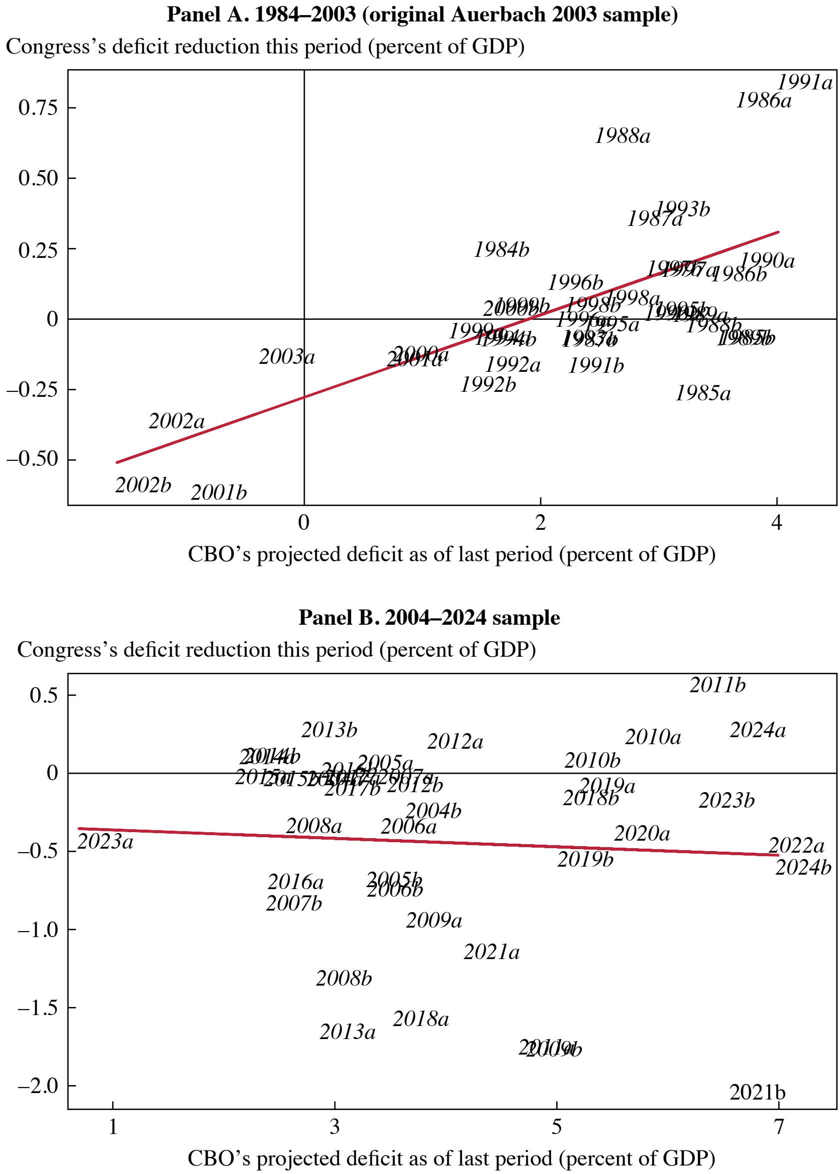
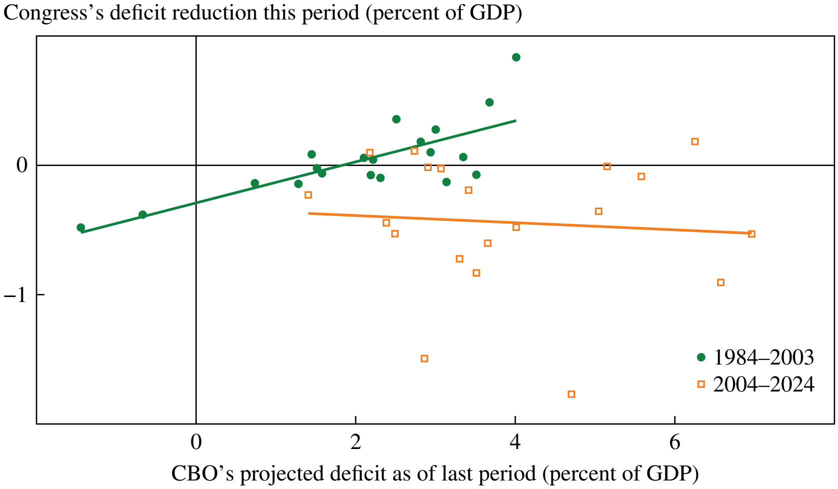


Figure 1. Congress Stopped Reducing the Deficit When Projected Deficits Rise (*Continued*)

Panel C. Both samples



Source: Auerbach (2003) and authors' calculations using the CBO data.

Note: 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.

to projected fiscal conditions and the debt-to-GDP ratio. Columns 4–6 replace projected surpluses with the projected change in the debt-to-GDP ratio between t and $t + 4$, the projected $t + 4$ debt-to-GDP ratio, and the lagged debt-to-GDP ratio, respectively. Column 7 adds the projected $t + 4$ debt ratio to the column 1 specification.

Column 5 finds the result, similar to Bohn's, that the projected debt-to-GDP ratio positively and significantly predicts legislated changes in the primary surplus. A 10 percent of GDP higher projected $t + 4$ debt ratio was followed on average by a 0.15 percent 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 2, panel A, reports a robust negative relationship between the lagged output gap and the projected surplus. When the lagged output gap is 1 percent of GDP larger (i.e., GDP is 1 percent more below potential), Congress enacted legislation that reduced the average surplus over the coming five years by 0.13 percent 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 3, panel A, column 1, reproduces the key result in table 2, panel A, column 1, 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]

5. The original CBO data contain the data necessary to test how well the projected primary surplus, projected interest, or projected real interest predicts legislated surplus changes. However, those data were not digitized by Auerbach (2003), have not been digitized by CBO as of this writing, and were not otherwise available to us in time for such tests.

Table 3. Additional Robustness of Fiscal Feedback in Practice Results

	Primary surplus											
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Panel A. Years 1984 through 2003 (original Auerbach 2003 period)												
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
r^2	0.47	0.48	0.44	0.47	0.42	0.48	0.26	0.48	0.29	0.48	0.36	0.36

(*continued on next page*)

Table 3. Additional Robustness of Fiscal Feedback in Practice Results (*Continued*)

	Primary surplus											
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Panel B. Years 2004 through 2024												
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	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
r^2	0.15	0.24	0.18	0.19	0.18	0.18	0.16	0.16	0.16	0.17	0.17	0.05

Source: Auerbach (2003) and authors' calculations using data from CBO.

Note: 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.

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 11 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.

I.C. 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 1, panel B, repeats the analysis of figure 1, panel A, 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-19 pandemic) as discussed above.[6] Figure 1, panel B, 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 2, panel B, 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 online appendix, table A-1, panel A). The 95 percent confidence interval in table 2, panel B, column 1, rejects the 1984–2003 estimate of −0.15 in table 2, panel A, column 1.

The various permutations in the remaining columns of table 2, panel B, confirm no statistically significant relationship remains. The additional robustness checks in table 3, panel B, 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 percent confidence interval continues to reject the 1984–2003 estimate.

6. Results for the full sample period 1984–2024 are shown in the online appendix, table A-1, panels B and C.

Figure 1, panel C, 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 1.5–4 percent of GDP and exhibit differently sloped relationships with the outcome in that overlapping range.

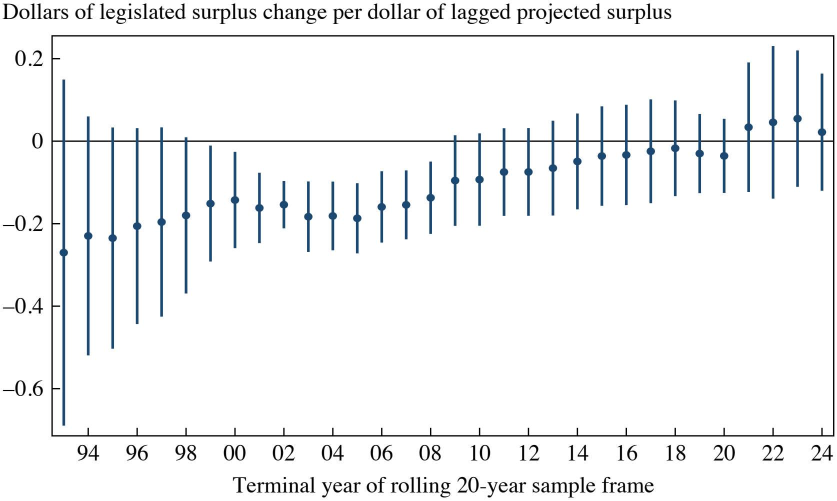
Figure 2, panel A, repeats the analyses presented in table 2, column 1, for different rolling time periods of up to twenty years. Specifically, the 2003 value plots the point estimate and 95 percent confidence interval from the first period of 1984 through the second period of 2003, nearly equaling the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

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

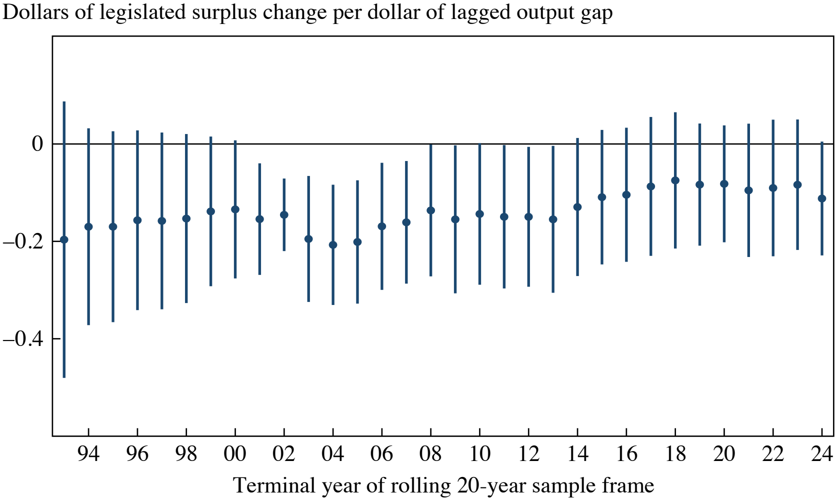
Figure 2, panel B, repeats panel A except for the lagged output gap explanatory variable, rather than the projected surplus explanatory variable. Though not the focus of this paper, panel B shows an analogous result to panel A: The previously substantial and statistically significant relationship between 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-19 pandemic, but balanced against that

Figure 2. Congressional Response by Twenty-Year Rolling Sample

Panel A. Effect of CBO's lagged projected surplus on legislated surplus change



Panel B. Effect of CBO's lagged output gap on legislated surplus change



Source: Auerbach (2003) and authors' calculations using the CBO data.

Note: This figure repeats the specification in table 2, column 1, for different rolling time periods of up to twenty years. Specifically, the 2003 value plots the point estimate and 95 percent confidence interval from the first period of 1984 through the second period of 2003, nearly equaling the result in table 2, panel A, column 1, 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.

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 from 2000 to 2020 except for a spike during the first Obama administration. We leave testing this and other hypotheses and their underlying causes to future work.

II. 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-to-GDP ratio. To see this, note that the debt-to-GDP ratio evolves according to the following relationship:

(2) $$\triangle b_t = \rho_t b_{t-1} - s_t,$$

where b_t is the debt-to-GDP ratio at the end of year t, $\triangle b_t$ equals the debt-to-GDP ratio change $b_t - b_{t-1}, \rho_t \equiv \dfrac{r_t - g_t}{1 + g_t}$ equals the excess interest rate

7. We thank our discussant William Gale for emphasizing its value.

(Yagan 2024) where r_t is the nominal interest rate in year t, 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-to-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-to-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-to-GDP ratio feed back into the rate at which the debt-to-GDP ratio increases. To assess the likelihood that the United States will reach a debt-to-GDP ratio that threatens fiscal stability, we use empirical evidence regarding these factors.

II.A. 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 $\triangle b$ equal to zero in equation (2) and letting $-s$ be the constant primary deficit, the long-run debt-to-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

8. This formula abstracts from what CBO calls "other means of financing," which is usually minor; see table 1-3 in CBO (2024b). Other means of financing include changes to loan present values under the Federal Credit Reform Act of 1990 as well as changes to the Treasury's cash balances such as during and after "extraordinary measures" to avoid debt ceiling default.

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 for 1962–2023 come from CBO's historical data series.[9] For years 1792–1961, the 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.

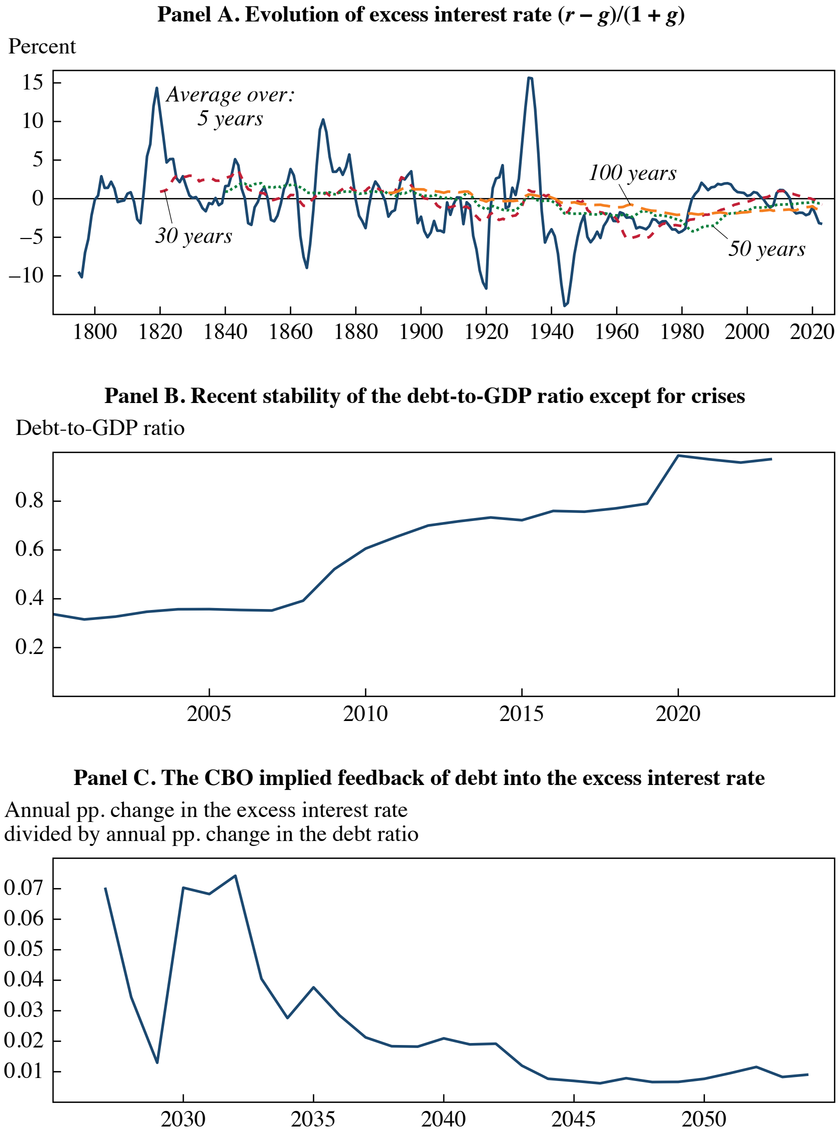
Figure 3, panel A, plots rolling averages of the excess interest rate in the United States since its founding. Annual values fluctuate greatly, in particular because of recessions. Long-term means of the excess interest rate matter most for debt sustainability. The graph plots the excess interest rate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

Over five-year periods, the excess interest rate fluctuated greatly. For example, it rose dramatically in the Great Depression, fell dramatically after World War II, and rose again during the Volcker disinflation (Hall and Sargent 2011). The five-year series shows that the variance in the excess interest rate declined dramatically in recent decades, perhaps because of the 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 1792–2023. 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 percent (i.e., –0.4 percentage points), the median has been 0.0 percent, the 5th percentile has been –4.0 percent, and the 95th percentile has been 2.8 percent. 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

9. CBO, *The Budget and Economic Outlook: 2024 to 2034*, under "Historical Budget Data: Feb 2024" (Washington: Congressional Budget Office, 2024), https://www.cbo.gov/publication/59710.

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



Source: Authors' calculations using data from CBO, Wallis (2000), and Bureau of Economic Analysis.

Note: Panel A plots various rolling averages of the excess interest rate $(r_t - g_t)/(1 + g_t)$ from 1792 to 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-to-GDP ratio over time. Panel C plots the implied feedback of the debt-to-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-to-GDP ratio between $t - 1$ and $t - 2$.

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								
1st	−19.6	−11.6	−8.6	−6.2	−5.1	−4.2	−2.5	−2.1
5th	−13.0	−7.2	−6.3	−4.4	−4.0	−3.4	−2.4	−2.0
10th	−7.6	−5.0	−4.0	−3.4	−3.2	−2.3	−2.3	−1.9
25th	−4.3	−2.9	−2.6	−2.0	−1.8	−1.9	−1.9	−1.6
50th	−1.4	−0.4	−0.2	−0.0	0.0	−0.6	−0.9	−0.8
75th	2.2	1.6	1.2	1.2	0.9	0.7	0.4	0.3
90th	8.0	4.3	3.9	2.9	2.4	1.5	1.5	0.9
95th	12.2	7.2	5.9	3.7	2.8	1.7	1.6	1.2
99th	24.2	14.4	8.5	4.2	3.0	2.0	1.8	1.3

Source: Authors' calculations using data from CBO, Wallis (2000), and Bureau of Economic Analysis.

Note: 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. The term 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 [1792, 1890] and the latest value equals the mean of ρ_t over years [1924, 2023].

estimated did not include debt-to-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.

II.B. Budget Shocks

Current forecasts of the federal budget outlook (e.g., CBO 2024b) suggest relatively stable primary surpluses as a share of GDP and a smoothly rising debt-to-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-to-GDP ratio, albeit one with a steeper slope. However, the debt-to-GDP ratio over the past two decades has behaved quite differently, with periods of relative stability punctuated by very sharp increases.

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

While this may partially reflect the underlying upward trend in the debt-to-GDP ratio (i.e., a period of relative stability of the debt-to-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.[10]

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-to-GDP ratio, along with shocks to the gap between interest rates and growth rates, as sources of uncertainty in the fiscal path.

II.C. The Prospect of Sudden Fiscal Consolidations

Even without gradual legislative feedback as observed for 1984–2003 by 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 percent of GDP when the debt-to-GDP ratio reaches 150 percent of GDP would likely weather any fiscal storm. In our simulations below, we therefore consider not only how likely it is that 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

10. If one looks back further, an additional large jump in the debt-to-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-to-GDP ratio occurred during World War II, as the debt-to-GDP ratio jumped to its historical high of greater than 100 percent. But this was followed by a period of rapid decline in the debt-to-GDP ratio, due in part to a policy of financial repression; see Hall and Sargent (2011). Thus, the jumps in the debt-to-GDP ratio associated with the past two recessions are the only "clean" episodes of this type of outcome in the past century. They are also the only two to have occurred during the "modern" period in which a substantial share of government spending is accounted for by social insurance.

advanced nations. Alesina and others (2018) update and refine the compilation of fiscal consolidations across the Organisation for Economic Co-operation and Development (OECD) for 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, Alesina and others (2018) in their data list the United States as having reduced the deficit by 4.4 percent 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 I identifies only 1.4 percent in cumulative deficit reduction on net across all legislation enacted 1990–1998.[11]

In the CBO data for 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 percent of GDP.[12] Moreover, that deficit reduction was not undone by new legislation over the subsequent decade.[13] Hence, deficit reduction equal to 2 percent of GDP was historically feasible in the United States. We use this finding in the simulations below.

III. Modeling the US Fiscal Trajectory

In this section, we develop a model to simulate the distribution of paths for the debt-to-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-to-GDP ratio within a certain period of time.

11. Note that these figures are not exactly comparable as their timing definitions differ.

12. 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.

13. Though the Budget Enforcement Act of 1990 replaced the Gramm-Rudman-Hollings spending caps with an alternative PAYGO 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.

III.A. The Model

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

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

where $\rho_t = \dfrac{r_t - g_t}{1 + g_t}$ is the excess interest rate defined in the previous section and e_s is a Poisson shock to the debt-to-GDP ratio, meant to represent the occurrence of a rare event that causes a jump in the debt-to-GDP ratio. This expression is the same as the standard law of motion for the debt-to-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 onetime shocks to the budget.

We parameterize the Poisson shock e_s to have an expected frequency λ of two shocks per one hundred years. We choose two to correspond to those shocks during the past century during which the debt-to-GDP ratio (and debt-to-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-to-GDP ratio during these two historical episodes:

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

The resulting value is 0.25, which we use in our simulations below.[14] That is, our simulations assume that on average there are two times per century when the debt-to-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-to-GDP ratio on interest rates, we add to our specification the lagged debt-to-GDP ratio. That is, the term ρ evolves according to the relationship:

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

14. We also obtain 0.25 when detrending, that is, when we compute the average increase net of the increase that would have occurred had the annual changes in the debt-to-GDP ratio during the shock period equaled its value in the year immediately prior to the shock.

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-to-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

Source: Authors' calculations.

Note: 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-to-GDP ratio, and a constant over different sample horizons. See the notes to table 4 for further details on the excess interest rate.

*Sample excludes four observations in the 1830s with undefined variables due to debt = 0.

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 1793, since 1900, and during the period since the Volcker disinflation (post-1985), are shown in the remaining columns of the table. For the stochastic term e_u, we assume normality with zero mean and standard deviation equal to the standard error of residuals from the same regression specification. Here, the choice of sample period is very important. We scale the stochastic shocks using the residuals from our baseline specification in column 1. Had we worked with one of the longer samples, the implied standard deviation of our stochastic element would have been nearly three times as large.

Estimates in table 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 –0.005. 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-to-GDP ratio as in Bohn (1998). With these potential feedback rules included, the evolution of the primary surplus follows the following equation:

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

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-to-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 2024b) 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 in how long these changes last.[15] 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-to-GDP ratio.[16]

15. In particular, the feedback estimates based on the 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 administration's tax cuts in 2001 and the Trump administration's tax cuts in 2017, both of which largely phased out at the end of a ten-year budget window and required additional legislation to be extended, which would also be counted as policy responses.

16. 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 θ, are lower than the value estimated by Bohn (1998). However, given that these parameters are estimated over a much shorter sample period and not significant when the projected surplus is included as an explanatory variable, we rely on the estimates and specification in the existing literature.

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-to-GDP ratio, equal to excess interest $\rho_t b_{t-1}$ minus the status quo surplus if there were no fiscal feedback $\theta s_{t-1} - (1 - \theta)\, a_s$.[17] 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-to-GDP ratio, which seems highly unrealistic. We set $a_b = 1$, assuming that fiscal tightening for this specification occurs when the debt-to-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 2, panel A. (We use a value for c approximately double that in the table because those estimates are for the semiannual frequency, that is, 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:

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

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

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

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

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

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

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

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

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.[18] One exception, and it is an important one for our modeling, involves the reaction to the Poisson shocks in the debt-to-GDP ratio. Because we exclude these from our measure of the primary surplus (they are treated as simply causing a jump in the debt itself), there is no direct response to them in the deficit-based feedback described by equation (7); the jump in debt only affects fiscal feedback through its impact on debt service. Because the debt-based feedback in equation (9) relates directly to changes in the debt-to-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-to-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 percent of GDP, based on our previous discussion of empirical evidence on fiscal consolidations, which suggests that a consolidation of this size is historically large but possible. We further assume that consolidations may occur once every T years and that

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

they are triggered when, following Furman and Summers (2020), real debt service is projected to average at least 2 percent of GDP over the next ten years and to be at least 2 percent in the tenth year.[19] So, for example, when real debt service initially breaches this ceiling, a 1.5 percent consolidation will occur. The next consolidation of 1.5 percent 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.[20]

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-to-GDP ratio after one hundred 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 one. 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 percent of fiscal adjustments took the form of taxes and 60 percent 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 versus spending-based fiscal consolidations, as considered by Alesina, Favero, and Giavazzi (2015). Note also that we do not consider the political difficulty of making different types of adjustments, which may be relevant given the shift over time in spending away from discretionary spending, which is subject to an annual appropriations process, toward old-age entitlements, which, absent new legislation, follow existing rules

19. 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 percent and the real growth rate, $g - \pi$, is 1.5 percent.

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

for determining benefits. Auerbach (2006) estimated that, for the period 1963–2004, US 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).[21] 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-to-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 (2024b).[22] We set the initial b_0 and intercept debt-to-GDP ratio a_b equal to one, roughly its current value, and set the initial excess interest rate value ρ_1 equal to -0.005, roughly its average value over the next five fiscal years.[23]

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

IV. Simulation Results

IV.A. 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

21. 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.

22. 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 administration's 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 percent of GDP over the next five years, rather than 2.5 percent (Auerbach and Gale 2024). We consider the larger primary deficit in an alternative specification below.

23. CBO's five-year average value of ρ_t is slightly higher (less negative) than -0.005, but the average debt-to-GDP ratio over this period is also slightly higher than 1.0. Given our assumed feedback of the debt-to-GDP ratio onto ρ, our assumed initial value of ρ is consistent with our assumed initial debt-to-GDP ratio.

Table 6. Parameter Values and Descriptions

Parameter	*Value*	*Description*
β_0	−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-to-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-to-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 occurrences of sudden feedback
S	0.015	Change in primary surplus-to-GDP ratio under sudden feedback

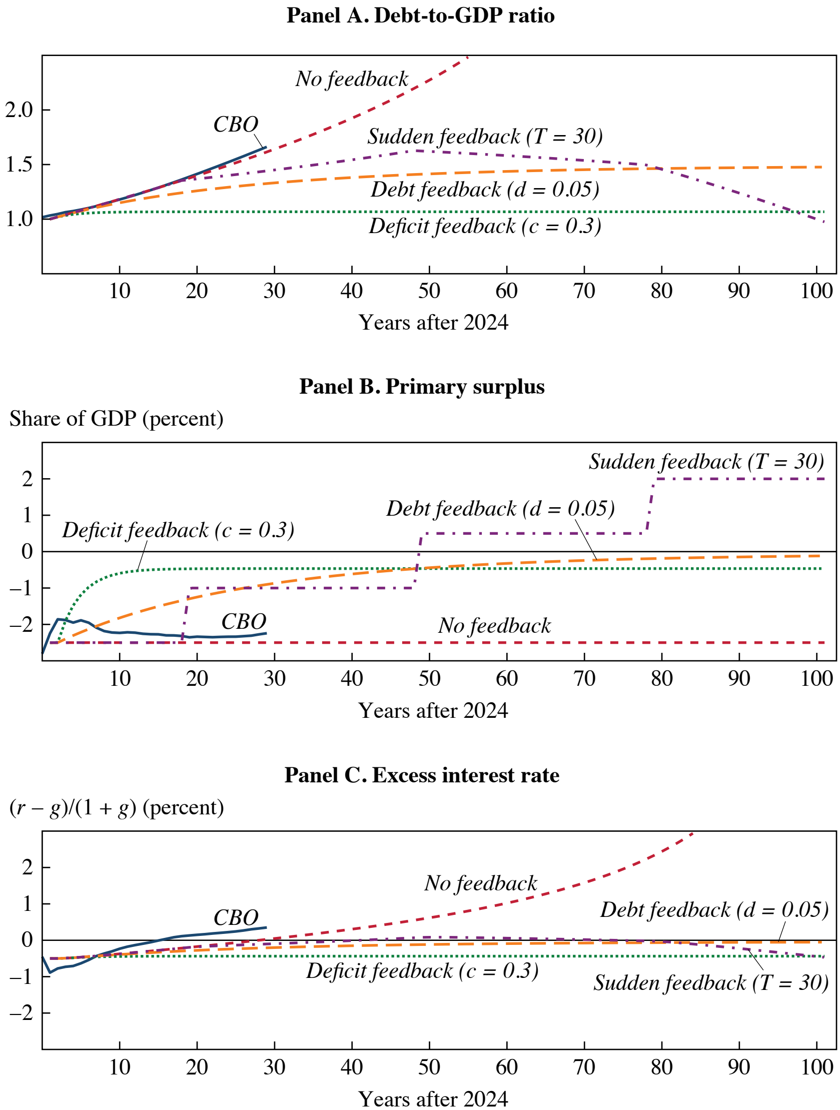
Source: Authors' compilation.
Note: This table lists parameters of our model, as defined in equations (3)–(6) and (11)–(12).

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-to-GDP ratio, and the Poisson shock equals zero as well.

Figure 4, panel A, shows the paths of the debt-to-GDP ratio under this assumption. Also displayed in the figure is the thirty-year path of the debt-to-GDP ratio projected by CBO (2024a). The dashed line labeled "No feedback" is our baseline projection. By construction, this projection follows the CBO projection closely over the next thirty years.[24] In particular, the debt-to-GDP ratios at the end of the thirty-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 these conditions, reflecting the simple relationship between changes in debt and changes in the excess interest rate in the CBO projections, shown in figure 3, panel C, and taking

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

Figure 4. Fiscal Paths Under Certainty



Source: CBO and authors' calculations.

Note: This figure assumes no shocks to the primary deficit or the excess interest and plots fiscal path variables over the coming one hundred 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).

account of the AR(1) structure of the evolution of ρ.[25] Beyond thirty years, the no-feedback simulation shows a steadily growing debt-to-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 4, panel A, show the impact of various feedback policies on the debt-to-GDP ratio. Both types of gradual feedback sharply reduce the growth of debt, with its value barely rising above one for the deficit-driven feedback case ($c > 0$). For the debt-driven feedback case ($d > 0$), the debt-to-GDP ratio rises gradually, approaching 1.5 by the end of the one-hundred-year period. Under the sudden feedback scenario, the debt-to-GDP ratio rises as under the no-feedback case until the real debt service condition is breached after nearly twenty years and at a debt-to-GDP ratio around 1.4, after which the 1.5 percent fiscal consolidation causes the debt-to-GDP ratio to rise less rapidly, until a second fiscal consolidation after another thirty years causes the debt-to-GDP ratio to decline steadily, starting from around 1.6. There is then a third fiscal consolidation after another thirty years, when the debt-to-GDP ratio is around 1.5. With the initial primary deficit of 2.5 percent of GDP, the three consolidations result in an annual primary surplus of 2.0 percent of GDP, which, even with initially elevated values of the debt-to-GDP ratio and hence the excess interest rate, is sufficient to eventually induce a sharp decline in the debt-to-GDP ratio, which accelerates as the debt-to-GDP ratio and hence the excess interest rate fall.[26]

The primary surpluses associated with these debt trajectories are shown in figure 4, panel B. With gradual deficit-driven feedback, the primary deficit falls quickly to around 0.5 percent of GDP, causing the debt-to-GDP ratio to stabilize. Feedback based on the debt-to-GDP ratio takes effect more gradually, because the response is to the debt-to-GDP ratio rather than the large deficits. Only as the debt-to-GDP ratio rises higher does the debt-based feedback strengthen, finally exceeding in strength the deficit-based feedback after about fifty 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-to-GDP ratio under control, the sudden feedback policy does so with a significant lag. Finally, note how

25. 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-to-GDP ratio and understate the severity of fiscal imbalances.

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

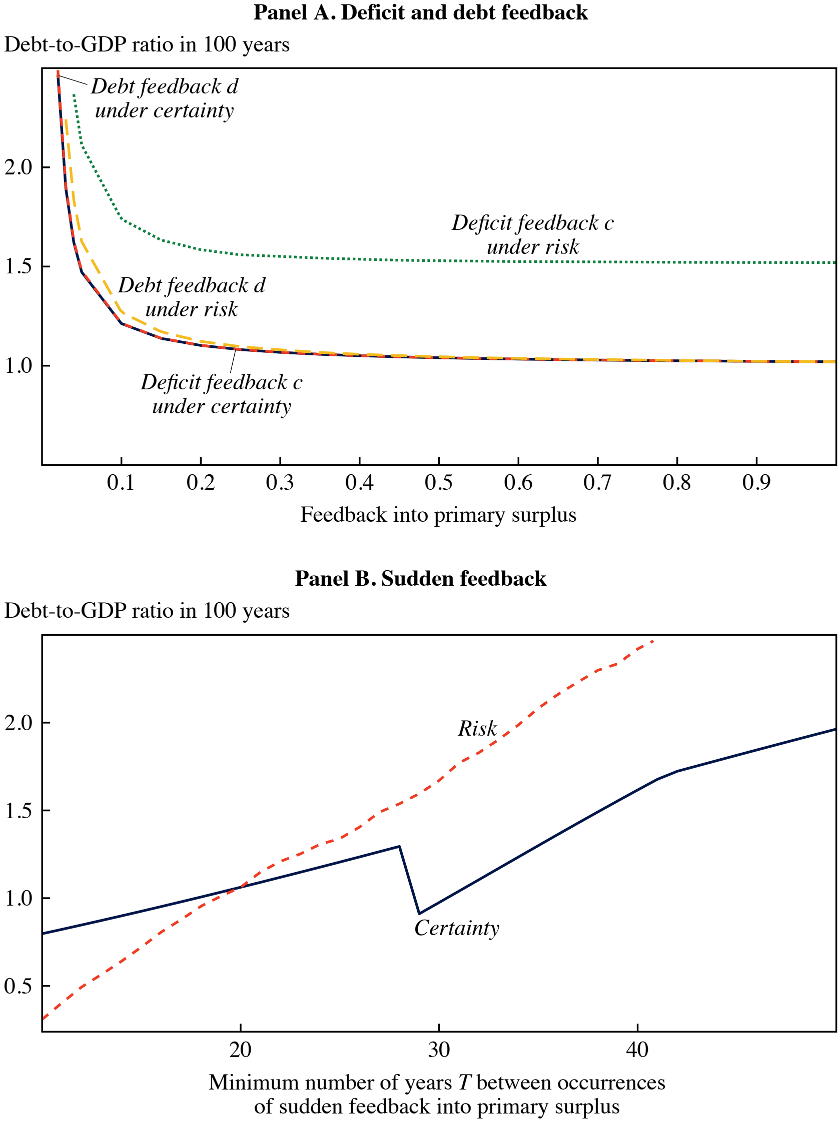
different all of these policies are from the CBO baseline, which shows very little movement in the primary surplus as a share of GDP.

Figure 4, panel C, 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 thirty-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-to-GDP ratio under certainty? Figure 5 considers this by displaying the debt-to-GDP ratio after one hundred years for variations in the key feedback parameters. Figure 5, panel A, 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 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-to-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 5, panel B, shows the terminal debt-to-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 twenty-nine-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 increases 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-to-GDP ratio. Once this jump happens, further increases in the minimum duration between adjustments continue to increase the terminal debt-to-GDP ratio. Eventually, the duration between shocks increases to the point that the number of sudden consolidations falls again, and the terminal debt-to-GDP ratio resumes its original linear increase with respect to the minimum time between sudden fiscal adjustments.

Figure 5. Feedback Sensitivity of Fiscal Paths



Source: Authors' calculations.

Note: This figure plots the year 100 debt-to-GDP ratio values plotted in figure 4, panel A (certainty), and figure 6, panel A (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.

Even with relatively infrequent consolidations being feasible, it is still possible to keep the debt-to-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-to-GDP ratio if it is of sufficient size, emphasizing the importance of the disappearance of fiscal feedback from the US 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.

IV.B. Results with Fiscal Shocks

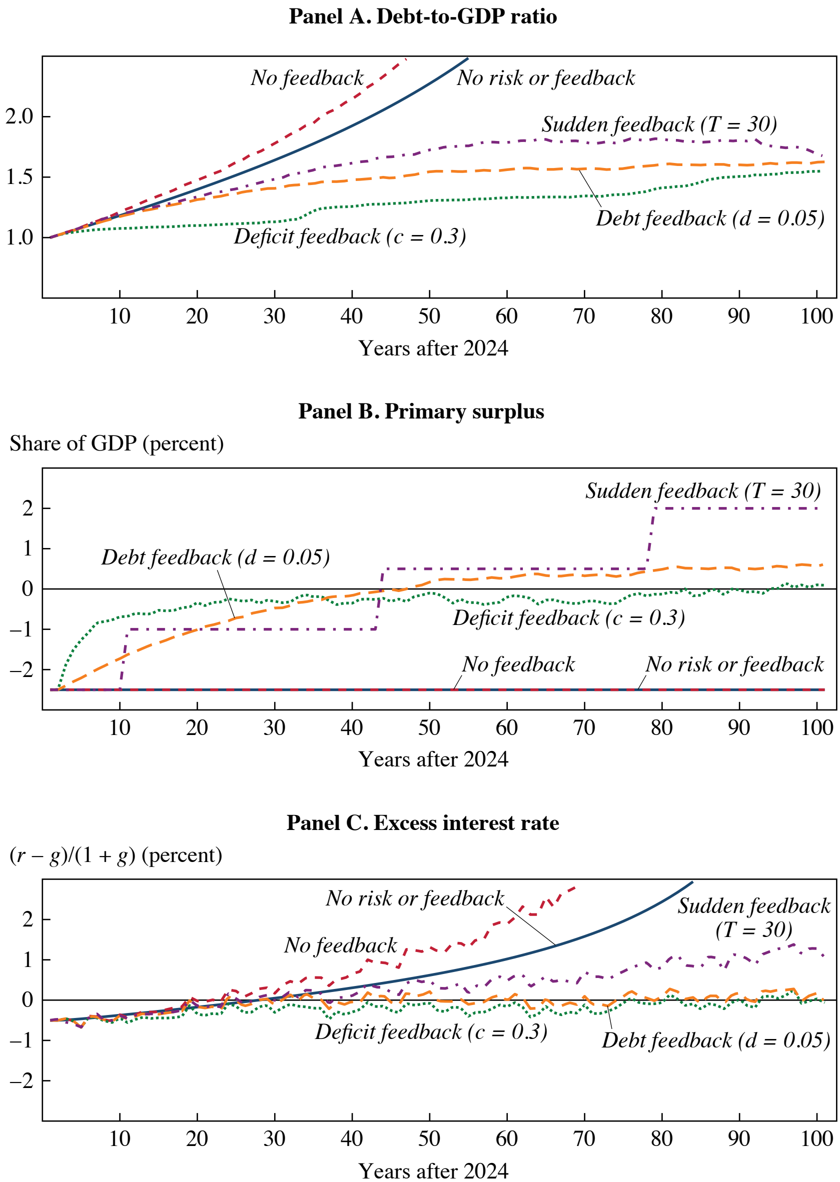
Under certainty, fiscal feedback can stabilize the debt-to-GDP ratio. But how likely is a given strength of feedback still to work once shocks are present?

BASELINE RESULTS Figure 6 provides some initial answers to this question, with the three panels showing median outcomes over the one-hundred-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 one thousand simulations for the given outcome, feedback series, and year. As figure 6, panel A, shows, the median debt-to-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 4, panel A). 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

Figure 6. Fiscal Paths Under Risk



Source: Authors' calculations.

Note: 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 nonzero 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 one thousand simulations.

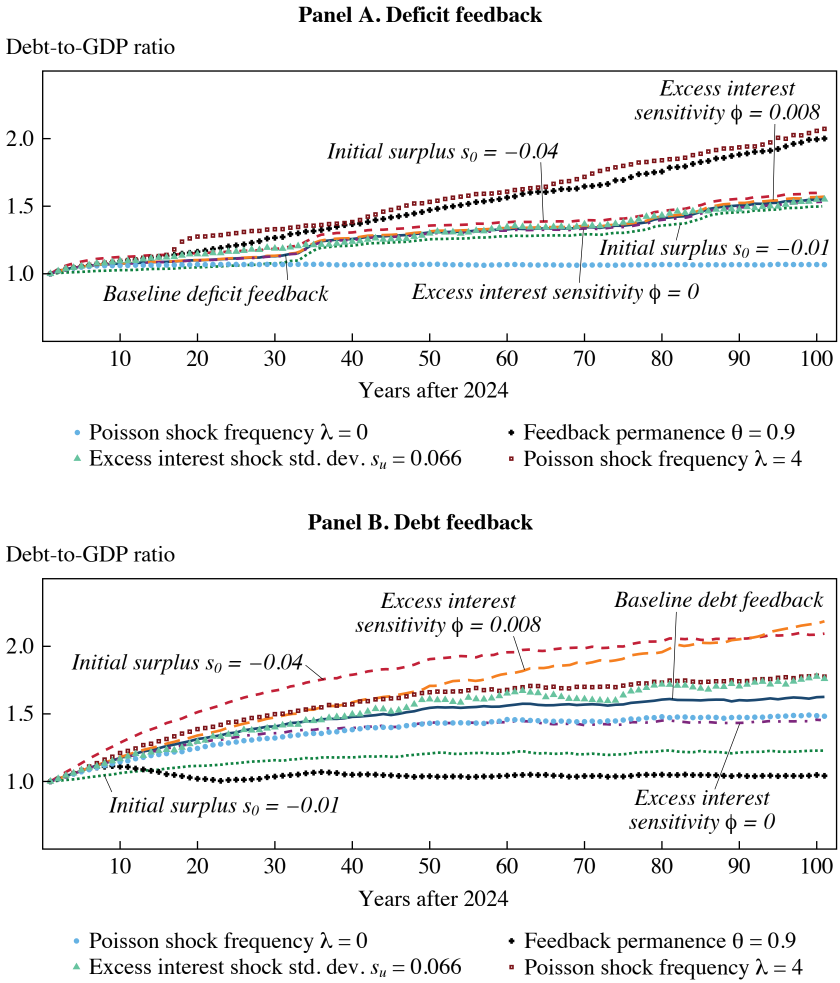
to Poisson shocks. The higher debt-to-GDP ratio generates an increase in the primary surplus only through the reaction to debt service being higher, which is much weaker than a response to the level of debt itself in the previous case. Thus, the median debt-to-GDP ratio rises steadily, reaching roughly the same value as under debt-based gradual feedback after one hundred 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-to-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-to-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 6, panel B. With greater uncertainty, both types of gradual fiscal feedback show higher median values than under certainty, reflecting the less favorable debt-to-GDP trajectories in figure 6, panel A. 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-to-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 6, panel C, 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 4, panel C, for two reasons. First, the median debt-to-GDP paths are different. Second, there are now shocks to the process for ρ, conditional on the debt-to-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 twenty years, when the median debt-to-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-to-GDP ratios.

Figure 7. Sensitivity of Fiscal Paths Under Risk



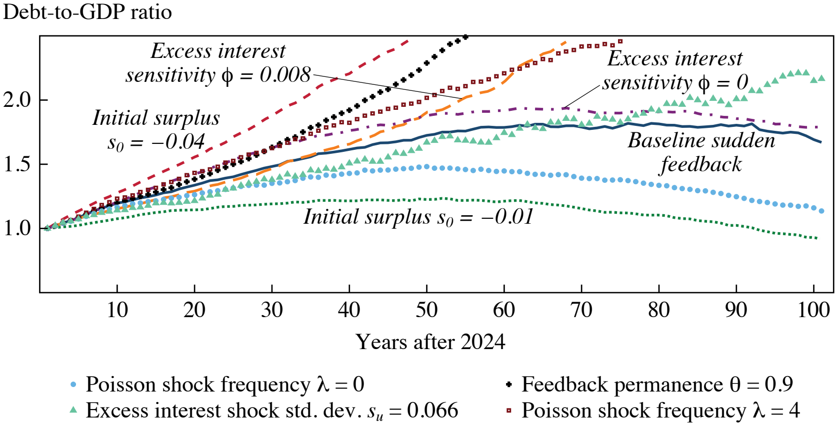
SENSITIVITY ANALYSIS How sensitive are the foregoing results to differences in parameter assumptions?

Figure 7 shows the impact under uncertainty of variations in assumptions about various parameters on the one-hundred-year median trajectory of the debt-to-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

Figure 7. Sensitivity of Fiscal Paths Under Risk (*Continued*)

Panel C. Sudden feedback



Source: Authors' calculations.
Note: This figure replicates figure 6, panel A, except for the following changes. This figure's "Baseline deficit feedback," "Baseline debt feedback," and "Baseline sudden feedback" series equal figure 6, panel A'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 given in the series name.

these shocks entirely ($\lambda = 0$) causes the median debt-to-GDP trajectory to be close to flat, similar to what we saw under certainty in figure 4, panel A. 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-to-GDP ratio exceeding 200 percent 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 $r - g$ 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 stochastic term in the expression for ρ, taken from the value for this term for the full sample (1793–2023) 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 ($\phi = 0.008$) 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-to-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 percent of GDP (to –4 percent or –1 percent) 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 7, panel A, is for the case in which fiscal feedback adjustments decay, where the parameter θ is less than one. Setting $\theta = 0.9$, meaning that about 35 percent of any fiscal change remains after ten 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 5, panel A, shows the impact of variations in the feedback parameter itself on the terminal debt-to-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 7, panel B, 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-to-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 5, panel A, where, unlike for the case of deficit-based adjustment, there is a relatively small rise in the curve that relates the terminal debt-to-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 zero. 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 5, panel A, we see that the presence of risk has relatively little impact on the relationship between the terminal debt-to-GDP ratio and the feedback parameter for the debt-based 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-to-GDP ratio in the presence of risk.

Figure 7, panel C, 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-to-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-to-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-to-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 $\phi = 0.04$, whereas the trajectory for $\phi = 0.08$ 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 5, panel B, shows the median terminal debt-to-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 when adjustments take place. Except at very high frequencies of adjustment, though, the median terminal debt-to-GDP ratio is shifted upward.

V. How Strong Does Fiscal Feedback Need to Be?

V.A. 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 the CBO data s_t^{CBO} in year t during crisis 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 the COVID-19 pandemic 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 noncrisis years, the counterfactual primary surplus under deficit-based feedback equals the actual primary surplus plus two adjustment terms:

$$s_t = s_t^{\mathrm{CBO}} + \triangle s_t + \sum\nolimits_{t'=2001}^{t-1} \triangle s_{t'-1}, \tag{13}$$

where $\triangle s_t$ denotes the deficit-based feedback rule's year t adjustment to s_t^{CBO}; and

(14) $$\triangle s_t = c\left[\rho_t^{\mathrm{CBO}} b_{t-1} - \left(s_t^{\mathrm{CBO}} + \sum\nolimits_{t'=2001}^{t-1} \triangle s_{t'-1}\right)\right],$$

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.[27]

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

(15) $$s_t = s_t^{\mathrm{CBO}} + \triangle\, s_t$$

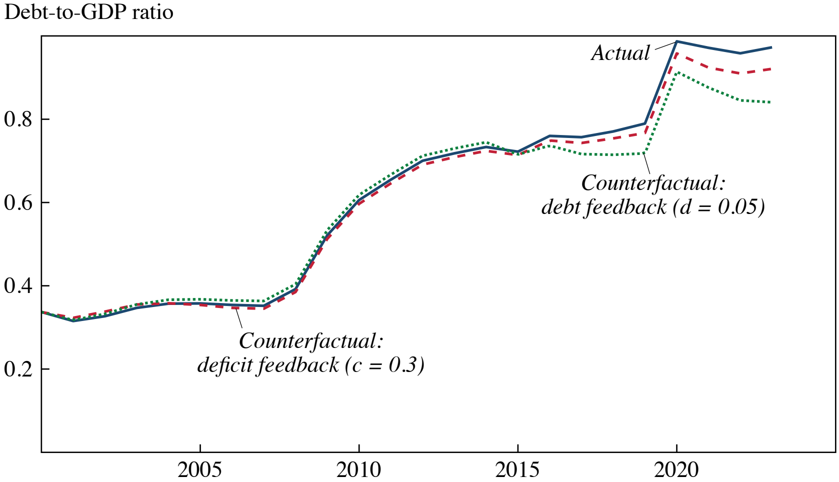
(16) $$\triangle s_t = d\left[b_{t-1} - b_{1999}\right].$$

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

Figure 8 presents the results of this counterfactual exercise, showing the actual evolution of the debt-to-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 $d = 0.05$). Under either alternative path, the current debt-to-GDP ratio would have been noticeably lower. This is especially true for debt-based feedback, which in

27. Our assumption of a fixed excess interest rate rules out a feedback rule reducing the excess interest rate by reducing the debt-to-GDP ratio, which overstates the magnitude of the primary surplus under feedback rules.

Figure 8. Recent Debt Ratio Path Under Counterfactual Fiscal Feedback



Source: CBO and authors' calculations.

Note: This figure plots the debt-to-GDP ratio in actuality 2000–2023 and under counterfactual deficit feedback [equations (13)–(14)] and debt feedback [equations (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.

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 to the debt ratio level via excess interest.

V.B. Avoiding One-Hundred-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? 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-to-GDP ratio that rise to arbitrarily high levels.

We take an alternative approach. We assume that there is a threshold level of the debt-to-GDP ratio that is not plausibly sustainable. That is, we assume that if the United States crosses a very high debt-to-GDP threshold within the next one hundred 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 the authors of 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 US debt-to-GDP ratio was below 0.5, and they considered failure definitions of the debt-to-GDP ratio crossing thresholds of one and 1.5. As we write this paper, the debt-to-GDP ratio is nearly one 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).

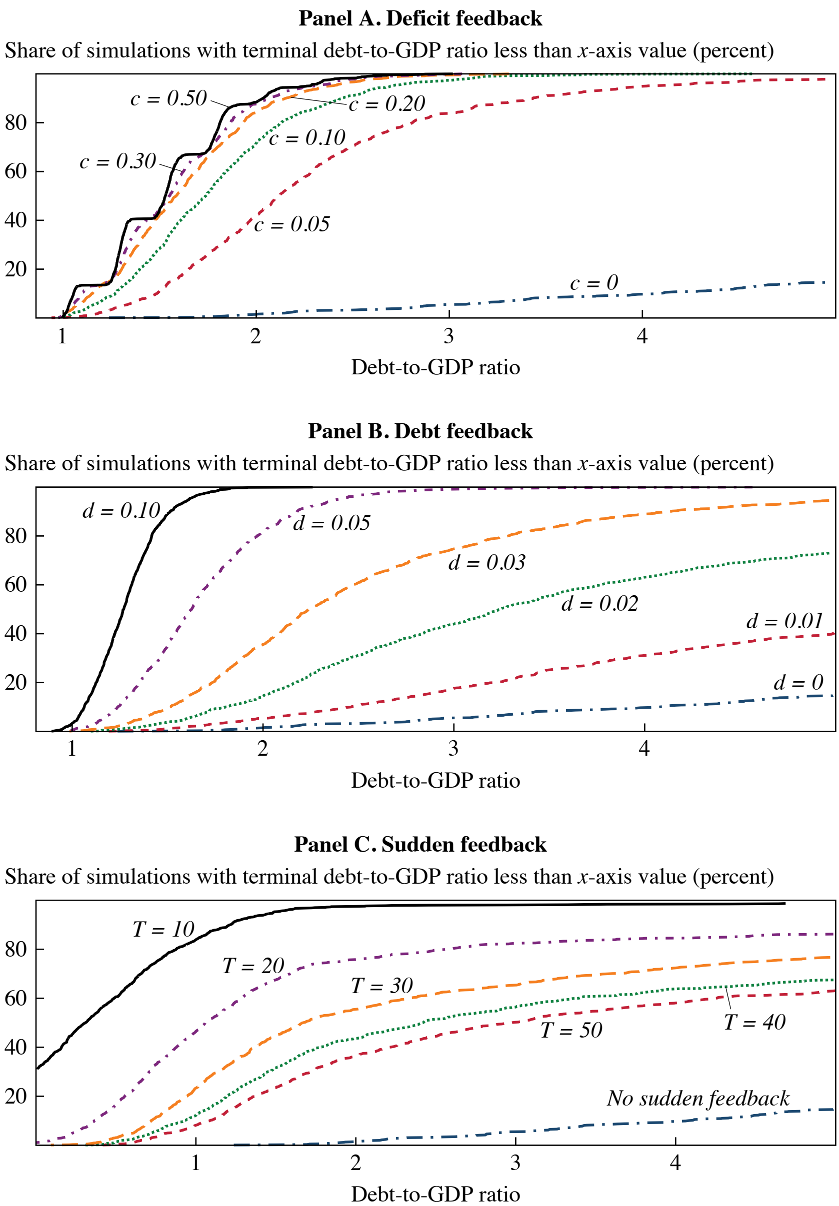
As a start to this analysis, before settling on a particular criterion for assessing success, we consider how likely the debt-to-GDP ratio is to remain under any particular value after one hundred years, for different values of the gradual feedback parameters c and d.

Figure 9, panel A, shows the likelihood of the debt-to-GDP ratio staying below values ranging from one to five after one hundred years for values of the deficit feedback parameter c ranging from zero (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.[28]

Figure 9, panel B, addresses the same question for debt-based gradual feedback for the feedback parameter d ranging from zero (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, $c = 0.30$ and $d = 0.05$ are similar, indicating that not only the median outcomes are similar after one hundred years—as already shown in figure 6, panel A—the distributions of outcomes after one hundred years are similar as well.

28. 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 $c = 0.50$ 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-to-GDP ratio by 0.25.

Figure 9. Cumulative Distributions of the Year 100 Debt-to-GDP Ratio Under Risk



Source: Authors' calculations.

Note: This figure plots the cumulative distribution function of year 100 debt-to-GDP ratios under various feedback parameters. The $c = 0.30$ series of panel A, the $d = 0.05$ series of panel B, and the $T = 30$ series of panel C use the same debt-to-GDP values underlying median debt-to-GDP values plotted in figure 6, panel A.

Table 7. How Strong Does Fiscal Feedback Need to Be?

Panel A. Certainty

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

Panel B. Risk

Success defined as at least 95 percent of simulations with year 100 debt less than (percent of GDP)	*Deficit feedback (1)*	*Debt feedback (2)*	*Sudden feedback (3)*
150	NA	0.13	10
200	NA	0.07	12
250	0.14	0.05	12
500	0.05	0.04	13

Source: Authors' calculations.

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

The analogous results for sudden feedback, shown in figure 9, panel C, 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, that is, once every ten years.

Table 7 considers alternative failure thresholds: the debt-to-GDP ratio exceeding 150 percent, 200 percent, 250 percent, or 500 percent of GDP one hundred 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-to-GDP ratio below 250 percent of GDP, deficit feedback of magnitude $c = 0.02$ is sufficient, while debt feedback of magnitude $d = 0.02$ is sufficient.[29] Both values are considerably smaller

29. The grid over which we search for values of c and d, by steps of 0.01, 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 $c = d$.

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-to-GDP ratio of even 150 percent is lower than every thirty years.

However, the necessary feedback responsiveness is considerably greater, accounting for fiscal shocks, as reported in table 7, panel B. Akin to the 95 percent statistical inference convention, we find the minimum feedback values necessary to prevent failure at least 95 percent of the time. We find that no amount of gradual deficit feedback $c \in [0, 1]$ prevents failure 95 percent of the time when defining failure as keeping the terminal debt-to-GDP ratio below 200 percent of GDP. When using the 250 percent (500 percent) debt-to-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 percent of GDP, but not 200 percent. For the debt-based gradual feedback, success is possible even at lower target debt-to-GDP ratios, but only for values of d above the historical estimate of 0.05 in Bohn (1998). However, this value (just) suffices for target debt-to-GDP ratios of 250 percent and above.

We further find that the minimum frequencies of sudden feedback needed to prevent failure 95 percent of the time are very large, as one would predict based on the results in figure 9. To prevent the debt-to-GDP ratio from rising to 250 percent of GDP, the government needs to be able to implement sudden fiscal consolidation at least as frequently as every twelve 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 one-hundred-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 6, panel A. This highlights the advantage of gradual feedback: As things begin to get out of control, being able to act immediately provides greater insurance against bad outcomes than waiting to make larger adjustments. It also begs the question of whether our conception of the sudden adjustment regime as a wait-and-see approach is really consistent with being able to take action as frequently as would be necessary to meet any of the terminal debt-to-GDP targets in table 7, panel B.

V.C. 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 percent of the time. For table 8, we define failure as the year 100 debt exceeding 250 percent of GDP.

The first row of panel A lists the CBO June 2024 baseline projection for the primary surplus, reproduced from the table 1-1 in CBO (2024b). The primary surplus oscillates between –2.2 percent and –3.1 percent 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-to-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 term $\sum_{t'=2025}^{t-1} \Delta s_{t-1}$ 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 percent of GDP smaller over the decade and 0.4 percent 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-to-GDP ratio of 2.2 percent and 2.3 percent of GDP, respectively.

The third and fifth rows of table 8 consider the stronger feedback needed to keep the debt-to-GDP ratio below 2.5 with a 95 percent 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 percent of GDP smaller over the decade and 1.9 percent of GDP smaller in 2034. Debt feedback of magnitude $d = 0.05$ implies an average primary deficit that is 0.5 percent of GDP smaller over the decade and 0.9 percent of GDP smaller in 2034. Panel B shows corresponding reductions in the 2034 debt-to-GDP ratio of 11.2 percent and 5.2 percent of GDP, respectively.

Table 8. What Does Fiscal Feedback Imply for Ten-Year Policy?

As a percentage of GDP											*Average*	
	2025	*2026*	*2027*	*2028*	*2029*	*2030*	*2031*	*2032*	*2033*	*2034*	*2025–2029*	*2025–2034*
Panel 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
Panel 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		

Source: CBO (2024b, table 1-1) and authors' calculations.

Note: 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 percent of GDP instead of the CBO baseline of −2.6 percent, yielding a 2034 debt equal to 120.2 percent of GDP instead of 122.4 percent.

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.

VI. 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-to-GDP ratio below 250 percent in one hundred years with 95 percent 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 percent 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 percent 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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Comments and Discussion

COMMENT BY

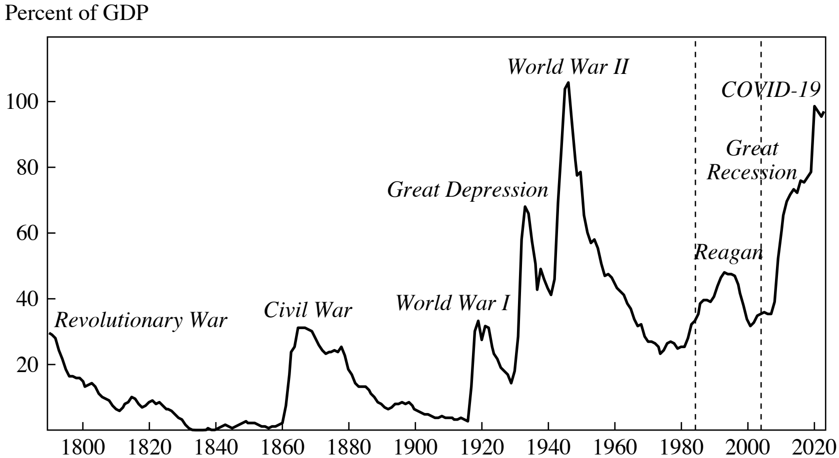
WILLIAM GALE[1] Alan Auerbach and Danny Yagan present two clear and compelling sets of results, which together lead to some crucially important follow-up questions. The first set of results, looking backward, shows that, between 1984 and 2003, Congress acted in a fiscally responsible manner, reducing deficits when projected deficits had risen. In the last twenty years, however, this fiscally stabilizing behavior disappeared. The second set of results, looking forward, shows that the fiscal position of the federal government will be (wildly) unsustainable if Congress does not respond to deficits or debt but is largely manageable if Congress responds in a fiscally responsible manner, similar to—or even weaker than—the way it responded in 1984 to 2003.

Whether these results represent good news or bad news depends, ultimately, on the answers to a few other questions: *Why* did policymakers change their behavior? *Will* they revert to fiscally responsible behavior, and if so, when and under what circumstances? One implication of the paper is that these political science or public choice questions take center stage in thinking about the fiscal outlook. Alternative answers translate directly into the difference between fiscal ruin and (relative) fiscal health.

HISTORICAL PATTERNS A historical perspective may be a useful way to start the discussion. Figure 1 shows that every peak debt episode in US history has been short-lived. Before 1980, the debt-to-GDP ratio spiked only during wars or the Great Depression. Typically, a large part of the

1. I am indebted to Ian Berlin for particularly valuable research assistance.

Figure 1. Debt to GDP, 1790–2023



Source: Congressional Budget Office (CBO).

subsequent budget retrenchment occurred via cuts in military spending. As a rough rule of thumb, starting from each peak, the debt-to-GDP ratio fell by half over about fifteen years. Explicit debt reduction accounted for only part of the decline; GDP growth and inflation accounted for the rest.

Ronald Reagan's tax cuts and increased defense spending created the first substantial rise in the debt-to-GDP ratio during a period of peace and prosperity. But, as Auerbach and Yagan show, congressional policy responses ameliorated that situation as well in a manner fairly typical of previous reductions in the debt-to-GDP ratio. In the last fifteen years, however, the nation has experienced another run-up in debt, due largely to the economic effects and policy responses associated with the Great Recession and the COVID-19 pandemic. If policymakers do not reduce the debt-to-GDP ratio substantially over the next fifteen years or so, that would be an aberration not just relative to the 1984–2003 period but also relative to all of US history. Reducing the debt-to-GDP ratio substantially in the near future, however, seems unlikely; indeed, merely stabilizing the ratio at or near current levels may not be possible and would in itself be a major accomplishment.

THE MODELS AND RESULTS Turning to the first set of results, figure 1, panel C, in the paper tells the story very concisely. During the earlier period, Congress responded in a stabilizing manner to both deficit projections and the output gap. Oddly, the response to the debt-to-GDP ratio was much less robust.

In the second period, Congress did not respond at all, on average, to fiscal figures or the output gap. This average nonresponse result is particularly interesting because Congress clearly did respond countercyclically to economic downturns like the Great Recession and the COVID-19 pandemic.

The second set of results is based on a budget projection model. With no economic uncertainty or fiscal feedback rules, the model closely parallels the Congressional Budget Office's (CBO 2024) projections (figure 4, panel A, in the paper). The paper models two sources of economic uncertainty. First, there are occasional large positive shocks to the debt. In the base case, there are, on average, two shocks per one hundred years and each raises the debt-to-GDP ratio by 25 percentage points. Second, the interest rate on government debt—technically, the excess interest rate, $(r - g)/(1 + g)$—varies with respect to its own past behavior, the debt-to-GDP ratio, and calibrated shocks, in a plausible and reasonable way.

Three types of fiscal feedback rules are modeled: gradual deficit-driven feedback, consistent with congressional behavior from 1984 to 2003; gradual debt-driven feedback, consistent with results in Bohn (1998); and a scenario that is called "wait and see" or "sudden feedback," which involves no continuous action but then generates a large fiscal consolidation when the debt hits a trigger value.

The authors carefully calibrate the model and present numerous results and extensive sensitivity analysis. Figure 6, panel A, in the paper provides a clear summary of the projections under base case parameter values. With no uncertainty and no fiscal feedback on the part of policymakers, the outlook is unsustainable. The debt-to-GDP ratio hits 250 percent in a little over fifty years and is on a sharp upward trend at that point. Adding economic uncertainty makes the results worse, because the periodic debt shocks are asymmetric. The debt-to-GDP ratio hits 250 percent in less than fifty years and, again, is clearly on an upward trend. Notably, all three of the fiscal feedback rules result in debt-to-GDP ratios between 155 percent and 167 percent of GDP after one hundred years (numbers provided by the authors). That is not ideal, but it is potentially manageable.

The authors ask: What would it take to generate a fiscally sustainable path? One of their candidate criteria for a sustainable path is to keep the debt-to-GDP ratio under 250 percent after one hundred years in 95 percent of the scenarios. It turns out that achieving this goal requires *less* fiscal responsiveness than Congress provided with respect to deficits in 1984–2003 or provided with respect to debt in 1916–1995. Translating that analysis into the next ten years, Congress would need to legislate deficit reductions between 0.5 percent of GDP (based on gradual debt feedback) and 1.1 percent of GDP (based on gradual deficit feedback).

Several aspects of the model and the results are worthy of note. First, there are important differences between nonstochastic budget projections and the stochastic projections the authors present. For example, the gap between the interest rate and growth rate ($r - g$) matters significantly in a nonstochastic framework, because it can lead to a debt-to-GDP spiral as higher interest rates raise net interest payments, which raise debt, which raises interest payments further, all relative to GDP. In the authors' model, the gap matters much less—it simply raises interest payments, which causes Congress to adjust the primary surplus upward in the gradual debt- or deficit-driven scenarios. As a second example, there are already several reasons to believe that nonstochastic budget projections (CBO 2024; Auerbach and Gale 2024) are too optimistic, including the assumptions of no future wars, pandemics, or depressions. The fact that the deficit shocks in the authors' model are asymmetric provides another reason why that is the case. Essentially, the fiscal outlook is worse, on average, than most nonstochastic budget projections present.

The model is very carefully and thoughtfully calibrated. The anchoring parameters are worth highlighting. In the gradual debt-driven feedback scenario, Congress responds not to any debt-to-GDP ratio but only to debt-to-GDP ratio above a baseline value (given by the parameter a_b). In the base case, this parameter is set to one (i.e., 100 percent, roughly the current value). This implies that the authors are modeling debt reduction that starts immediately—that is, in 2025. In practice, it seems unlikely that the political system is ready for significant debt reduction anytime soon and that debt and deficits are likely to rise rather than fall in the immediate future. As the authors show, raising the anchoring parameter would raise the debt-to-GDP ratio in the long term. It would also, of course, change the estimate of how much fiscal retrenchment would be needed in the next ten years. For example, if a_b were set at 1.3, no reductions would be required in the next decade, under the baseline. The anchoring parameter for the annual primary deficit is implicitly set to zero in the model, so that Congress responds to any primary deficit, not just those above some nonzero threshold. This does not seem unreasonable, especially because the intercepts in the regressions for deficit feedback in 1984–2003 and 2004–2024 are not significantly different from zero.

The only parameter choice that raises issues for me is that the Poisson shock to the debt has a mean frequency of two times per one hundred years.

In setting this value, the authors present reasons to ignore the debt-increasing experiences in World War II and the Great Depression. But even if those situations are omitted (and I am not sure they should be), our two most recent big debt shocks have come not just in the last one hundred years but in the last twenty years. So, the question arises—were the last twenty years a blip or a trend?

Variations in the frequency of big debt shocks have relatively small effects in the gradual *debt*-driven feedback scenario (figure 7, panel B, in the paper). The reason is that Congress "just" cuts deficits more in response to having more debt shocks. But repeated deficit cuts would inflict real economic pain. It seems possible that having to make more of such changes would wear on legislators and citizens. As discussed below, this sort of "fiscal fatigue" may actually be a cause of the change in congressional behavior that the authors find.

A related issue is that the debt shocks are modeled as a kind of "immaculate" debt creation—the authors assume the shocks do not increase the deficit in the year in which they occur; they just increase the debt. As a result, under the gradual *deficit*-driven feedback scenario, Congress does not respond directly to debt shocks, it only responds to the higher interest payments that arise in the future because the debt has increased. This biases the results against the effectiveness of the gradual deficit-driven feedback scenarios, and it makes the frequency of debt shocks a big driver of outcomes in the deficit-driven feedback scenario (figure 7, panel A, in the paper).

The authors write that, in general, the effects of the gradual debt-driven feedback scenario and the gradual deficit-driven feedback scenario should be roughly similar. But the creation of immaculate debt drives a substantial wedge between the results for these scenarios with respect to the frequency of big debt shocks. The difference between zero and four debt shocks in a century turns into a difference in the debt-to-GDP ratio after one hundred years of about 100 percentage points under the gradual deficit-driven scenario (where the direct effects of the debt increase are ignored) but only about 30 percentage points under the gradual debt-driven scenario.[2]

Besides the three forms of fiscal feedback that the authors model, there are at least two kinds of fiscal responses that could be analyzed. The first

2. These results are based on the scenarios in figure 7, panels A and B, in the paper. The precise numbers are not shown in the paper but were provided by the authors.

would be a "hybrid" response, where legislators respond to both deficits and debt. This would avoid the situation above, where legislators respond to the government's fiscal status (gradual deficit- and debt-driven feedback) but end up with widely varying outcomes because of particular modeling assumptions. The second type of policy that could be analyzed is a delayed, gradual, long-term response, such as the increase in the normal retirement age legislated in the Social Security reforms in 1983. A policy like this may have only trivial effects in the budget window but could still have substantial long-term effects.

In thinking about sustainable outcomes, the authors highlight the possibility of keeping the debt level below 250 percent of GDP. Despite the recent run-up in debt, that seems to me like a relatively weak criterion for claiming fiscal success. But aiming for lower ratios would require even stronger fiscal feedback and restraint.

Finally, it is worth understanding the empirical implications of adjusting policy over the next ten years to be consistent with the gradual deficit- and debt-feedback rules that generate sustainability (as defined above). Following the gradual debt-driven feedback rule would require tax increases or spending reductions equaling 0.5 percent of GDP over the next ten years. Following the gradual deficit-driven feedback rule would require deficit cuts of 1.1 percent of GDP. These figures translate into fiscal consolidations of $1.8 trillion and $3.9 trillion, respectively. It is difficult for me to see how changes of this magnitude (and even in this direction) will occur over the next ten years.

THE CHANGE IN POLICYMAKER BEHAVIOR I want to devote the rest of my comments to the big questions that reading the paper raises in my mind: Why did policymakers change their behavior? What will it take to get them to change back to making fiscally responsible choices? I start with a few caveats. First, I do not have the answer to either question. As an economist, I am particularly humble about addressing issues that presumably lie largely in the domain of political science and public choice. Second, it seems likely that there could be multiple factors at work, rather than a single "smoking gun." I group the potential causal factors that I could come up with into four categories: public opinion, economic and budget conditions, the operation of government, and political leadership.

Public opinion. In theory, legislators respond to public preferences, following the classical median voter model (Downs 1957). As the authors note, Cox, Epp, and Shapiro (2022) examine long-running Gallup and Pew polls that track the number of Americans who rank the budget deficit as the most important problem facing the country. They find, generally, that concern was high in the 1980s and 1990s, then low since 2000, except for a spike during the debt ceiling negotiations under President Barack Obama.[3]

However, it turns out that classic models connecting public opinion and politicians' position taking are flawed. In their landmark paper, Gilens and Page (2014) show that the likelihood of a bill's passage correlates closely with support (or opposition) from the wealthy and corporations, while the preferences of average Americans have almost no effect. At the same time, politicians are more likely to take meetings with constituents when it is revealed that they are also campaign donors (Kalla and Broockman 2016). If anything, there is evidence that politicians attempt to mold public opinion toward their policy preferences rather than the other way around (Jacobs and Shapiro 2000).[4]

Additional factors suggest that changes in public opinion are not driving the change in legislative behavior. First, while the public does not like deficits, tax increases and spending cuts are not popular either. This hardly gives politicians a guidebook on how to respond. Moreover, polls often proxy for partisanship. Pew Research Center (2014) found that Republicans cared more about the budget deficit during the Obama and Clinton administrations, while Democrats cared more during George W. Bush's presidency. Likewise, there is consistently a large partisan gap in consumer sentiment data, which flips each time control of the White House changes hands (O'Trakoun 2024).

3. There are several additional Gallup questions on the deficit, which span different segments of the 1984–2024 period. Depending on the year and the statement ("worry about federal spending and the budget deficit a great deal"; "extremely important" that Congress deals with the federal budget deficit issue in the next year; "the current federal budget deficit [is] a very serious problem for the country"), the share of respondents agreeing ranges anywhere from 25 percent to as high as 64 percent. As a result, these questions provide no clear evidence of a major realignment in public opinion between the two periods. If anything, the share of Americans who worry about the deficit a great deal has declined slightly since 2011 when Gallup first introduced that specific question. See Gallup, "Federal Budget Deficit," https://news.gallup.com/poll/147626/federal-budget-deficit.aspx.

4. More generally, poll results can be notoriously fickle. They can depend on the precise questions that are asked—for example, respondents demonstrate higher support for government redistribution when asked about aid for "poor people" than "people on welfare" (Smith 1987)—and even the order in which questions are asked. Acquiescence bias makes respondents more likely to agree with a given statement than if they are given two options explicitly—for example, "Should Congress increase spending" versus "Should Congress increase or decrease spending." Social desirability bias can lead respondents to give answers that they think the surveyor wants to hear, even if it does not reflect their true opinions.

Differences in economic and budget conditions. Another possible class of explanations revolves around economic and budget differences between the two periods that could affect the willingness of Congress to act against deficits.

Economy. One clear difference is economic growth, which averaged 3.4 percent in the first period and just 2.1 percent in the second. This difference is largely due to the Great Recession and the COVID-19 pandemic in the second period, while the earlier period encompassed the economic boom of the 1990s and most of the Great Moderation (Blanchard and Simon 2001; Bernanke 2004). While the authors show that their results hold when they remove recession years, baseline economic growth was still around 1 percentage point lower in the second period, even without these years.

Likewise, interest rates were markedly different between the two periods. Real rates on government debt averaged 2.77 percent in the first period and then averaged –0.56 in the second, including several years where the benchmark nominal interest rates were at or close to the zero lower bound during and following the Great Recession.[5] With lower interest rates, the average ratio of net interest payments to GDP was lower in the second period than in the first (1.5 percent versus 2.7 percent) even though the average debt-to-GDP ratio was higher in the second period than in the first (67.2 percent versus 40.3 percent). The relative absence of pressure from financial markets—or from those who just generally worry that net interest payments are a waste of money—to cut the deficit in the second period relative to the first may have lessened lawmakers' interest in debt reduction. Conversely, rates may have also been low because of other factors (e.g., a saving glut or excess demand for safe assets), which allowed policymakers to act opportunistically, given cheap credit.

Last, the change in behavior could simply be the result of lawmakers updating their priors about how much debt is sustainable. As the debt increased without immediate consequences (and the United States observed similar trends in peer nations), lawmakers may have decided they had been underestimating the amount of available fiscal space. If so, it automatically follows that lawmakers grew less concerned about running deficits.

5. For this calculation, I define the nominal interest rate on government debt in year t as the ratio of net interest payments in year t to the sum of the debt in year $t-1$ and one-half the primary deficit in year t, and then calculate the real interest rate by subtracting GDP inflation from the nominal interest rate in year t. Real interest rates using a consumer price index (CPI) deflator showed a similar drop, from 2.09 percent in the first period to –0.78 percent in the second.

Budget. In the earlier period, the US budget benefited from the so-called peace dividend following the breakup of the Soviet Union in 1991. Over President Bill Clinton's eight years in office, defense spending as a share of GDP dropped from 4.3 percent to 2.9 percent, with most of the savings going toward deficit reduction.[6] This military wind down helped ease budgetary pressures during the first period, although defense spending grew following the attacks of September 11, 2001.

In addition, the composition of the federal budget changed markedly over the last forty years. Over the second period, average entitlement spending made up 59.7 percent of the primary budget and 64.2 percent of the overall budget. Analogous figures in the first period are 47.9 percent and 55.3 percent.[7] Cuts to entitlement spending arguably face stronger political headwinds, making it more difficult to cut spending at the scale needed for substantive deficit reduction (Auerbach 2006).

Operation of government. Several potential explanations for the change in legislative behavior focus on the internal workings of Congress and the executive branch.

Polarization and sorting. Political views have become more polarized among elected officials (see, e.g., Andris and others 2015; Campbell 2018; Mason 2018). Based on DW-NOMINATE scores, which use roll call votes to place legislators on a scale between −1 (liberal) and 1 (conservative), Pew Research found that the average House Republican has become more conservative, with a score changing from 0.25 to 0.51 over the last fifty years (DeSilver 2022). The average Democrat became more liberal, though the shift was far smaller, from −0.31 to −0.38. The trends are similar for Senate Democrats and Republicans. Bonica and others (2015) construct a comprehensive time series of polarization going back even further and show polarization passing its Reconstruction-era high in 2015.

In addition, there is less ideological diversity within each party. This one-two punch has hollowed out the political middle, leaving no overlap between conservative Democrats and liberal Republicans since 2002 in the House and 2004 in the Senate (DeSilver 2022). This is a major break from the Roosevelt coalition that brought together some of the most liberal and most conservative members of Congress—especially on social

6. CBO, "Budget and Economic Data," under "Historical Budget Data," https://www.cbo.gov/data/budget-economic-data#2.

7. Author's calculations based on the historical budget data from CBO (see link in footnote 6).

issues—under the umbrella of the Democratic Party. The trend in partisan sorting is also visible in party unity scores for both parties, which have grown from under 60 percent around 1970 to over 90 percent in recent years, further contributing to the rise in party line votes (Carney 2015).

Polarization and sorting at the congressional level have significant legislative consequences. These trends have ushered in a new politics of obstruction, primarily conceived of and implemented by Newt Gingrich as a way for Republicans to win back control of the House. With the arrival of a young, hard-line freshman class following the 1994 midterm elections, the Republican strategy became to oppose anything that Democrats could claim as a win, an approach that Democrats have since replicated against Republican proposals (Mann and Ornstein 2012).

As bipartisanship decreased, incentives to tackle the deficit diminished as well, as both parties now see deficit reduction as simply giving the other party room to maneuver on their priorities the next time they are in the majority. This impasse is made only more difficult by the No New Taxes pledge, which a vast majority of the Republican caucus has signed. In fact, not a single Republican voted for a tax increase from 1990 to at least 2012 (Appelbaum 2012).[8] By removing tax increases from the table, the pledge makes it nearly impossible to negotiate bipartisan deficit reduction, especially given Democratic opposition to major spending cuts. While this shift began during the first period, it solidified in the second, suggesting it could contribute to these critical changes in policymakers' response to growing debt.

Unified government and reconciliation. One additional consequence of polarization is a decline in ticket splitting, which in turn has increased how often one party has unified control of the White House, Senate, and House of Representatives. Since the start of the twenty-first century, each president has begun his term with unified control of government and used that opportunity to pass a large reconciliation bill that increased deficits, contrary to reconciliation's original purpose of deficit reduction. Unified government allowed for the passage of both the 2001 and 2003 Bush tax cuts, the Affordable Care Act, the Tax Cuts and Jobs Act, and both the American Rescue Plan and the Inflation Reduction Act under the Biden administration. Unified government under President Clinton was the only instance of unified government in the last forty years that passed legislation

8. Eighty-five House Republicans joined Democrats in allowing some of the Bush tax cuts on the wealthy to expire in 2012, though they had the blessing of Grover Norquist, the architect of the tax pledge.

shrinking the debt. Therefore, if unified government is a good predictor of deficit-increasing legislation, then a higher prevalence of unified government could explain part of the behavior shift away from deficit reduction.[9]

Pent-up demand. Another potential explanation is that legislators and citizens could only stomach fiscal responsibility for so long. For example, when the Republicans took control of Congress and the White House in 2001, CBO projected that the debt would fall to just 7.1 percent of GDP in 2008 (CBO 2001). In response, under the George W. Bush administration, taxes fell, and discretionary and mandatory spending went up as a share of GDP, a historically rare instance of all three happening simultaneously. This arrested a downward trend in the federal debt, leaving actual debt in 2008 at 40.8 percent of GDP (CBO 2009). It may have been that pent-up demand for big fiscal policy packages was always going to bubble over, and it was just a matter of when.

Budget rules. Some commentators have been quick to blame the expiration of budget rules for the demise in good legislative behavior on the debt. On the statutory side, pay-as-you-go (PAYGO) rules were allowed to lapse between 2002 and 2010, after first being introduced in 1990. On the legislative side, the House first implemented a PAYGO rule in 2007, though Republicans have transitioned to a cut-as-you-go (CUTGO) rule each time they regained a majority in 2011 and 2023 (Heniff 2023). CUTGO only applies to increases in mandatory spending and cannot incorporate tax increases as offsets.

I agree with the authors, though, that budget rules are mainly indicative of intentions, not causal for budget outcomes. Rudolph Penner, former CBO director, aptly described this view: "The problem is not the process, the problem is the problem" (*Washington Post* 1984, par. 6).

Political leadership. Political leaders changed their tune on deficit reduction. This may have given legislators the go-ahead—intentionally or unintentionally—to turn their focus away from fiscal responsibility. Or legislators felt that they no longer had the political cover from national

9. Nevertheless, it is unclear that unified governments have always been bad for the deficit historically. Earlier scholarship often finds an association between higher budget deficits and divided government, viewing split control of government as an obstacle to negotiating deficit reduction that legislators had a vested interest in pursuing; see, for example, Cutler (1990). This suggests, therefore, that unified control simply makes it easy for the party in power to achieve its goals and that those goals have shifted from deficit reduction to either tax cuts or spending increases. Ultimately, it seems recent deficit increases under unified governments are downstream of changes in baseline legislator preferences.

leaders to seek difficult deficit reduction measures that would hurt local interests in their state or district. Either way, leadership attitudes have clearly changed.

For example, even as Reagan supported deficit-increasing tax cuts and higher defense spending in 1981, other party leaders were skeptical, such as Senate Republican Majority Leader Howard Baker who commented that it was a "riverboat gamble . . . that this new economics will work" (Sullivan 1981, par. 1). Just a year later, Reagan himself argued that the "single most important question facing us" was the debt, presenting a choice to "make port or go aground on the shoals of selfishness, partisanship, and just plain bullheadedness" (Reagan 1982, pars. 41, 42). Likewise, despite significant objections from the Republican rank and file at the time, President George H. W. Bush recanted his No New Taxes pledge in order to reach a deficit reduction deal. He stated, "It is clear to me that both the size of the deficit problem and the need for a package that can be enacted require all of the following: entitlement and mandatory program reform, tax revenue increases, growth incentives, discretionary spending reductions, orderly reductions in defense expenditures, and budget process reform" (Bush 1990, par. 2).

In the 1992 election, Ross Perot managed to garner 19 percent of the popular vote against Bush and Clinton, running primarily on a plan to balance the federal budget. Clinton therefore understood the political salience of the issue and made it a top priority to work with Congress to achieve his goals. This feeling permeated the Clinton administration. Treasury Secretary Robert Rubin preached his own "Rubinomics," a philosophy that deficit reduction would spur lower interest rates and stronger economic growth (Uchitelle 2006). Meanwhile, Clinton strategist James Carville, reflecting on how Clinton's campaign promise of a middle-class tax cut turned into the 1993 tax increase, saw the importance of deficit reduction in the political system at that time, famously saying that if he could be reincarnated, he "would like to come back as the bond market. You can intimidate everybody" (Uchitelle 1994, par. 8). In President Clinton's 1996 State of the Union, he argued that improving the country "begins with balancing the budget in a way that is fair to all Americans." He further urged Congress to act on a "broad bipartisan agreement that permanent deficit spending must come to an end" (Clinton 1996, par. 12).

Within a decade though, the mood had shifted dramatically. On January 19, 2004, former Treasury Secretary Paul O'Neill was reported in *Time* describing how, after the 2002 midterms, which the Republicans swept, Vice President

Dick Cheney rejected O'Neill's warnings that budget deficits were a growing economic threat, retorting: "Reagan proved deficits don't matter" (Dickerson 2004, par. 1). (So, the simple explanation of change in congressional behavior is the timing of this quote—right at the beginning of 2004!)

This shift in leaders' behavior has continued since. During Obama's presidency, conservatives seized on his comment to David Letterman that "we don't have to worry about [debt] short term. But it is a problem long-term and even medium-term" (Weisenthal 2012, par. 3). A few years later, Trump chief of staff Mick Mulvaney privately told supporters that "nobody cares" anymore about the deficit, ahead of the 2019 State of the Union (Ward and Matthews 2019, par. 38). And President Joe Biden, while frequently boasting about reducing the deficit from COVID-19-era highs on the campaign trail, nevertheless pursued an ambitious spending agenda even after his planned tax increases on the wealthy faltered.

Neither candidate in any of the last several presidential elections has run on a deficit reduction platform. If it takes strong White House leadership to corral Congress into taming deficits, that leadership was hard to find for the last two decades. But this begs the question of what caused that change in leadership opinions!

CONCLUSION And it begs the question of what will cause policymakers to change their behavior back. My instinct is to say "a crisis" and pretty much nothing less. The fiscal discipline required for one hundred years of gradual debt- or deficit-driven feedback seems to be a much larger burden than our legislative system can bear. It would be interesting to know if similar legislative trends have occurred in other countries, many of which have parliamentary rather than republican systems but also seem to have been marked by increases in polarization.

A good paper provides compelling answers to some questions and lets people see the world in a different light that helps generate important new questions. Auerbach and Yagan have succeeded on both scores.

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COMMENT BY

VALERIE A. RAMEY This paper by Auerbach and Yagan offers important new insights on the state of US debt and deficits. First, they rigorously document something that we all suspected: Congress doesn't respond to deficits anymore. The previous work by Auerbach (2003) showed that between 1984 and 2003 Congress enacted legislation to raise the primary surplus in response to an increase in projected future deficits. The feedback was modest but nonetheless present. The current paper reestimates that feedback rule for 2004 to 2024 and finds no legislative response to projected deficits. Second, the authors highlight an important feature of the path of debt-to-GDP ratios since 2004: Crises lead to positive debt shocks that ratchet up the US debt-to-GDP ratio, but there are no corresponding negative debt shocks. Moreover, the debt-to-GDP ratio does not fall after the crisis has passed. Third, the authors explore whether various feedback rules can keep the debt path under control when there are no shocks. They estimate and simulate paths from various fiscal feedback rules, both deficit-based and debt-based. In the absence of shocks, even modest deficit or debt feedback keeps the debt ratio at sustainable levels, but with no feedback the debt ratio rises exponentially. Fourth, they generalize the model to the more realistic case in which interest rates and debt are hit by shocks, and interest rates respond to the level of debt. The simulations show the strength of feedback, either to debt or deficits, required to keep the debt-to-GDP ratio below certain values 95 percent of the time over a one-hundred-year period. The results show the post-2003 absence of feedback is unlikely to keep the debt-to-GDP ratio below levels even as high as 500 percent.

My comments consist of four parts. First, I discuss debt dynamics and how Auerbach and Yagan's fiscal rule relates to Bohn's (1998) fiscal rule. Second, I comment on several features of their stochastic model simulations. Third, I explain why I am pessimistic about spending reductions going forward. Finally, I conduct a case study of the sources of the decline in the debt-to-GDP ratio in the immediate post–World War II period and conclude that inflation accounted for the entire decline.

DEBT DYNAMICS AND FISCAL RULES It is useful to compare Auerbach and Yagan's rule to the famous Bohn (1998) rule. To begin, the debt dynamics identity specifies that

$$b_t - b_{t-1} = \left(\frac{r-g}{1+g}\right) b_{t-1} - s_t,$$

where b_t is the debt-to-GDP ratio at the end of period t, r is the real interest rate, g is the growth rate of real GDP, and s_t is the primary surplus divided by GDP. Bohn (1998) showed that if the primary surplus reacts sufficiently strongly to the level of debt, then any level of debt is sustainable. Bohn's rule is:

$$s_t = d \bullet b_{t-1} + \textit{cyclical component}.$$

The key parameter in the feedback rule is d. The cyclical component captures factors such as the procyclicality of tax revenue. With Bohn's rule, debt evolves as follows:

$$b_t - b_{t-1} = \left(\frac{r-g}{1+g} - d\right) b_{t-1} - \textit{cyclical component}.$$

Bohn showed that if $d > \dfrac{r-g}{1+g}$, then the debt ratio will never explode. He estimated the value of d over long historical US data and found that the value was sufficiently large to prevent debt ratio explosions.

In contrast, Auerbach and Yagan's baseline rule specifies that primary surpluses respond to the Congressional Budget Office (CBO) forecasts of the primary surplus-to-GDP ratio over the next five years. There is no feedback from debt in their baseline rule. This feature seems odd at first, both because debt sustainability is the focus of the analysis and standard optimal control implies that the feedback rule should depend on debt, which is the state variable.

Why did Auerbach and Yagan exclude debt from their baseline rule? Their estimates, shown in table 2 in the paper, indicate that the coefficients on the projected surplus are much more important than the coefficients on projected debt or lagged debt. This is also true for the more reactive 1984–2003 period. Is the absence of debt a problem for their rule? Not necessarily. To see this, consider the analysis above. They are essentially setting Bohn's coefficient, d, to be equal to zero in their baseline rule. However, as Bohn's results show, if interest rates are less than the growth rate of GDP, the debt ratio will not explode even with $d = 0$. Thus, Auerbach and Yagan's rule can prevent debt from exploding if the interest rate remains below the growth rate of GDP.

However, as Blanchard, Leandro, and Zettelmeyer (2021) note, the outlook is not so rosy if we consider the addition of two realistic factors: stochastic shocks and political and economic constraints on the size of primary surpluses that a government can generate. Considering the constraints, let $\bar{s}$ be the upper limit to the primary surplus. Then the maximum sustainable debt is

$$b^* = \bar{s}\left(\frac{r-g}{1+g}\right)^{-1}.$$

If $\bar{s}$ equals 1.5 percent and $\frac{r-g}{1+g}$ equals 1.5 percent, then the maximum sustainable debt is 100 percent. For stochastic shocks, the analysis becomes more complicated. That is why stochastic simulations, like the ones conducted by Auerbach and Yagan, are so important for assessing debt sustainability.

COMMENTS ON AUERBACH AND YAGAN'S STOCHASTIC SIMULATIONS In their stochastic simulations, Auerbach and Yagan consider a world in which infrequent shocks from a Poisson process hit debt, while other shocks affect the $r - g$ term. They find that both their rule using the estimated feedback from 1984 to 2003 and Bohn's estimated historical rule have a high probability of keeping the debt-to-GDP ratio under 250 percent for one hundred years. In contrast, the post-2003 lack of feedback, even augmented with sudden consolidations when the interest expense exceeds 2 percent of GDP, has much lower probability of keeping the debt-to-GDP ratio under 250 percent.

Generalizations of their model are likely to lead to even more pessimistic conclusions. I will highlight three: the frequency of the budget shocks, effects of fiscal consolidations on GDP, and the possibility of covariances between the two types of shocks.

Auerbach and Yagan parameterize the Poisson process so that the rare budget shocks hit on average twice per hundred years. For reasons I do not understand, they focus on the global financial crisis and COVID-19 pandemic but ignore the Great Depression and World War II. One has only to read the current ominous news about the global military situation or bird flu to suspect that the frequency of these rare shocks is probably at least twice as high as the authors' parameterization.

Auerbach and Yagan also omit the negative effects of fiscal consolidations on GDP, meaning that they are assuming multipliers of zero on both spending and taxes. While there is debate about the magnitudes of these multipliers, most economists do not think they are zero. Evidence from Guajardo, Leigh, and Pescatori (2014) and others suggests that multipliers on fiscal consolidations are large, above three for tax-based consolidations and around unity for spending-based consolidations. Thus, once we recognize that fiscal consolidations lower both the numerator and denominator of the debt-to-GDP ratio, we see how difficult it is to keep the debt-to-GDP ratio in a manageable range.

A third generalization worth considering is the possibility that shocks are correlated. To see why this possibility can be important, suppose news arrives of a secular decline in GDP growth, that is, g falls to a lower level. Standard models predict that there is likely to be a recession in the short run, due to the negative effects of the news on consumption and investment. This effect reduces GDP in the denominator of the debt-to-GDP ratio. But this recession is likely to lead the government to enact a deficit-financed stimulus, which raises the debt in the numerator. Although the stimulus is temporary, the debt-to-GDP ratio will not decline subsequently because the lower g leads to an increase in the $\frac{r-g}{1+g}$ term. In this scenario, Auerbach and Yagan's debt-to-GDP shock and excess interest shock are correlated. This correlation means that the risk of explosive debt paths is greater. One has only to focus on the 1930s portion of their figure 3, panel A, to see some of these forces in play: The $\frac{r-g}{1+g}$ term shoots up at the same time the government is using Keynesian stimulus to lower the unemployment rate. The worry is that fundamental shocks, such as growth slowdowns, lead to both an increase in excess interest and more demand for fiscal stimulus.

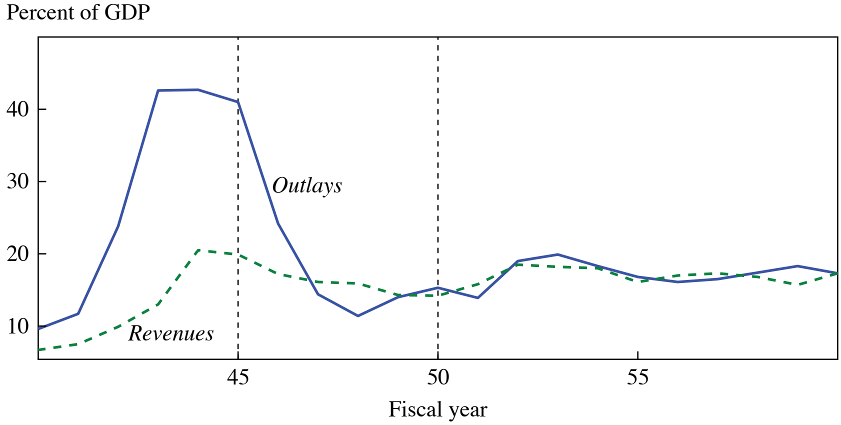
Finally, I would like to point out the implications of Auerbach and Yagan's debt-to-GDP shocks when the feedback rule imposes a zero parameter on the debt-to-GDP ratio. This rule implies that the government should ignore the effects of past shocks, such as pandemics and financial crises, on the debt. Thus, their rule leads to hysteresis in the debt-to-GDP ratio whenever there are crisis shocks to the debt-to-GDP ratio, such as those during the global financial crisis and COVID-19 pandemic.

PESSIMISM ABOUT FUTURE FISCAL REACTION FUNCTIONS Auerbach and Yagan document the decline in the extent to which the government has tried to increase primary surpluses in response to high projected deficits. I am even more pessimistic going forward because of structural changes in the nature of spending.

During the twentieth century, the major forces raising the debt-to-GDP ratio were mostly temporary—military buildups, stimulus packages, and large-scale infrastructure projects. These programs led to booms in government spending for several years but then a return to normal. During the twenty-first century, two major forces raising the debt-to-GDP ratio are the aging of the population and the rise in relative health care prices. According to the CBO (2024, fig. 2-5), Social Security outlays are currently 5.2 percent of GDP in 2024 and are projected to rise to 5.9 percent by 2054 because of aging. The government's major health care programs account for 6.3 percent of GDP in 2024 and are projected to rise to almost 10 percent in 2054. Of that increase, 2.6 percent is due to cost growth and 1.2 percent is due to aging. Unless Congress makes politically difficult cuts in health care entitlements or raises taxes, the debt-to-GDP ratio will continue to rise. There is currently little political discussion about possible measures.

WHY THE DEBT-TO-GDP RATIO DECLINED IN THE IMMEDIATE AFTERMATH OF WORLD WAR II The current level of the debt-to-GDP ratio is approximately equal to its value at the end of World War II. From the post–World War II peak just over 100 percent, the ratio declined to 23 percent by the mid-1970s. Numerous commentators argued that the United States mostly grew its way out of debt, that is, the real interest rate, r, was significantly less than the growth rate, g. However, Acalin and Ball (2024) question that interpretation. Building on Hall and Sargent (2011), who highlight the importance of positive primary surpluses, and Reinhart and Sbrancia (2015), who argue that interest rates were so low only because of financial repression, Acalin and Ball (2024) carefully construct a counterfactual path of the debt-to-GDP ratio since World War II under the assumption that there were no budget surpluses and no distortions to interest rates. They find that the debt-to-GDP ratio would have fallen only to 74 percent by the mid-1970s. They also discuss the role of unanticipated inflation, though

Figure 1. Federal Revenues and Outlays



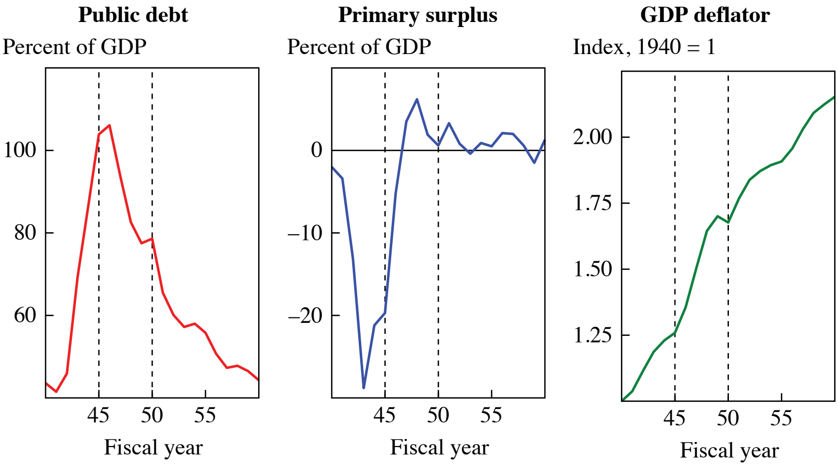
Source: Office of Management and Budget (2024).
Note: All data are on a fiscal year basis. The vertical lines indicate the end of World War II (August 1945) and the start of the Korean War (June 1950).

they start their analysis in 1952 when data on inflation expectations first became available.

Here I present a case study of the spending, revenue, and the debt-to-GDP ratio in the immediate aftermath of World War II. Figure 1 shows annual data on federal government revenues and outlays as a percentage of GDP. The years shown are fiscal years; fiscal year 1950 begins July 1, 1949, and ends June 30, 1950. The first vertical line indicates the end of World War II (August 1945) and the second one indicates the start of the Korean War (June 1950). Outlays rose by about 30 percentage points of GDP in World War II and by 4.6 percentage points in the Korean War.

Figure 2 shows debt in the hands of the public, the primary surplus, and the GDP deflator. The first panel shows that the debt-to-GDP ratio fell from over 100 percent in fiscal year 1945 to 83 percent by fiscal year 1948. The second panel shows that the primary surplus moved from very negative values during World War II to strongly positive values by fiscal year 1947. The third panel shows that the price level, as measured by the GDP deflator, rose steeply between 1945 and 1948. Price controls, accompanied by rationing, kept inflation low during the war. The war ended in August 1945 and rationing of all items (except sugar) was lifted by the end of the year. In February 1946, the Office of Price Administration switched from the stricter "hold the line" price controls to adjustable price controls and in

Figure 2. Debt Dynamics: 1940–1960



Source: Office of Management and Budget (2024).
Note: All data are on a fiscal year basis.

June 1946 lifted the controls (Rockoff 1984, table 4.3). As Rockoff documents, inflation surged from February 1946 through July 1946.

The debt-to-GDP ratio fell steeply between 1945 and 1948. We can decompose that change into changes in nominal debt (*debt*), real GDP (Y), and prices (P) using the following equation:

$$\Delta \ln\left(\frac{debt}{P \bullet Y}\right) = \Delta \ln\left(debt\right) - \Delta \ln\left(Y\right) - \Delta \ln\left(P\right).$$

Table 1 shows two versions of the decomposition. In both versions, debt is measured at the end of the fiscal year, June 30. In the fiscal year version, I use the Office of Management and Budget's method of dividing debt by GDP corresponding to the fiscal year ending June 30; this is the version shown in figure 2. In the second version, I use the Bureau of Economic Analysis GDP series during the *calendar* year so that debt is measured at the midpoint of the GDP measurement.[1] Because GDP fell so much when World War II ended, there is a noticeable difference between the two methods.

1. Bureau of Economic Analysis, "Gross Domestic Product (Implicit Price Deflator)," retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/A191RD3A086NBEA.

Table 1. Decomposition of Decline in Debt-to-GDP Ratio from 1945 to 1948

GDP version	$\Delta \ln\left(\frac{debt}{P \bullet Y}\right)$	$\Delta \ln(debt)$	$- \Delta \ln(Y)$	$- \Delta \ln(P)$
Fiscal year	–23%	–8%	– (–12%)	– 27%
Calendar year	–27%	–8%	– (–8%)	– 28%

Source: The fiscal year data are from the Office of Management and Budget (2024). The calendar year data on GDP and the price level are from the Bureau of Economic Analysis.

The decline in the debt-to-GDP ratio is 23 percent if I divide by fiscal year GDP and 27 percent if I divide by calendar year GDP. The difference is entirely due to the behavior of real GDP—fiscal year GDP fell 12 percent whereas calendar year GDP fell 8 percent. Both of these estimates of the real GDP decline completely offset the effect of the 8 percent fall in nominal debt on the debt ratio. In contrast, the price level's rise of 27 percent (28 percent) accounts for all or more of the decline in the debt-to-GDP ratio. Thus, the burst in inflation was the dominant factor leading to the decline in the debt-to-GDP ratio in the three years after the end of World War II. Interest rates did not rise in response only because the US government was engaging in financial repression.

The Korean War began only five years later, generating a significant rise in government outlays not only for the "hot war" but also for the Cold War. While the rise shown in figure 1 looks small compared to World War II, it dwarfs the subsequent increases for the Vietnam War or the Carter-Reagan buildup. However, primary surpluses did not turn negative because the US government financed the Korean War with tax increases (Ohanian 1997). Neither President Harry Truman nor the Congress wanted to allow the new military spending needs to derail the progress made against the debt.

CONCLUSIONS In sum, Auerbach and Yagan's paper presents thought-provoking new estimates of fiscal rules in practice in the United States and an analysis of the likely consequences for the future of the debt-to-GDP ratio. This paper should give pause to even the most ardent debt optimist.

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GENERAL DISCUSSION Jón Steinsson observed that the US debt-to-GDP ratio has consistently risen in times of war and subsequently comes back down. He pointed to the markedly different experience of the United Kingdom, explaining that their debt-to-GDP ratio increased steadily from 1700 to 1815 after which it proceeded to decrease for the next hundred years.[1] Steinsson argued that this was an example of a case where the debt-to-GDP ratio could look very ill-behaved for a very long time before reversing course and being brought back under control. He stated that he was concerned about the evolution of the debt-to-GDP ratio in the United States, but that it was hard to make strong inference about this series with short samples.

Jason Furman remarked that while many economists were worried about the debt-to-GDP ratio when it was as low as 35 percent of GDP, it is now

1. Luke Lanskey and Conor O'Loughnan, "300 Years of UK Public Finance Data," UK Office for Budget Responsibility, July 20, 2023, https://articles.obr.uk/300-years-of-uk-public-finance-data/index.html.

over 100 percent of GDP, the economy is still growing at about 3 percent, and the ten-year Treasury yield is about 4 percent, suggesting deficits are perhaps less troubling than many economists believe.[2] Douglas Elmendorf replied that what worried the public in the 1980s and 1990s was that a large deficit would trigger higher interest rates or higher inflation. The past few decades with low interest rates and low inflation have made the public less sensitive to a rising deficit, he argued. But if this were to change, the public's concern about the deficit may be swayed as well.

On whether financial markets care, Jonathan Pingle noted that at its November 2023 refunding announcement, the Treasury surprised markets with its plans for the duration of issuance, which subsequently caused the Adrian, Crump, and Moench (ACM) ten-year term premium to fall.[3] Pingle pointed out that this was a new, noteworthy degree of sensitivity in financial markets to the supply of duration, which could signal a change in market attitudes regarding the volume of federal debt issuance.

Furman suggested that it is possible that the fiscal reaction function is sensitive to real debt service rather than deficits. He cited his work with Lawrence Summers on this and urged future research to consider a systematic analysis of policymakers' reaction to debt service.[4] Furman also posited that the zero lower bound and the need to remedy deficient demand could plausibly explain why policymakers did not react to deficits post-2004. Furman then pointed out that policymakers are not necessarily rational and time consistent, suggesting stricter rules would be preferable. As a result, he expressed surprise that the authors did not recommend a greater deficit reduction in the near term.

Neil Mehrotra asked the authors about their assumptions regarding the response of interest rates to a higher debt-to-GDP ratio. He noted that there is not much empirical evidence to support the assumption by the Congressional Budget Office (CBO) that a percentage point increase in debt-to-GDP ratio

2. Bureau of Economic Analysis, "Gross Domestic Product," https://www.bea.gov/data/gdp/gross-domestic-product; Federal Reserve Board, "Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity, Quoted on an Investment Basis," retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/DGS10.

3. US Department of Treasury, "Quarterly Refunding Statement of Assistant Secretary for Financial Markets Josh Frost," press release, November 1, 2023, https://home.treasury.gov/news/press-releases/jy1864; Federal Reserve Bank of New York, "Treasury Term Premia," https://www.newyorkfed.org/research/data_indicators/term-premia-tabs#/interactive.

4. Jason Furman and Lawrence Summers, "A Reconsideration of Fiscal Policy in the Era of Low Interest Rates," discussion draft, November 30, 2020, https://www.brookings.edu/wp-content/uploads/2020/11/furman-summers-fiscal-reconsideration-discussion-draft.pdf.

raises the interest rate by three or four basis points. Mehrotra pointed out that, in the authors' paper, the relationship between debt-to-GDP ratio and interest rates is relatively unstable, and that structural overlapping generations (OLG) models can find substantially smaller effects of debt-to-GDP ratio on interest rates.

In response to Mehrotra, Alan Auerbach explained that they estimate a sensitivity of 0.8 basis points per percent change in the debt-to-GDP ratio, which is smaller than CBO's current estimate of 2 basis points per percent change. That said, the CBO model also incorporates things like the impact of demographic changes on interest rates, and for that reason their model is understating the partial relationship in the CBO model.

Danny Yagan agreed with Mehrotra that the estimates of the relationship between debt-to-GDP ratio and the excess interest rate are very unstable. This supports the comments by Furman and the discussion by William Gale that interest rates seem to be falling despite steadily rising debt. He explained that this observed trend informed the decision to model a "wait-and-see" approach—if politicians and the public remain unconvinced that debt levels matter until interest rates do eventually rise, then they might wait to take action.

Henry Aaron shifted the focus of the discussion, emphasizing that the forces affecting deficits and debt are largely political in nature and have to do with political willingness to levy taxes. He suggested that an examination of the political process would be key to understanding the past and future trajectory of deficits and debt.

David Romer echoed Aaron, stressing the importance of political science to the discussion. Comparing the situation to a game of chicken, he concluded that the optimal strategy for either political party will always run some risk of a disastrous outcome. For example, if either Republicans or Democrats believe there is a good chance that the fiscal situation will turn out well, then they will not compromise on their tax or spending priorities. Taken at face value, this simple model of the political situation implies a strictly positive chance of a disastrous fiscal outcome.

Louise Sheiner added that until the public care about the deficit, politicians have no reason to be fiscally responsible. For example, if a responsible policymaker decides to pay for their priorities using tax revenue, then it will just create room for the other political party to enact a tax cut or spending increase when they come into power. She concluded that this dynamic will continue to play out unless politicians have a strong reason to be fiscally responsible, and she speculated that rising interest rates might end up being that reason.

Joe Beaulieu predicted that rising debt levels will result in some sort of fiscal pain and suggested thinking more about the extent of such fiscal issues and how they would manifest.

Auerbach agreed with Sheiner's point that it doesn't make political sense for one party to be fiscally responsible if the other will simply take advantage of it the next time they come into power. He noted that in 1990, President George H.W. Bush worked with a Democratic Congress to enact budget cuts, but the current political environment is not conducive to similar cooperation. Agreeing with Gale's discussant remarks, Auerbach suggested that the public is less convinced that deficits matter than they used to be. While politicians succeeded in reforming Social Security in 1983 and enacting budget cuts in 1990, he ventured that the likelihood of that happening again is slim. This, Auerbach proposed, represents a general change in the political environment surrounding debt and deficits.

Ethan Ilzetzki explained that he viewed the issue in three layers. The first involves the type of empirical reaction functions and debt sustainability exercises that the authors conducted. The second is the fiscal rules that try to enforce the desired fiscal behavior. Ilzetzki was skeptical of this layer, given the absence of international examples where fiscal rules have successfully brought down deficits. To explain this phenomenon, Ilzetzki pointed to the third layer: institutional enforcement of fiscal rules. He contended that in the rare examples where fiscal rules do work, it can be attributed to the strength of fiscal institutions. In the context of the paper, he asked what might have changed about the institutional enforcement of formal or informal fiscal rules in the past twenty years that led to the lack of fiscal feedback that the authors document.

Deborah Lucas compared the current rising debt-to-GDP ratio in the United States to similar situations internationally, and expressed concerns about the general lack of understanding of possible spillover effects from one country to another. She commented that it would be interesting to look at a time series for debt-to-GDP ratio in other countries with similar fiscal pressures. Lucas also noted that with a sufficiently high stock of debt, the interest rate would eventually incorporate a risk premium, which could accelerate the growth of debt even more. She asked the authors if they had considered adding that dynamic into their model.

Maurice Obstfeld raised three points. First, he asked the authors to what extent they considered about the maturity structure of debt and whether they thought that structure responds systematically to deficits or the level of debt. Second, he related the intertemporal budget constraint to the market reaction to government debt. If markets believe that Congress is not adhering to an intertemporal budget constraint, then they will price in that lack of confidence to the interest rate on government debt. Finally, Obstfeld mentioned research by Bank of England economist Oliver Bush that used England's historical response to government debt to highlight the importance of explicitly signaling when policy is responding to rising debt levels.[5]

Wendy Edelberg discussed the relationship between inflation and deficits. She commented that a credible, independent Federal Reserve forestalls predicted deficits from being inflationary, which implies that the only way for deficit levels to impact inflation is through unanticipated increases in the deficit. Additionally, although inflation has been an effective remedy to high debt levels in the past, strategic inflation cannot remedy the current fiscal imbalance because it makes it harder to finance persistent deficits. Finally, Edelberg pondered what the risk premium in the interest rate actually reflects. She dismissed inflation because of its inability to solve persistent deficits and called into question the risk of default because that would cut us off from financial markets, which would make it impossible to finance borrowing.

Marc Goldwein suggested that the authors incorporate interest cost feedback into their model and consider eliminating extrapolations of onetime discretionary spending from their CBO-projected deficits.

Robin Brooks asked about the frequency of large fiscal shocks that the authors used in the model and inquired about the absence of the Great Depression and World War II. He also mentioned a number of recent bond market events, including the one in the United States in March 2020, Europe in June 2022, and the United Kingdom in October 2022.[6] Brooks emphasized that in each of those cases, the central bank intervened significantly to counteract the bond market reactions. This suggests that monetary policy plays an important role in the whole conversation around debt and deficits.

On the omission of macroeconomic fluctuations from the model, Auerbach noted that the baseline estimates of deficit feedback are residualized for the

5. Oliver Bush, "Fiscal Financing Regimes and Nominal Stability: An Historical Analysis," working paper 374 (London: London School of Economics and Political Science, 2024), https://eprints.lse.ac.uk/126211/.

6. Jordan Barone, Alain Chaboud, Adam Copeland, Cullen Kavoussi, Frank Keane, and Seth Searls, "The Global Dash for Cash in March 2020," *Liberty Street Economics*, Federal Reserve Bank of New York, July 12, 2022, https://libertystreeteconomics.newyorkfed.org/2022/07/the-global-dash-for-cash-in-march-2020/; Eshe Nelson, "European Central Bank Announces Efforts to End Bond Market Turmoil," *New York Times*, June 15, 2022, https://www.nytimes.com/2022/06/15/business/ecb-bond-market.html; Huw Jones, "UK Bond Market Crash Takes Shine off Big Bang Plans for London," Reuters, October 4, 2022, https://www.reuters.com/business/finance/uk-bond-market-crash-takes-shine-off-big-bang-plans-london-2022-10-04/.

GDP gap, which accounts for the reduced ability to enact fiscal consolidation when the economy is weak. He acknowledged that by suppressing normal macroeconomic fluctuations, he and Yagan are assuming that those fluctuations cancel out and have a limited effect on the long-run trajectory of the debt.

In response to Brooks, Yagan admitted that it is more an art than science. Connecting this question with earlier comments by Mehrotra and Furman, Yagan identified the timing of deficit shocks and the excess interest rate as the two main types of uncertainty incorporated in the model. Other uncertain factors that are harder to model include the central tendency of the excess interest rate and any unexpected changes in global demographics. Emphasizing that we can't use a wait-and-see approach with climate change but we can enact an immediate fiscal consolidation, Yagan concluded that some of the political behavior around deficits could actually be interpreted as a calculated trade-off between two risks, rather than an outright dismissal of fiscal risks.

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 (1)	Revenues (2)	Primary outlays (3)	Primary surplus (4)	Primary surplus (5)	Primary surplus (6)	Primary surplus (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	Observation	Source(s) of legislated surplus change	Source of projected surplus
1981a	Jul 1981		2013a	Feb 2013	Aug 2012
1983a	Mar 1983	Jul 1981	2013b	May 2013	Feb 2013
1984a	Jan 1984	Mar 1983	2014a	Feb 2014	May 2013
1984b	Feb 1984, Aug 1984	Jan 1984	2014b	Apr 2014, Aug 2014	Feb 2014
1985a	Feb 1985	Aug 1984	2015a	Jan 2015	Aug 2014
1985b	Aug 1985	Feb 1985	2015b	Mar 2015, Aug 2015	Jan 2015
1986a	Feb 1986	Aug 1985	2016a	Jan 2016	Aug 2015
1986b	Aug 1986	Feb 1986	2016b	Mar 2016, Aug 2016	Jan 2016
1987a	Feb 1987	Aug 1986	2017a	Jan 2017	Aug 2016
1987b	Mar 1987, Aug 1987	Feb 1987	2017b	Jun 2017	Jan 2017
1988a	Feb 1988	Aug 1987	2018a	Apr 2018	Jun 2017
1988b	Mar 1988, Aug 1988	Feb 1988	2018b	May 2018	Apr 2018
1989a	Jan 1989	Aug 1988	2019a	Jan 2019	May 2018
1989b	Feb 1989, Aug 1989	Jan 1989	2019b	May 2019, Aug 2019	Jan 2019
1990a	Jan 1990	Aug 1989	2020a	Jan 2020	Aug 2019
1990b	Feb 1990, Jun 1990	Jan 1990	2020b	Mar 2020, Sep 2020	Jan 2020
1991a	Jan 1991	Jun 1990	2021a	Feb 2021	Sep 2020
1991b	Feb 1991, Aug 1991	Jan 1991	2021b	Jul 2021	Feb 2021
1992a	Jan 1992	Aug 1991	2022a	May 2022	Jul 2021
1992b	Mar 1992, Aug 1992	Jan 1992	2023a	Feb 2023	May 2022
1993a	Jan 1993	Aug 1992	2023b	May 2023	Feb 2023
1993b	Mar 1993, Sep 1993	Jan 1993	2024a	Feb 2024	May 2023
1994a	Jan 1994	Sep 1993	2024b	Jun 2024	Feb 2024
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			

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.