Can U.S. Treasury Markets Add and Subtract?*

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Abstract

Treasury markets respond to the news in CBO cost estimates of individual bills about the future funding requirements from pending legislation. Treasury yields increase on days with major deficit-increasing bills, driven by an increase in expected inflation and nominal term premia, along with a decrease in convenience yields. The effects are three times larger for cost revisions for emergency spending proposals, which are unfunded and have a high probability of enactment. Our high-frequency estimates imply that a 1 percentage point one-time increase in deficits/GDP increases the 10-year nominal yield by 0.75 bps. This effect is equivalent to a 6.75 bps increase in yields for a persistent shock to deficits. Investors use these cost releases to learn about the U.S. fiscal stance. In a model with learning, we find that investors attributed a significant portion of the deficit news from cost releases to revisions in policy parameters and that 57% of the total deficit impact was expected to be unbacked.

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The lack of enforcement and credibility in Congressional budget rules makes it challenging to ascertain the precise trajectory of fiscal policy, as lawmakers have consistently deviated from their official revenue and spending targets in recent decades.[1] An important contributor to these biases in budget targets and rising realized deficits is the increasing use of off-budget spending and frequent loosening of fiscal rules since the late 1990s, underscoring the loss of fiscal discipline.[2] When fiscal rules are not enforceable, the funding requirements from pending legislation are informative about the U.S. fiscal trajectory.

We show that cost estimates for individual legislative proposals from the Congressional Budget Office (CBO) are a regular source of news about Congress' incremental funding needs from legislative agendas (including off-budget spending) and changes in budget rules. Each year, the CBO provides hundreds of cost projections for legislative proposals at horizons of up to ten years. These cost estimates are published after committee approval but before voting on the bill. We collect the cost releases for all bills introduced by Congress from 1997 to 2022—including revisions in cost estimates—totaling 15,533 cost projections. The CBO has an informational edge relative to market participants because its analysts provide technical assistance in the early stages of the bill and have direct access to the bill's legislators, giving analysts a unique glimpse of the bill's scale and implementation.

We take a granular approach to extracting surplus news from individual legislative proposals because most enacted bills entail multi-year cash flows, implying that a significant fraction of the realized surplus today was determined by past legislative actions. We show that the cost releases provide forward-looking and daily updates on Congress' funding needs from the continuous lawmaking process, which is informative about future realized spending over the next decade. Indeed, Congressional Budget Committees use the CBO cost estimates to set future budget targets. We argue that investors use the incoming fiscal news—including the CBO cost releases—to learn about

[1] Auerbach and Yagan (2024) attributes the weak enforcement and credibility in US fiscal rules to the lack of a supranational government or constitutional restriction behind any enacted budget rules.

[2] In a supplemental note to this paper, Gomez Cram, Kung, and Lustig (2024) describe the increasing use of off-budget spending categories since the 1990s, such as emergency spending and OCOs, revisions in spending limits, waivers of mandatory spending limits, among others. This note also documents the large biases in surplus targets from the executive branch and Congress across horizons.

the unprecedented shift in the stance of fiscal policy over our sample period.

Aggregating the multi-year cash flow estimates from CBO cost releases provides a measure of each proposal's budgetary impact. We first establish that these cost estimates contain fiscal news by regressing daily changes in Treasury values on these cost revisions. We focus on the aggregate Treasury value because it is backed by the present value of future surpluses. Cost revisions projected to increase deficits systematically decrease Treasury values and increase Treasury yields. Treasury yields do not show evidence of pre-trends before the releases and exhibit an immediate and permanent response that grows in magnitude over subsequent days. Our regression evidence remains robust after controlling for a wide range of macroeconomic news around the cost releases.

The estimated effects on Treasury values are concentrated around cost releases projecting large deficit increases, which characterize over 80% of the proposals in our sample. We identify proposals with a large budgetary impact and compute Treasury value changes around their report dates. These large deficit-increasing proposals (e.g., tax cuts or spending increases) increase 10-year Treasury yields on average by 0.38 basis points. The cumulative increase in yields on these days exhibits a smooth downward trend summing to approximately 433 basis points at the end of our sample period.

We examine the relevant channels for which Treasury portfolio values adjust to budgetary news by examining the movements in nominal government discount rates and expected inflation. Nominal term premia increase with a cumulative effect of 2 percentage points, while convenience yields decrease by 0.8 percentage points. following the cost releases of large deficit-increasing proposals. In contrast, short rates and Treasury default risk show no significant movements. Market expectations of inflation increase across horizons, with the 10-year inflation swap rate rising by 164 bps. These increases in expected inflation and nominal term premia drive up long-term nominal yields, with the 10-year yield rising by a cumulative 433 bps. A decomposition of the 10-year nominal yield response attributes 39% to expected inflation, 44% to nominal term premia, 17% to convenience yields, and insignificant effects to nominal short rates and credit risk.

Fed policy imputed a secular downward drift to long-term bond yields over this period (Hillenbrand, 2025). The cumulative decline of the 10-year nominal yield on FOMC meeting days is 318 basis points, effectively offsetting the cumulative effect of large

negative proposals. Most of the FOMC-induced yield changes accelerated after the Fed's large-scale asset purchases at the start of the Financial Crisis in 2008, suggesting that the Fed may have been leaning against the fiscal wind. See Hall and Sargent (2022) who compare U.S. fiscal and monetary policy during the pandemic and the world wars.

While the systematic price responses around the cost releases suggest that they contain fiscal news relevant to Treasury investors, we would also like to distinguish the impact of the bill's cash flow news from potential revisions in the bill's enactment probability. To better isolate cash flow news, we focus on the subset of spending proposals with the emergency designation. Emergency spending bills are unfunded and typically have strong bipartisan support. Congress has increasingly used the emergency designation to circumvent budget rules over the past few decades, even outside crises.[3] Strong bipartisan support implies that the ex-ante probability that these emergency proposals are enacted is close to one, allowing us to better isolate the expected cash flows for the proposal. Bypassing budget rules implies that there are no expected fiscal offsets over the budgeting horizon (i.e., 5-10 years) to fund these emergency bills, implying that the cost estimates are more likely to capture the direct cash flow impact of the bill in the near term.

We extract deficit news by taking revisions from consecutive cost estimates within an emergency proposal. Before any formal CBO cost release, investors may form expectations about these cost estimates. For larger emergency bills, we often observe an approximate dollar figure publicly circulated before the first formal CBO cost release, allowing investors to anchor their expectations about the size of the bill. We obtain these informal estimates from White House requests, Congressional committees, leadership negotiations, or media reports preceding the first public CBO report. We then compute the cash flow revision in the first CBO cost release relative to these informal estimates to obtain a full set of revisions that we interpret as cash flow surprises within a bill.

Regressing Treasury values and yields on our cash flow surprise measure, we find that a one-time 1% increase in the present value of deficits scaled by GDP over the budgeting horizon corresponds to a 0.75 bps increase in 10-year nominal yields after one day. This point estimate is conservative because the effect grows to approximately 2 bps after one

[3] Boccia and Lett (2024) surveys how the increasing trend of emergency spending and other off-budget activities by Congress has contributed to the growing deficit.

week as the event window expands. Given a deficit persistence of 0.9, this implies a cumulative increase in yields of approximately 6.75 bps ($\approx 0.75 \times 0.9/(1-0.9)$) to 18 bps ($\approx 2 \times 0.9/(1-0.9)$) in response to a 1% increase in the deficit-to-GDP ratio.

To further contextualize these estimates, we compute the revisions in the present value of deficits from the CBO Long-term Budget Outlook reports. The 2023 report (projecting deficits from 2023 to 2053) indicates a 246% increase, while the 1997 report (projecting deficits from 1997 to 2031) implies a -7.01% change, resulting in a total increase of 253% of GDP. Applying our elasticity estimates, this change corresponds to an increase in 10-year nominal yields of at least 1.95 percentage points.

It is important to note that the Treasury response reflects any cash flow news from the individual bill and any aggregate news about surpluses or government discount rates conveyed in the cost releases. The first part of our analysis has focused on extracting cash flow news only about the individual proposal from the cost releases. However, the cash flow revision may not only be attributed to an additive shock but could be due to revisions in the policy rule. The second part entertains this possibility by allowing for the cost releases to reveal changes to the aggregate fiscal stance or long-run expectations of fiscal offsets (which relate to aggregate surpluses or discount rates). Our CBO sample occurs in an unusual period of the U.S. fiscal history, marked by a radical departure in its fiscal stance. We show that professional analysts had not predicted the drift in deficits at the start of our sample but had to learn about it using incoming data.

We find persistent biases and continual downward revisions in analyst forecasts inconsistent with a standard full information rational expectations (FIRE) framework. Analysts strongly revise their forecasts about surpluses downwards around the large negative cost releases, aligning with the yield increases on these days. In addition to providing cash flow news about individual proposals, the analyst forecasts, therefore, suggest that the cost releases are also informative signals about the trend in aggregate deficits.

We relax full information and allow the cost releases to contain news about the pure additive cash flow component and revisions in the policy parameters and states from Bayesian learning in a present value framework. We capture the fiscal stance at two different horizons. The policy parameters governing surpluses and government discount

rates over the 10-year budgeting horizon capture the near-term fiscal stance, while the parameters governing the expected debt burden in 10 years capture the long-run fiscal stance (e.g., long-term expectations of tax increases or spending cuts arising from a fiscal consolidation).

Given the sharp departure from the fiscal discipline in the 1990s, investors initially assigned a low probability to the actual path of rising deficits over the subsequent decades. A high intensity of large negative cost releases corresponded to a sequence of deficit shocks and allowed investors to learn about the loosening of fiscal policy, reinforcing the devaluation of Treasurys. We also find that investors expected that some of the near-term deficit news over the budgeting horizon would eventually be offset by long-run tax increases or spending cuts (57 cents of every dollar in the fiscal expansion is passed through to Treasury valuations). Running regressions with model-implied data suggests that a 1% increase in the present value of deficits scaled by GDP over the 10-year budgeting horizon corresponds to a 3.39 bps decline in Treasury values, and assuming a Treasury portfolio duration of four years, this implies a 0.85 bps rise in nominal yields, both consistent with our empirical estimates. Our model attributes a significant portion of the deficit news from cost releases to revisions in policy parameters that reinforce the negative cash flow shocks.

We relate to the empirical literature linking government debt valuations to surplus news using budget identities (e.g., Berndt, Lustig, and Yeltekin (2012), Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2024a), Cochrane (2022), Coibion, Gorodnichenko, and Weber (2021), and Hilscher, Raviv, and Reis (2022)). We distinguish our paper by exploiting high-frequency and granular data about the cash flows of individual legislative proposals to isolate when bond investors learn about future surpluses, evidenced by the significant response of Treasury valuations to cost releases in daily event windows.

Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2024b) do not find evidence that Treasury values respond to news about future surpluses using aggregate data at a quarterly frequency. We provide suggestive evidence that the actions of the Fed may have been counteracting the effects of these fiscal shocks over our sample, making it challenging to identify the effect of surplus news on Treasury values at lower frequencies. Our paper contributes to the small but growing literature on the pricing of fiscal risk in bond markets

(Dai and Philippon, 2005; Bretscher, Hsu, and Tamoni, 2020; Corhay, Kind, Kung, and Morales, 2023). We find that large negative proposals steepen the term structure, consistent with Bretscher et al. (2020)'s findings that government spending predicts bond excess returns. While there is a large literature on high-frequency identification of the effects of monetary policy shocks on interest rates and bond yields, especially around FOMC announcements starting with Kuttner (2001); Cochrane and Piazzesi (2002); Nakamura and Steinsson (2018), our paper is the first to use this approach for fiscal shocks.[4]

Our approach to measuring surplus news at the bill level and extracting relevant information from cost projections builds on the narrative approach to constructing fiscal shocks (e.g., Romer and Romer (2010), Ramey (2011), Mertens and Ravn (2012), Guajardo, Leigh, and Pescatori (2014), Alesina, Favero, and Giavazzi (2019), Drautzburg (2020), Bianchi, Gómez-Cram, and Kung (2024), and Hazell and Hobler (2024)). We show that the CBO cost projections at the bill level reveal fiscal news with significant pricing implications.

In our model, bond investors learn about long-run dynamics in macroeconomic data (e.g., see Croce, Lettau, and Ludvigson, 2015; Collin-Dufresne, Johannes, and Lochstoer, 2016; Gomez Cram and Lawrence, 2024; Kozlowski, Veldkamp, and Venkateswaran, 2020; Johannes, Lochstoer, and Mou, 2016; Farmer, Nakamura, and Steinsson, 2024; Giacoletti, Laursen, and Singleton, 2021; Li, Van Nieuwerburgh, and Renxuan, 2025). We build on this literature by showing that Bayesian investors who are learning about the persistent trend in deficits through incoming cost releases in a present value framework can generate bond price drifts.

In traditional macro models, monetary policy has a small influence on long-term real rates. To anchor short rates, central bankers rely on measures of the equilibrium real rate that are assumed to be invariant with respect to monetary policy (See, e.g., work by Laubach and Williams, 2003; Holston, Laubach, and Williams, 2017, on rstar). Recently, there has been more evidence that monetary policy impacts long-term real rates (Hanson

[4]In an influential earlier study, Laubach (2009) computes the response of forward rates to changes in the CBO's annual projections for the deficit/GDP ratio. Laubach (2009)'s estimates of the elasticity of yields with respect to deficits are much larger but his work relies on annual revisions in the overall CBO projections.

and Stein, 2015; Hillenbrand, 2025; Bianchi, Lettau, and Ludvigson, 2022). Our findings suggest that the Fed may have been actively neutralizing the effect of fiscal news on long-term real rates, especially after the Financial Crisis in 2008.

1 Data and measurement

This section first describes the information provided by the cost estimates of individual legislative proposals from Congress. We then provide a present value framework for interpreting the news content in the cost estimates.

1.1 CBO cost estimates

The Congressional Budget Act of 1974 (CBA) established centralized budgeting with revenue and spending targets specified in the budget resolution. The CBA also created the Congressional Budget Office (CBO), which is a non-partisan agency that provides hundreds of cost estimates of legislative proposals and other budgetary information each year. The CBO is legally required to provide cost estimates for a legislative proposal after committee approval but before it is voted on by the full Senate and House.[5] These cost estimates are designed to calculate the impact of legislative proposals on the federal budget across multiple years. The CBO promotes transparency by posting cost estimates on its website (`cbo.gov`), granting access to members of Congress, their staff, and the public. Congress can use these estimates to enforce budget rules.

The CBO gets a unique glimpse of the legislative path of a given proposal before the public cost release.[6] For example, CBO analysts have direct access to the legislators of the bill to gather specific details of the scale and implementation of the bill used to prepare the estimates. The analysts also provide confidential cost estimates of alternative legislative options in the early stages of the bill and before the public cost release to help guide the congressional committee in selecting the legislative path for the bill. In that sense, the public cost estimates reflect private information about legislators' preferences

[5] On average, the cost estimates occur 60 days before the congressional vote on the proposal and 150 days after the proposal is introduced.

[6] See, for example, "How CBO Prepares Cost Estimates" (`www.cbo.gov/publication/53519`).

regarding the size and scope of the bill.

We analyze all legislative proposals introduced by Congress covering the 105th Congress (1997-1998) to the 117th Congress (2021-2022), yielding 15,050 unique proposals. Our sample starts in 1997 because that is when the cost releases began to comprehensively cover all proposed legislation. For each bill, we obtained the CBO published cost estimate along with any updates in the cost estimates, detailing the projected cash flow effects of the proposed legislation on three key components of the federal budget for the current year and the subsequent five to ten years: discretionary spending, mandatory (or direct) spending, and federal revenues.[7] These cost estimates provide a comprehensive coverage of legislative proposals, including policy agendas, major budgetary events (e.g., Reconciliations, Consolidated Appropriations, Supplemental Appropriations), and revisions in budget rules. Figure B.1 illustrates that there is significant coverage by major media outlets in the days following the cost releases. Appendix C provides examples of the cost estimates.

From each cost estimate document, we collect the net surplus impact by year, bill number, title, legislative status, and publication date. We augment the data gathered from the cost estimate document with key legislative actions and corresponding dates (i.e., when the bill was first introduced in the House and Senate, committee meetings, congressional vote, and if the bill was signed into law by the president) from `congress.gov`.

We measure each proposal's budgetary impact by aggregating the multi-year cash flow projections, where positive (negative) cash flows are defined as net surplus (deficit) contributions. For a proposal z with cost estimates published at time $t + \Delta t$, we first normalize its projected cash flows by nominal GDP forecasts for the corresponding years. We then compute the discounted sum of these surplus-to-GDP ratios, $\hat{\text{CF}}^{(j)}_{z,t+\Delta t}$:

$$\texttt{cbo}^{(z)}_{t+\Delta t} \equiv \sum_{j=1}^{T} \nu^{j-1} \hat{\text{CF}}^{(j)}_{z,t+\Delta t}, \tag{1}$$

where ν is the discount factor set to 0.997.[8] The nominal GDP forecasts are from the

[7] For bills authorizing discretionary activities or programs (requiring subsequent funding), cost estimates typically offer budgetary details for a 5-year horizon as directed by the Budget Act. Bills that affect mandatory spending or revenues stipulate a 10-year horizon.

[8] The parameter ν is the steady-state discount factor $\nu \equiv e^{-\hat{r}_g}$ in the log-linear approximation of

most recent CBO Budget and Economic Outlook report prior to the cost estimate of proposal z.

The CBO typically updates its cost projections for bills with a substantial budgetary impact as the legislation progresses through Congress. When such updates occur, we construct $\texttt{cbo}^{(z)}_{t+\Delta t}$ using the initial cost release and subsequently update it based on the revisions in projected cash flows between consecutive estimates for the same bill z.[9] In some cases, the cost estimate appears first on the relevant Congressional Committee reports before being posted on the CBO website. When this occurs, we set $t + \Delta t$ to the earlier posting date if both cost estimates are the same. If the estimates differ, we compute revisions in the projected cash flows and use these revisions when constructing $\texttt{cbo}^{(z)}_{t+\Delta t}$. Hence, by tracking revisions within an individual bill and between Congressional committee reports, we capture both the timing and magnitude of incremental changes in information from the cost projections.

Figure 1 plots our series for $\texttt{cbo}^{(z)}_{t+\Delta t}$, where we sum the cash flow contributions of cost releases reported on the same day. The vast majority of the proposals (81%), if enacted, would increase deficits, reflecting the large reversal in fiscal policy starting in the late 1990s toward less fiscal discipline in the most recent two decades. The average size of a proposal is -0.19% of GDP with a standard deviation of 1.30% of GDP. Around 20% of these proposals are later enacted as law.

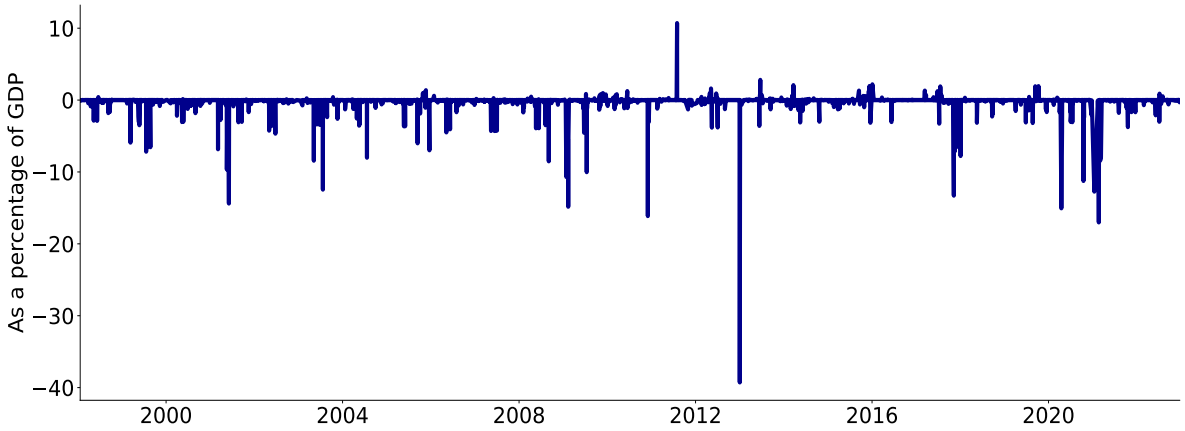
We focus on the budgetary effects of legislative actions as a source of surplus news because they are the most important driver of the CBO's aggregate surplus revisions reported in the Budget and Economic Outlook documents. Legislative changes account for 56% of the variance in CBO's aggregate surplus revision projections. Economic changes (updates to the agency's economic forecast) and technical changes (a residual category) each account for 22% of the variance. Appendix D provides details of this aggregate decomposition of surplus revisions.

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the budget identity, where $\hat{r}_g$ denotes the unconditional mean of the log inflation and growth-adjusted aggregate Treasury portfolio return.

[9] For example, the American Rescue Plan Act of 2021 (H.R.1319) received multiple CBO cost estimates. The initial estimate on February 20, 2021, projected a 10-year budgetary impact of $1,910,134 million. The CBO later revised this estimate to $1,921,087 million on March 3, 2021 (as engrossed by the House) and to $1,844,112 million on March 10, 2021 (as passed by the Senate). In this case, the first cost estimate is $1,910,134 million, while the revisions—computed as the difference between consecutive projections for the same bill—amount to $10,953 million and -$76,975 million, respectively.

Fig. 1. **Bill-level cash flow contributions**



Notes: This figure shows the aggregate cash flow contribution of proposal z at time $t + \Delta t$, expressed as $\texttt{cbo}^{(z)}_{t+\Delta t} \equiv \widetilde{\mathbb{E}}_{t+\Delta t} \sum_{j=1}^{T} \nu^{j-1} \hat{S}^{(z)}_{t+j}$. The subscript $t + \Delta t$ indicates the release date of the cost estimate. The figure aggregates the cost estimates at the daily level by summing the costs of each bill reported on the same day. The steady-state annual discount rate, denoted by $\nu = 0.96$, is calculated as the average annual return of the nominal government debt portfolio, adjusted for growth and inflation. The dataset encompasses 15,533 unique cost estimates, spanning from the 105th Congress (1997-1998) to the 117th Congress (2021-2022).

1.2 Link between cost estimates and Treasury values

We look at Treasury values because they can be linked to the present value of surpluses using the government budget identity. Specifically, the current log market value of the government debt-to-GDP ratio, b_t, can be expressed in terms of future surplus-to-GDP ratios, $\hat{S}_{t+j}$, and government discount rates adjusted for expected growth and inflation, $\hat{r}_{gt+j}$, as follows:

$$b_t = \alpha^\star + \mathbb{E}_t \sum_{j=1}^{\infty} \nu^{j-1} \gamma \hat{S}_{t+j} - \mathbb{E}_t \sum_{j=1}^{\infty} \nu^{j-1} \hat{r}_{gt+j}, \tag{2}$$

where $\mathbb{E}_t(\cdot)$ denotes the bond investor's conditional expectations, $\nu \equiv e^{-\hat{r}_g}$ and $\hat{r}_g$ is the steady-state discount rate adjusted for growth and inflation, and $\alpha^\star$ and γ are other constants of the linearization. Details of the approximation and the expressions for $\alpha^\star$ and γ are contained in Appendix E.

We use the log Treasury market value changes to test if there is news embedded in the cost releases. We assume that the response of log debt to GDP to a cost release is

dominated by changes in the Treasury market value in narrow event windows, so that

$$\Delta b_{t,t+1} \equiv \log\left(\frac{B_{t+1}}{Y_{t+1}}\right) - \log\left(\frac{B_t}{Y_t}\right) \approx \log(B_{t+1}) - \log(B_t), \tag{3}$$

where B_t denotes the aggregate market value of nominal government debt held by the public at time t, and Y_t is nominal GDP. We compute B_t following Hall and Sargent (2011), with details provided in Appendix A.

We then infer the news content using the Treasury value response to cost releases in a present value framework:

$$\underbrace{\Delta b_{t+\Delta t}}_{\substack{\text{Treasury}\\ \text{response}}} = \underbrace{\Delta \texttt{cf}^{(z)}_{t+\Delta t}}_{\substack{\text{cash flow news}\\ \text{of proposal z}}} + \underbrace{\Delta \texttt{CF}_{t+\Delta t}(\texttt{current \& future bills}\backslash z)}_{\text{aggregate surplus news excluding z}} - \underbrace{\Delta \texttt{DR}_{t+\Delta t}.}_{\substack{\text{discount rate}\\ \text{news}}} \tag{4}$$

Changes in log Treasury values, $\Delta b_{t+\Delta t}$, around cost releases at time $t+\Delta t$ suggest that $\texttt{cbo}^{(z)}_{t+\Delta t}$ contains news. Equation (4) indicates this news could directly relate to cash flows of proposal z, measured by $\Delta \texttt{cf}^{(z)}_{t+\Delta t}$. We first focus on extracting the cash flow news directly from the cost estimates pertaining to individual proposals.

The last part of our paper entertains the possibility that the cash flow revision from the first part may not only be attributed to a pure additive cash flow shock but could also be due to revisions in the policy rule. If part of the cash flow shock from the bill was attributed to revisions in the fiscal rule, this would generate changes in $\Delta b_{t+\Delta t}$ per the present value relation, which is reflected in the last two terms relating to aggregate cash flows and discount rates. Appendix E details how individual bill cash flows relate to aggregate Treasury values.

2 News in cost projections

Motivated by the present value relation, we first establish that these cost estimates contain fiscal news by regressing daily changes in Treasury values on these cost revisions

$$\Delta b_{t-1,t+1} = a + b \cdot \texttt{cbo}^{(z)}_{t+\Delta t} + \epsilon_{t+1}, \tag{5}$$

Table 1. **Treasury value and bond yield responses around cost releases**

	A. Treasury values		B. 10-Year bond yields	
	(1)	(2)	(3)	(4)
$\texttt{cbo}^{(z)}_{t+\Delta t}$	1.44	1.32	-0.36	-0.33
t-statistic	[2.78]	[2.53]	[-2.34]	[-2.19]
Constant	0.83	0.69	-0.23	-0.20
t-statistic	[0.59]	[0.49]	[-0.84]	[-0.73]
R^2 in %	0.13	3.07	0.19	2.44
Observations	3,259	3,259	3,259	3,259
Controls	No	Yes	No	Yes

Notes: Panel A presents regression results for the equation:

$$\Delta b_{t-1,t+1} = a + b \cdot \texttt{cbo}^{(z)}_{t+\Delta t} + \epsilon_{t+1},$$

where $\Delta b_{t,t+1}$ is the daily change in the value of the government debt portfolio computed using procedures similar to Hall and Sargent (2011). $\texttt{cbo}^{(z)}_{t+\Delta t}$ denotes the aggregate surplus of each proposal, where we sum the cash flow contributions of cost releases reported on the same day. In column (2), we control for macroeconomic news coinciding with the measurement window from day $t-1$ to $t+1$ and the cumulative Treasury value changes realized over the previous week. Treasury value changes are measured in basis points, while $\texttt{cbo}^{(z)}_{t+\Delta t}$ is expressed as a percentage of GDP. t-statistics are reported in squared brackets using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$. Panel B reports similar results using changes in the 10-Year nominal yield, measured in basis points.

where $\Delta b_{t-1,t+1}$ measures the two-day change in log Treasury market value. We use a two-day window because cost releases after market hours will affect Treasury values on the next trading day. We aggregate the cash flow contributions on days with multiple proposals. The error term is denoted by ϵ_{t+1}, while a and b are parameters. If the CBO cost release did not contain any news about government cash flows or discount rates (or other economic news), the slope coefficient, b, would be zero.

Column 1 in Panel A of Table 1 presents our baseline results. The coefficient on $\texttt{cbo}^{(z)}_{t+\Delta t}$ is positive and statistically significant with a t-statistic of 2.78. In terms of economic magnitude, a one standard deviation decrease in projected cash flow contributions from the legislative proposal (equivalent to 1.30% of GDP) leads to a 1.87 basis point decline in the government bond portfolio value. These results indicate that announcements of increases in deficits from changes in spending and revenues reduce Treasury values.

Our previous regression specification computes Treasury value changes in a daily event window around CBO cost releases. The rationale is that our cash flow measure

$\texttt{cbo}^{(z)}_{t+\Delta t}$ reveals substantial budgetary news within this window, enabling a high-frequency identification strategy. However, one concern is that other news affecting bond prices might systematically occur within this tight event window. We next incorporate a comprehensive set of controls in our regression to address potential concerns about these confounding effects.

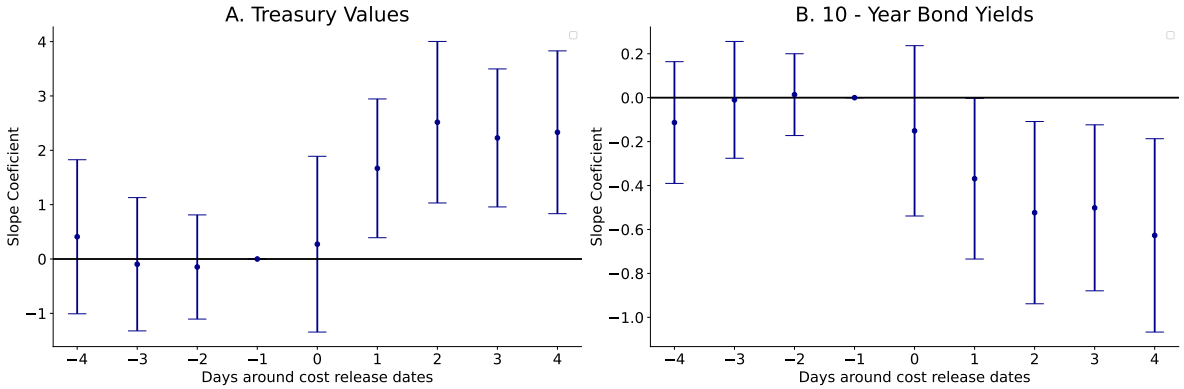
We augment specification (5) with macroeconomic news releases that coincide with our measurement window from day $t-1$ to $t+1$. Controlling for macroeconomic news is important as they explain a substantial portion of yield curve movements on days with scheduled macro announcements, as documented by Gürkaynak, Kısacıkoğlu, and Wright (2020). Using Bloomberg Professional Service, we standardize surprises for the top 20 macroeconomic indicators, including FOMC announcements, Non-Farm Payrolls, and Consumer Price Index releases. We compute these surprises as the standardized difference between actual and median forecasted values. Table A.1 in the Appendix lists the macroeconomic announcements used as controls.

We also control for cumulative Treasury value changes computed over a weekly window from day $t-7$ to $t-1$. While bond prices at the start of our event window should reflect all public information, this control accounts for other relevant news occurring before the cost releases that may generate pre-event price drifts correlated with our cash flow contribution measure.

Column 2 of Table 1 demonstrates that adding these controls to specification (5) has minimal impact on our main result. The coefficient decreases slightly from 1.44 to 1.32 and remains statistically significant with a t-statistic of 2.53. Next, we extend our event window to one week before and after the cost release date to examine pre-trends and longer-term Treasury value responses. Panel A in Figure 2 shows no evidence of pre-trends, with estimated coefficients close to zero before the announcement. Moreover, the Treasury value responses grow in magnitude over subsequent days without exhibiting reversals after the release date.

Panel B in Table 1 presents results for the 10-year nominal yield. The coefficient on $\texttt{cbo}^{(z)}_{t+\Delta t}$ is negative and statistically significant with a t-statistic of -2.34. Since we define cash flows as surpluses, the negative coefficient indicates that bond yields rise when projected deficits increase. The results remain robust when controlling for a wide range

Fig. 2. **Treasury value responses around bills' cost estimates**



Notes: Panel A plots the estimated response of Treasury values to CBO cost releases over different horizons. Each point represents the coefficient b from the regression:

$$\Delta b_{t-1,t+h} = a + b \cdot \texttt{cbo}^{(z)}_{t+\Delta t} + \epsilon_{t+h},$$

where $\Delta b_{t-1,t+h}$ denotes the cumulative change in the value of the government debt portfolio from day $t-1$ to day $t+h$, and $\texttt{cbo}_{t+\Delta t}$ measures the aggregate surplus of legislative proposals announced on the same day. Treasury value changes are in basis points, while $\texttt{cbo}_{t+\Delta t}$ is expressed as a percentage of GDP. The bars represent 95% confidence bands computed using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$. Panel B reports similar results using changes in the 10-Year nominal yield, measured in basis points.

of macroeconomic announcements (Column 2). Panel B of Figure 2 shows no evidence of pre-trends before the releases while exhibiting a permanent response that grows in magnitude over subsequent days.

Figure B.2 shows the sensitivity of yields to $\texttt{cbo}^{(z)}_{t+\Delta t}$ across the term structure, plotting regression coefficients and confidence intervals for each maturity. The impact of cash flow projections on nominal yields increases with maturity. The effect on the one-year yield is small and statistically insignificant but becomes significant beyond the two-year horizon and grows larger for longer maturities.

2.1 Measuring the effects of large deficit proposals

The regression evidence suggests that cost estimates contain fiscal news. This subsection shows that the news in our cost estimates is concentrated among proposals projected to considerably increase deficits if enacted. Treasury values decline significantly following these cost releases, attributed to higher expected inflation and nominal term premia and lower convenience yields, as reported in Subsection 2.1.3.

We classify legislative proposals into binary categories by sign (`positive` and `negative`) and by size (`small` and `large`) based on the cash flow contribution measure. We first categorize proposals into those with `positive` and `negative` values of $\texttt{cbo}^{(z)}_{t+\Delta t}$ separately. Within each sign category, we rank proposals with the largest cash flow contribution in absolute value (i.e., $|\texttt{cbo}^{(z)}_{t+\Delta t}|$) in a 3-month rolling window. We then define `large` proposals as those exceeding the median absolute value in each sign category, yielding `large positive` and `large negative` subsets of proposals. Using a rolling window avoids lookahead bias in our selection criteria.[10]

Our identification assumption is that the change in Treasury values on days when there is a `large` proposal is dominated by the news content of the cost release, as small bills likely have a negligible impact on Treasuries given their minimal effect on the budget. In all of our tests, we exclude all large proposal days that coincide with a three-day window around FOMC meeting days. The rationale for excluding these days is that FOMC meeting days might drive the variation of bond returns on those days. We also show that our results are robust to excluding days with large macro announcements.[11]

2.1.1 Treasury value responses

We compute the average daily Treasury value changes conditioning on the `large negative` and `large positive` proposals in Table 2. Panel A shows that the average daily change on days with large negative proposals is -1.84 bps (t-statistic =-2.20), while on other days, the average daily effect is 0.57 (t-statistic = 1.34). The average Treasury value change on all days is close to zero and lacks statistical significance (0.07, t-statistic =0.20), reflecting how the significant negative price effect on large negative proposal days (comprising 20% of the trading days) offsets the positive effect on the remaining trading days.

We also measure the economic relevance of the daily estimates by summing the Treasury value changes over our sample in Panel A of Table 2. The cumulative change on large negative proposal days is approximately -21%. In contrast, the cumulative change is 25% on other days. We assess the statistical significance of these cumulative effects by

[10]Table B.3 in the Appendix shows that our results are robust to varying both the size cutoff for large proposals beyond our baseline median threshold and the length of our three-month rolling window.

[11]Table B.1 in the Appendix shows that both the daily and cumulative changes in Treasury values are larger when we exclude days coinciding with FOMC meetings or major macroeconomic releases.

Table 2. **Changes in Treasury values**

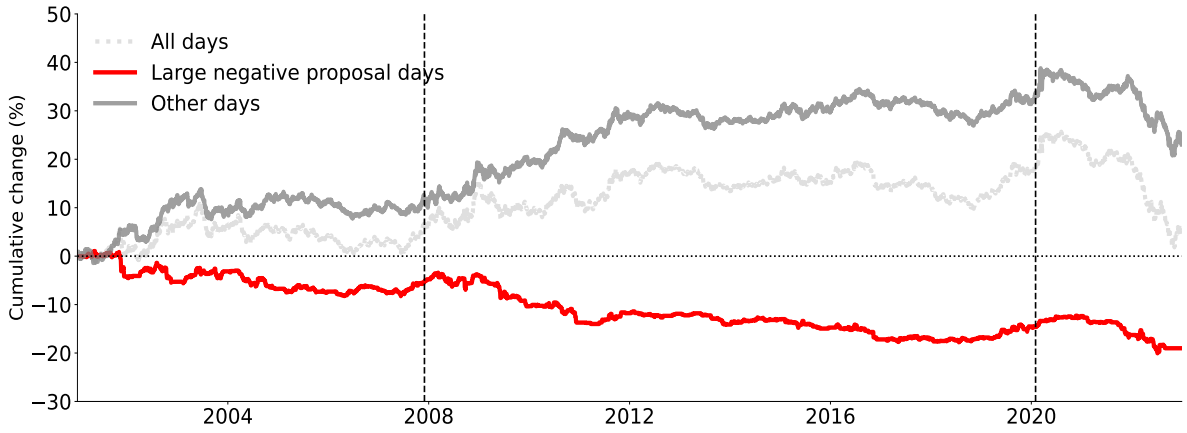
A. Large negative proposal days	Large negative proposal days (1)	Other days (2)	All days (3)
Mean bps	-1.84	0.57	0.07
t-statistic	[-2.20]	[1.34]	[0.20]
p-value	(0.02)	(0.92)	–
Cumulative change in %	-20.70	24.75	4.06
p-value	(0.00)	(0.98)	–
Observations	1,125	4,372	5,497
B. Large positive proposal days	**Large positive proposal days (1)**	**Other days (2)**	**All days (3)**
Mean bps	-0.64	0.10	0.07
t-statistic	[-0.34]	[0.25]	[0.20]
p-value	(0.38)	(0.54)	–
Cumulative change in %	-1.08	5.14	4.06
p-value	(0.34)	(0.61)	–
Observations	170	5,327	5,497

Notes: This table presents the average daily and cumulative changes in Treasury values, organized across three different sets of days. In Panel A, column 1 reports changes on days with large negative proposals, specifically excluding those that overlap with FOMC meeting days. Correspondingly, in Panel B, Column 1 reports changes on days with large positive proposals, also excluding any day coinciding with FOMC meeting days. Column 2 in both panels reports changes on other trading days, and column 3 reports changes across all trading days. t-statistics are in squared brackets. In parentheses, we report the percentage of simulated Treasury value changes that fall below the actual realizations. To determine these percentiles, we generate 10,000 samples. Each sample randomly selects without replacement 1,125 days and 170 days, corresponding to the number of observations in our actual sample for large negative and positive proposals, respectively. Then, for each of these samples, we calculate the average daily and cumulative changes in the Treasury values.

generating 10,000 samples, each randomly selecting 1,125 and 4,372 days to align with the number of large negative proposal days and the other days in our sample, respectively. We then calculate the cumulative changes in the Treasury values for each random sample. We find that less than 1% of the simulations have cumulative effects below the actual realization of -21% on large negative proposals days. The table reports these one-tailed p-values in parenthesis. Figure B.3 in the Appendix plots the distribution of simulated statistics and actual realization.

The red line in Figure 3 plots the cumulative daily changes on days with large negative

Fig. 3. **Cumulative change in Treasury values on days of large negative proposals**



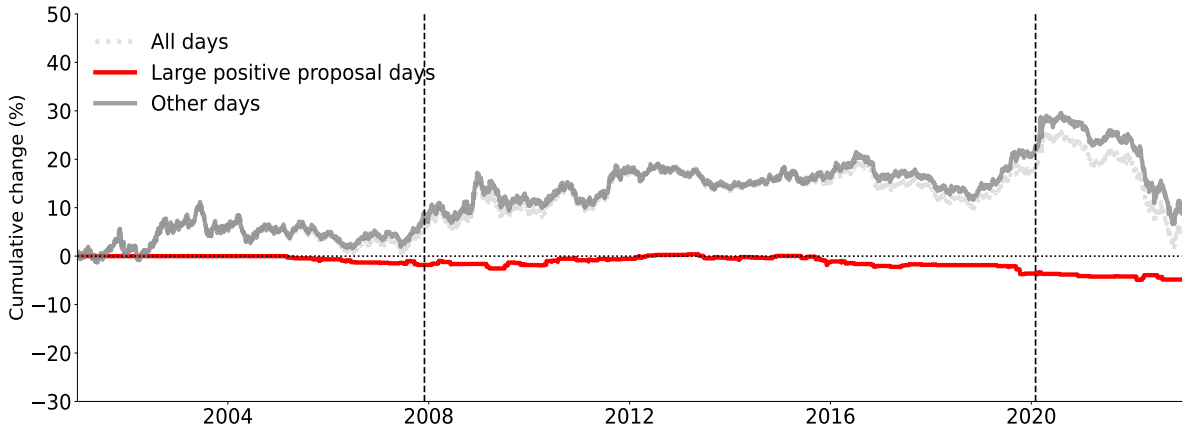
Notes: This figure shows the cumulative change in Treasury values on three different sets of days. The light gray line displays the cumulative change using all trading days. The red line shows the cumulative change using the large negative proposal days that do not coincide with FOMC meeting days. The dark gray line shows the cumulative change using all remaining trading days. The vertical lines denote the start of the global financial crisis and the COVID-19 recession. The sample period runs from January 2000 to December 2022.

proposals and sets the change to zero on days without. The dark grey line shows the cumulative change on the other days without large negative proposals. The light grey line corresponds to the cumulative changes using all trading days in our sample. The red line illustrates a smooth downward trend in the change of Treasury values on large negative proposal days, highlighting that our estimated effects are attributed to a steady flow of news lowering Treasury values and not to a few large observations.

Panel B of Table 2 reports the average and cumulative change in Treasury values on large positive proposal days. The average daily change on these days is close to zero and statistically insignificant (t-statistic = -0.38). The red line in Figure 4 indicates that the cumulative changes on large positive proposal days remain near zero throughout the sample period.[12]

[12]Table B.2 in the Appendix presents separate regression estimates for large negative and large positive proposals. For large negative proposals, we find statistically significant effects on both Treasury values and yields. For large positive proposals, while the point estimates suggest that projected surplus increases raise bond values and lower yields, these effects are not statistically significant, reflecting the limited number of surplus-increasing bills in our sample.

Fig. 4. **Cumulative change in Treasury values on days of large positive proposals**



Notes: This figure shows the cumulative change in Treasury values on three different sets of days. The light gray line displays the cumulative change using all trading days. The red line shows the cumulative change using the large positive proposal days that do not coincide with FOMC meeting days. The dark gray line shows the cumulative change using all remaining trading days. The vertical lines denote the start of the global financial crisis and the COVID-19 recession. The sample period runs from January 2000 to December 2022.

2.1.2 Long-term nominal yields

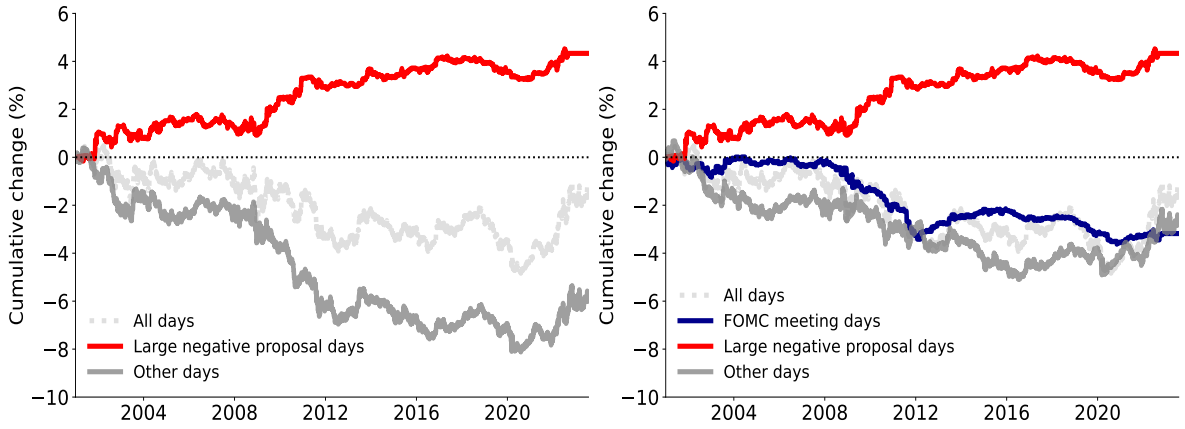
This section documents that long-term nominal yields increase around cost releases projecting large deficit increases. Column 1 of Panel A reports the average daily change in the 10-year zero coupon Treasury yield on days with large negative proposals, excluding FOMC announcement days. The average daily change is 0.38 bps, with a t-statistic of 2.16.

The cumulative change on days with large negative proposals is 433 basis points,[13] while on other days, the cumulative change is -570 basis points. The negative trend on other days accelerated after the financial crisis in 2008, which is illustrated in the left panel of Figure 5. The large positive cumulative effect on days with large negative cost releases partially offsets the negative trend on other days, as evidenced by the small negative average daily change when considering all days.

The right panel of Figure 5 highlights an important source of the negative trend

[13]The reaction in long-term yields to large negative proposals is predominantly attributed to adjustments in nominal term premia rather than changes in the average expected path of future short rates. Specifically, the cumulative change comprises a 1.64 percentage point increase in expected short rates and a 2.69 percentage points in the nominal term premium, totaling a 4.33 percentage points cumulative increase in the nominal yield.

Fig. 5. **Changes in 10-year bond yields**



Notes: The light gray lines denote the cumulative changes in the 10-year nominal bond yield over our sample period. The red lines depict the cumulative changes on large negative proposal days that do not coincide with FOMC meeting days. The dark blue line in the right panel shows the changes on FOMC meeting days. The dark gray lines denote the cumulative changes around the remaining days.

in long-term nominal yields. The blue line corresponds to the cumulative changes in the three days centered around FOMC meetings following Hillenbrand (2025), which documents that Fed policy contributed to the secular decline in interest rates over the past few decades. The negative trend around FOMC days is also exhibited in our sample (cumulative effect of -3.18 percentage points), and accounts for the accelerating decline in interest rates immediately after the Financial Crisis. The red line shows the opposite pattern on the days with cost releases of large negative proposals, offsetting the majority of the effects of monetary policy. Table B.10 in the Appendix tabulates the average daily and cumulative yield changes observed on FOMC meeting days.

The offsetting effects on FOMC days and large negative proposal days also provide a potential explanation for why papers such as Jiang et al. (2024b,a) do not find systematic evidence that surplus news extracted from aggregate surplus data affects Treasury yields at lower frequencies (e.g., quarterly).

2.1.3 Nominal discount rates and expected inflation

We next explore how the Treasury portfolio value adjusts to the budgetary news in the cost releases by examining the responses of nominal government discount rates and expected inflation.

Table 3. **Changes in long-term yields**

	Large negative proposal days (1)	Other days (2)	All days (3)
Mean bps	0.38	-0.13	-0.02
t-statistic	[2.16]	[-1.41]	[-0.30]
p-value	(0.93)	(0.20)	–
Cumulative change in %	4.33	-5.70	-1.37
p-value	(0.99)	(0.01)	–
Observations	1,128	4,518	5,646

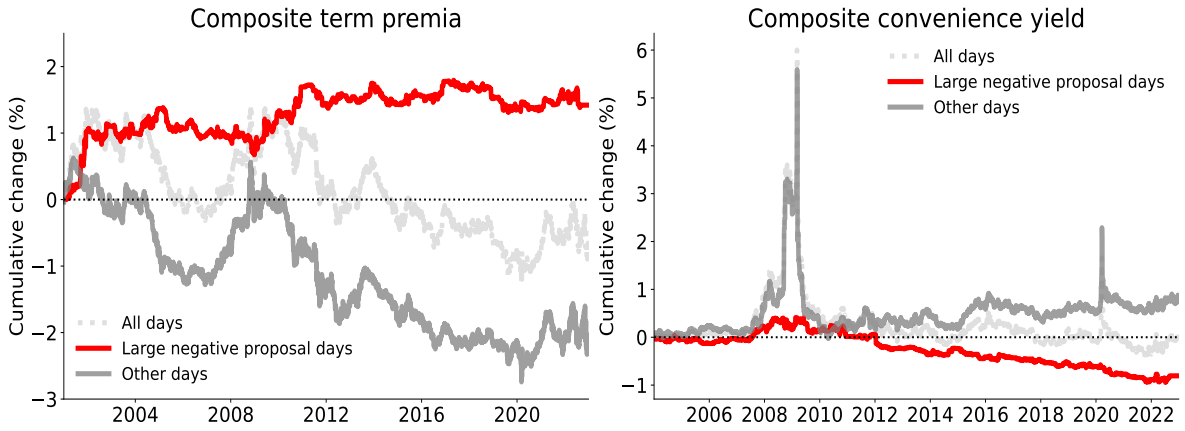
Notes: This table presents the average daily and cumulative changes in the 10-year nominal yield, categorized across three distinct sets of days. Column 1 reports changes on days with large negative proposals that do not coincide with FOMC meeting days. Column 2 reports changes on other trading days, and column 3 reports changes across all trading days. t-statistics are presented within square brackets. We report the percentage of simulated changes that fall below the actual realizations in parentheses.

We start by analyzing how components of the nominal government discount rate respond to cost releases of large negative proposals. We decompose the nominal government discount rate into the convenience yield, default risk, and nominal term premia components at the aggregate Treasury portfolio level and the nominal short rate. Appendix F provides the derivation of this decomposition, which assumes a representative investor deriving utility from nominal government bond holdings (e.g., Krishnamurthy and Vissing-Jorgensen (2012)) and accounts for partial default risk.

The left panel of Figure 6 plots in red the cumulative changes in the composite nominal term premia around days with large negative proposals. This composite measure weights maturity-specific term premia from Adrian, Crump, and Moench (2013)'s affine model by their Treasury market value shares.[14] The cumulative increase over our sample period is 2 percentage points and statistically significant (p-value = 0.99), suggesting systematic increases in term premia on these announcement days. In contrast, the premium shows a downward trend on other days with a cumulative decrease of 270 basis points. Panel A of Table B.4 tabulates these results, while Table B.11 presents the responses for individual maturities.

[14]We compute market weights by maturity by first decomposing outstanding Treasuries into their stripped cash flows. The market value for maturity j equals the total nominal payments due j years from time t multiplied by the price of a zero-coupon bond maturing at $t + j$. We also lag the maturity weights by one day when constructing the composite term premium measure.

Fig. 6. **Changes in the composite term premia and the composite convenience yields**



Notes: The light gray lines show the cumulative change in the composite nominal term premium (left plot) and the composite convenience yields (right plot) over the sample period. The red line shows the cumulative change on large negative proposal days that do not coincide with FOMC meeting days. The dark gray line denotes the cumulative changes around the remaining days.

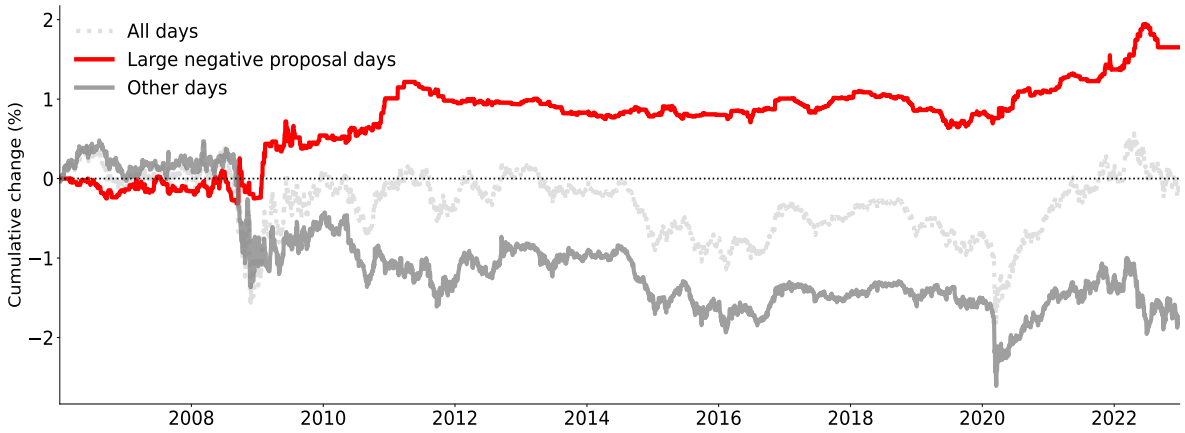
The right panel of Figure 6 plots in red the cumulative changes in the composite convenience yield around cost releases projecting large deficit increases. This yield measure combines maturity-specific Aaa corporate Treasury spreads weighted by Treasury market value shares.[15] The cumulative decline over our sample period is 0.81 percentage points (p-value = 0.10), suggesting systematic decreases in convenience yields on these announcement days. In contrast, the convenience yield shows an upward trend on other days, with a cumulative increase of 0.75 percentage points. Panel B of Table B.4 tabulates these results.

We find no significant movements in Treasury default risk or short rates. We infer default risk from CDS spreads, focusing on the five-year contract given its high trading volume. These CDS spreads show negligible changes around large negative cost releases, with point estimates near zero. Similarly, the three-month Treasury bill rate exhibits no significant response on these days, although it declines on other days during our sample period, reflecting extended monetary policy accommodation. Panels C and D of Table B.4 in the Appendix tabulate these results.

We next investigate how expected inflation contributes to Treasury value responses.

[15]We follow Krishnamurthy and Vissing-Jorgensen (2011, 2012), Acharya and Laarits (2023), and Cieslak, Li, and Pflueger (2023) by using the spread between Aaa-rated corporate bonds and Treasury yields as proxies for convenience yields.

Fig. 7. **Changes in inflation expectations**



Notes: The light gray lines show the cumulative change in 10-year inflation swaps over the sample period. The red line shows the cumulative change on large negative proposal days that do not coincide with FOMC meeting days. The dark gray line denotes the cumulative changes around the remaining days.

Figure 7 plots in red the cumulative changes in inflation expectations around cost releases projecting large deficit increases. We measure inflation expectations using zero-coupon inflation swaps. The cumulative increase in 10-year inflation expectations over our sample period is 1.64% and statistically significant (p-value = 0.05), suggesting systematic increases in expected inflation on these announcement days. In contrast, inflation expectations show no clear trend on other days. Table B.5 tabulates these results, while Table B.9 provides evidence from shorter-maturity swaps.

The expected inflation response is consistent with models of the fiscal theory featuring long-term government debt if the cost releases revealed news about higher deficits or nominal discount rates (e.g., Cochrane (2001) and Corhay et al. (2023)). We presented evidence of higher nominal discount rates, and we will provide evidence for the cash flow news margin in Section 4.

We provide suggestive evidence that decomposes the effects of the 10-year nominal yield by separately considering the effects on the components at the corresponding maturity without imposing the Euler equation (highlighted in equation (F.17) from the Appendix). We find on the large negative days a 0.21 bps change in the 10-year inflation swaps (Table B.5, Column 1), a 0.24 bps change in the 10-year nominal term premia (Table B.10; Column 1) and a -0.09 bps in the convenience yield (Table B.4; Column 1),

and insignificant effects to nominal short rates and credit risk. These estimates suggest that the 10-year nominal yield response on large negative days can be decomposed as 39% to expected inflation, 44% to nominal term premia, and 17% to convenience yields.

2.2 Emergency spending bills

This section focuses on a subset of the proposals that allow us to extract a direct measure of the cash flow surprises. We focus on spending proposals with an emergency designation. These bills are exempt from budget rules (i.e., unfunded), typically have strong bipartisan support, and are fast-tracked. The strong bipartisan support and quick passage suggest a high ex-ante probability that the emergency bills will be passed, allowing us to better isolate the deficit news in the cost releases from potential revisions in the enactment probability. Bypassing budget rules eliminates expectations of near-term fiscal offsets, making their cost estimates more likely to reflect the full budgetary impact.

There has been a significant increase in the share of emergency spending in both the discretionary and mandatory categories in our sample period, allowing Congress to circumvent budget rules and contribute to the rising deficits. For example, emergency spending accounted for around 10% of discretionary spending in the past decade. The rise in emergency spending is a reflection of the gradual erosion of fiscal discipline over the past few decades.

We have 39 unique emergency spending bills in our sample, with an average of two CBO cost estimates for each bill, allowing us to compute revisions within a proposal as it evolves through the lawmaking process. These bills have strong bipartisan support, averaging 283 and 66 yea votes in the House and Senate, respectively, representing 68% support in each chamber. Bills require a simple majority to pass (218 votes in the House, 51 in the Senate), though Senate filibusters often necessitate 60 votes and expedited procedures can require a two-thirds majority. They also move quickly through Congress, averaging 168 days (149 median) from introduction to passage, compared to 275 days (247 median) for other bills.

Panel A of Table 4 estimates how Treasury values respond to CBO cost estimates and subsequent revisions for emergency spending bills, denoted by $\texttt{cbo}_{t+\Delta t}^{(em)}$, where the em

superscript indicates emergency spending. The coefficient of 3.74 (t-statistic = 6.36) is substantially larger than our baseline estimate of 1.32 (Column 2, Table 1) and remains significant even after accounting for macroeconomic news (Column 2). Panel B examines the corresponding effects on long-term nominal yields, finding a coefficient of -1.10 (t-statistic = -4.18, Column 5), which exceeds the baseline estimate of -0.36 (Column 3, Table 1). This effect remains largely unchanged when controlling for macroeconomic news (Column 6).

The initial cost estimate may not capture the surprise as investors may form expectations about these cost estimates before any CBO scoring. However, an approximate dollar figure may be publicly circulated before the first formal CBO cost release, allowing investors to anchor their expectations about the size of the bill. For larger emergency bills, we often observe these informal estimates from White House requests, Congressional committees, leadership negotiations, or media reports preceding the first public CBO report. We now compute the cash flow revision in the first CBO cost release relative to these informal estimates. We interpret this full set of revisions from the emergency proposals as the cash flow surprises.

Columns 3 and 7 of Table 4 report the coefficient estimates using these cash flow surprises. Since we define cash flows as surpluses, negative revisions correspond to deficit news. These estimated coefficients imply that a 1 percentage point increase in the present value of deficits divided by GDP, leads to a 3.03 bps decline in Treasury values (t-statistic = 5.59, Column 3) and a 0.75 bps rise in 10-year nominal yields (t-statistic = -2.79, Column 7). If we assume that the growth rate of GDP equals the discount rate, then this would amount to a $(0.9/0.1) \times 0.75 = 6.75$ basis point increase in the 10-year yield for a typical shock to the deficit/output ratio with a persistence of 0.9.

As an additional robustness test, we regress the cash flow surprises with initial revisions relative to informal numbers on three broad categories of predictors available to investors before the cost release and use the residuals as a regressor.[16] First, we include news from the top 20 macroeconomic indicators over the preceding year and changes in

[16]Recent studies document have also documented predictability of monetary policy surprises by macro news (Miranda-Agrippino, 2016; Cieslak, 2018). Bauer and Swanson (2023) attribute this predictability to market participants gradually learning about the Fed's reaction function, finding that investors had systematically underestimated the Fed's responsiveness to economic conditions.

Table 4. **Treasury value and bond yield responses around emergency cost releases**

	A. Treasury values				B. Yields			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\texttt{cbo}^{(em)}_{t+\Delta t}$	3.74	3.74	3.07	3.06	-1.10	-1.13	-0.75	-0.68
t-statistic	[6.36]	[7.01]	[5.59]	[9.52]	[-4.18]	[-6.36]	[-2.79]	[-3.18]
Constant	4.97	1.17	-4.43	1.99	-1.12	-0.99	0.70	-0.23
t-statistic	[0.54]	[0.21]	[-0.79]	[0.22]	[-0.87]	[-0.66]	[0.42]	[-0.16]
R^2 in %	2.38	66.62	69.52	1.30	6.74	28.01	29.6	3.60
Observations	78	78	78	78	78	78	78	78
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Informal Estimates	No	No	Yes	Yes	No	No	Yes	Yes

Notes: This table presents regression results around emergency spending bills. Panel A presents regression results for the equation:

$$\Delta b_{t-1,t+1} = a + b \cdot \texttt{cbo}^{(em)}_{t+\Delta t} + \epsilon_{t+1},$$

where $\Delta b_{t,t+1}$ is the daily change in the value of the government debt portfolio computed using procedures similar to Hall and Sargent (2011). $\texttt{cbo}^{(em)}_{t+\Delta t}$ denotes the aggregate surplus of each proposal, where we sum the cash flow contributions of cost releases reported on the same day. In column (2), we control for macroeconomic news coinciding with the measurement window from day $t-1$ to $t+1$ and the cumulative Treasury value changes realized over the previous week. In column (3), we compute the cash flow revision in the first CBO cost release relative to informal cost estimates. In column (4), we regress the cash flow surprises with initial revisions relative to informal numbers on three broad categories of predictors available to investors before the cost release and use the residuals as a regressor. Panel B reports similar results using changes in the 10-Year nominal yield. Treasury values and yields are measured in basis points, while $\texttt{cbo}^{(em)}_{t+\Delta t}$ is expressed as a percentage of GDP. t-statistics are reported in squared brackets using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$.

the Chicago Fed National Activity Index. Second, we capture financial market conditions through the Chicago Fed's National Financial Conditions Index and S&P 500 returns. Third, we include fiscal indicators: the budgetary effect of previous emergency spending, changes in realized federal surplus-to-GDP ratios, revisions to fiscal targets from the President's Budget and Budget Resolutions, and analysts' revisions of surplus forecasts. Table 4 presents results with the estimated coefficients remaining largely unchanged (Columns 4 and 8).

Figure B.8 in the Appendix shows that the estimated coefficient increases as the event window extends from one day to two weeks after the cost release. For example, the response of the 10-year nominal yield to a 1% increase in the deficit-to-GDP ratio is approximately 0.75 bps after one day but grows to about 2 bps after one week.

Table B.12 in the Appendix examines Treasury value responses around cost releases for other major spending bills. We focus on significant legislation that includes mandatory spending and budget reconciliation measures, which often use PAYGO waivers to bypass spending limits.[17] We find substantially larger effects for these major spending bills, with estimated coefficients of approximately 3 (t-statistics above 3), consistent with those observed for emergency spending.

2.3 Additional results

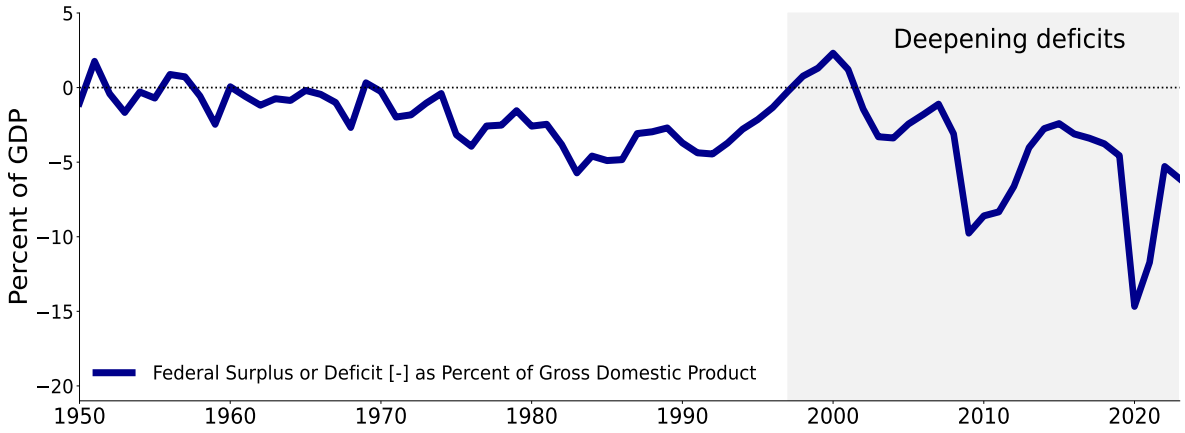
This section summarizes the additional robustness tests and analyses with the corresponding Tables provided in the Appendix. We show that the effect of the cash flow projections on the government bond portfolio is primarily due to its impact on debt over five years, with only minimal effects observed for shorter maturities, in Appendix B.2.

Table B.7 presents the average daily and cumulative changes in Treasury values before, on, and after the large negative proposal days. We find a negligible change in Treasury values (with t-statistics below 0.7) in the days leading up to the cost release. There is a statistically significant drop in Treasury values on the day of the cost releases, as previously shown in Section 2.1.2. Treasury values decline in the days following the cost release, although this decline is not statistically significant (t-statistics above -0.7).

Table B.8 shows the average daily and cumulative changes in Treasury values on specific dates associated with crucial junctures in the legislative process, focusing on the large negative proposals. The first of these dates represents the bill's introduction in either the House or the Senate. The second is the day the CBO cost estimate report is released (the focus of our main analysis). The third date corresponds to the bill's voting in either the House or the Senate, and the final date denotes its enactment into public law if passed. We find the largest average effect on the days of the CBO cost release. The effects are negative on the other three legislative dates, but only statistically significant on the voting days.

[17] Mandatory spending (e.g., Social Security, Medicare, Medicaid) accounts for roughly two-thirds of federal spending. Since 2010, these expenditures have been subject to PAYGO rules that trigger automatic sequestration when spending limits are exceeded. However, Congress increasingly bypasses these limits through waivers, particularly for major bills.

Fig. 8. **Federal Surplus or Deficit [-] as Percent of Gross Domestic Product**



Notes: The dark blue line depicts the federal surplus or deficit [-] as percent of gross domestic product.

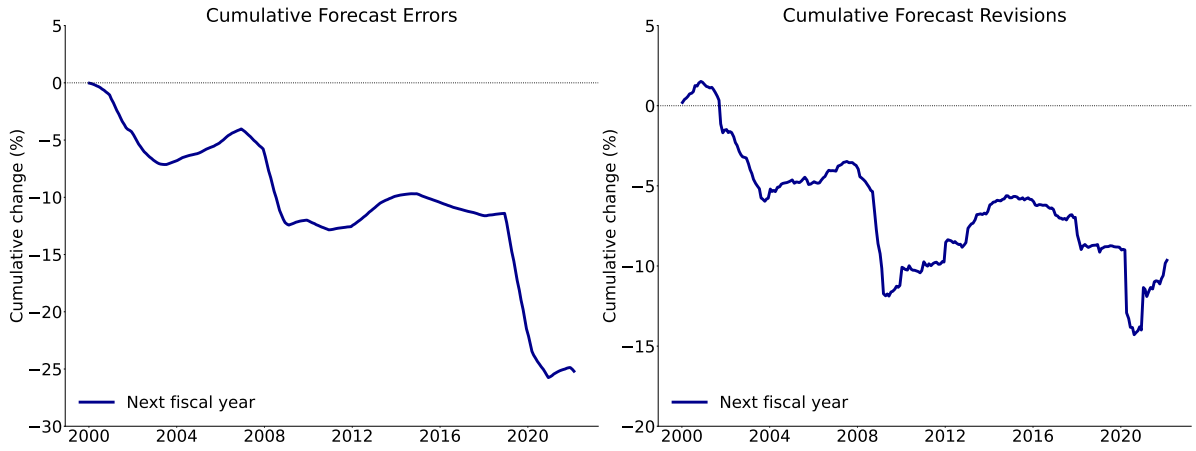
3 News about the fiscal stance

The previous section focused on extracting cash flow news about the individual proposal from the cost releases. We now entertain the possibility that the cash flow shock is partly driven by revisions in the aggregate fiscal stance. In the context of the present value decomposition from equation (4), we now consider that the cost estimates provide informative signals about underlying trends in aggregate deficits and government discount rates (in addition to the cash flows about the individual proposal).

Our CBO sample occurs in an unusual period of the U.S. fiscal history, marked by a radical departure in its fiscal stance. Figure 8 plots the federal surplus to GDP ratio with our sample period highlighted in gray, illustrating the extraordinary drift in deficits and a significant reversal of the fiscal consolidations in the 1990s. We argue that it was unlikely for investors to have anticipated this persistent trend.

We first show that professional analysts had not predicted the drift in deficits at the start of our sample but had to learn about it using incoming data. We find persistent biases and continual downward revisions in analyst forecasts inconsistent with a standard full information rational expectations (FIRE) framework. We then show that analysts strongly revise their forecasts about surpluses downwards around the large negative cost releases, aligning with the negative Treasury value responses on these days, indicating that these releases are informative signals about the trend in deficits.

Fig. 9. **Cumulative forecast errors and revisions of the U.S. budget**



Notes: This figure shows cumulative forecast errors and revisions in Consensus Economics forecasts for the next fiscal year's budget surplus expressed as a percentage of GDP. Forecasts are scaled by the most recent CBO GDP forecast for the corresponding horizon. We scale the cumulative monthly forecast errors by dividing them by 12. The left panel shows cumulative forecast errors, while the right panel shows cumulative forecast revisions. The sample period ranges from January 2000 to February 2023.

We obtain analyst forecasts about deficits for the next fiscal year from Consensus Economics, which conducts monthly surveys. The survey polls an average of 20 economists for their projections on the U.S. budget up to a one-year horizon. We use the mean of these individual forecasts. While the forecasts only go up to a one-year horizon, they still contain news about longer-term deficits since legislation typically involves multi-year cash flows.

Figure 9 plots monthly cumulative forecast errors (left panel) and forecast revisions (right panel) pertaining to deficits in the next fiscal year. We scale the forecast errors and revisions by the CBO's most recent GDP forecast for the corresponding forecast horizon for deficits. Since January 2000, analysts have consistently underestimated the magnitude of realized deficits (left panel) and revised their expectations of deficits downwards (right panel).

Analyst forecast revisions correlate strongly with CBO cost releases. Table 5 presents the estimated coefficients from regressing analyst forecast revisions on CBO cost releases. When CBO estimates project a 100 basis point decrease in surplus-to-GDP, analysts revise their next-year surplus forecasts downward by 38 basis points of GDP (coefficient = 0.38, t-statistic = 9.03, Column 1). This relationship remains robust after controlling

Table 5. **Analyst forecast revisions and cost releases**

	Analyst forecast revisions	
	(1)	(2)
$\texttt{cbo}^{(z)}_{t+\Delta t}$	0.38	0.34
t-statistic	[9.03]	[5.75]
Constant	0.03	0.06
t-statistic	[0.34]	[1.10]
R^2 in %	11.92	22.13
Observations	205	205
Controls	No	Yes

Notes: This table presents regression results for the equation:

$$\Delta fr_t = a + b \cdot \texttt{cbo}_t + c \cdot X_t + \epsilon t,$$

where Δfr_t denotes the monthly revision in analyst surplus forecasts for the next fiscal year, scaled by GDP. $\texttt{cbo}_t$ represents the monthly sum of CBO cost estimates, also scaled by GDP. Column (2) includes control variables X_t: the lagged surplus-to-GDP ratio and the yield curve slope. Forecast revisions and CBO estimates are expressed as percentages of GDP. t-statistics are reported in squared brackets using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$.

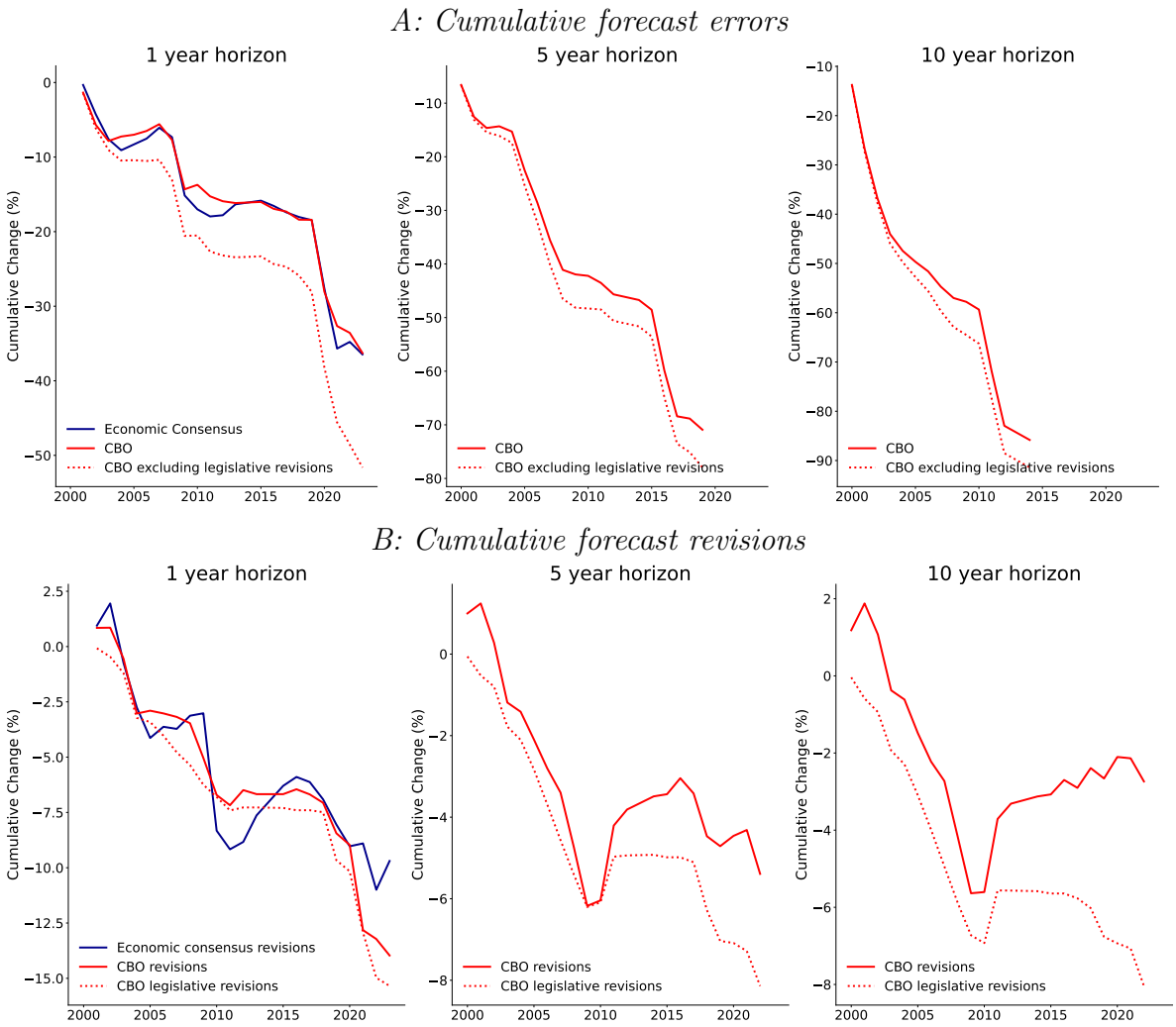
for macroeconomic variables including lagged surplus-to-GDP ratios and the yield curve slope (Column 2).

We extend our analysis to longer forecast horizons using CBO Budget and Economic Outlook reports, which provide projections up to 10 years ahead. Unlike Economic Consensus forecasts, the aggregate CBO budget projections are not forecasts of aggregate deficits but cash flow projections based on currently enacted bills that do not account for future legislative actions. With this caveat in mind, we use the CBO budget outlook to provide suggestive evidence of deviations from FIRE in long-run expectations about deficits.

Figure 10 presents cumulative forecast errors (Panel A) and revisions (Panel B) using CBO projections for horizons of one, five, and ten years. At the one-year horizon, we compare Economic Consensus forecasts (dark blue line) with CBO projections (red line) and the contribution from legislative changes (dotted red line).[18] The left panel demonstrates that analysts' forecasts and CBO projections closely track each other. At longer horizons, the cumulative forecast errors and revisions do not exhibit the business

[18]The CBO decomposes the budget outlook into the contributions from legislative, economic, and technical changes.

Fig. 10. **Cumulative budget errors and revisions in consensus forecasts and CBO projections**



Notes: This figure displays cumulative revisions in budget forecasts, scaled by GDP, from Consensus Economics (dark blue line) and CBO projections (red solid line). The red dotted line represents cumulative changes from budgetary effects of laws enacted since the CBO's previous baseline projections. All forecasts/projections are scaled by the most recent CBO GDP forecast for the corresponding horizon. The left panel shows the one-year ahead budget balance forecast, while the middle and right panels display the 5-year and 10-year CBO projections, respectively. The sample goes from 2000 to 2023.

cycle patterns in shorter-term forecasts. Instead, they consistently reveal biases and downward revisions in budget projections reflecting the legislative changes.

Table B.13 in the Appendix demonstrates that Economic Consensus forecasts about the budget exhibit several common forecast anomalies suggesting deviations from FIRE beyond bias and constant downward revisions. The forecast errors are autocorrelated, they deviate from one-for-one movements with actual realizations as demonstrated by Mincer-Zarnowitz regressions (Mincer and Zarnowitz, 1969), and they display underreaction

to new information as revealed by Coibion-Gorodnichenko regressions (Coibion and Gorodnichenko, 2015).

In standard FIRE models, investors know the model describing the budgetary process (e.g., cash flow and discount rate dynamics) and observe all corresponding parameters, states, and shocks. Based on observable information, agents form expectations as statistically optimal forecasts that are correct on average and equal to realizations. In this sample, it seems implausible to assume that investors knew the full model governing the dynamics of the surplus. Investors in 1997 were unlikely to anticipate the unprecedented drift in deficits over the next 25 years, but instead had to learn about the persistent loosening of fiscal policy using incoming data.

We entertain departures from full information next in an estimated present value framework where Bayesian investors need to recursively learn about the fiscal stance. This framework allows the cost releases to contain news about the pure additive cash flow component and revisions in the policy parameters and states. Anchoring prior beliefs at the start of our sample using past data, investors initially assigned a low probability to the path of increasing deficits materializing in our sample, which marked a significant departure from past policy. A high intensity of large negative cost releases corresponded to a sequence of deficit shocks and allow investors to learn about the loosening of fiscal policy, reinforcing the devaluation of Treasurys.

4 Learning about the Fiscal Stance

We model the fiscal stance at two different horizons. The unobservable persistent components of surplus policy and government discount rates over the 10-year budgeting horizon capture the near-term fiscal stance, while the unobservable components of the expected debt burden 10-years from now capture the long-run fiscal stance (e.g., long-run expectations of tax increases or spending cuts). Bond investors learn about the stance of future policy at these two different horizons using incoming data from CBO cost releases, realized surpluses, and bond price data.

We find that the cost releases enable investors to learn about the parameters governing the fiscal policy. Parameter learning is slow, given the significant persistence and magni-

tude of the departure in fiscal policy, which is akin to rational agents gradually learning about the unobservable persistent components of the nominal short rate highlighted in Farmer et al. (2024). Investors at the start of our CBO data sample in 1997 would have observed a significant budget consolidation throughout the 1990s and found the reversal and subsequent drift in policy over the next few decades to be unlikely.

We show that a high intensity of large negative cost releases corresponds to a long sequence of negative cash flow shocks. Since these cash flow realizations are highly unlikely given the investors' prior, they lead investors to revise parameter estimates, amplifying the negative impact of deficit shocks on Treasury values in our model. The model can also reproduce insignificant Treasury value changes to large positive proposals. There are far fewer positive cost releases and they are sparsely distributed over our sample, which do not generate significant parameter revisions.

4.1 The model and learning from CBO cost estimates

The model operates on a monthly frequency to align with aggregate realized surplus data sampled at the highest frequency available. We use the superscript 'o' notation to denote variables observed by the investor and T to denote the longest forecast horizon of the CBO's cost estimates (i.e., 10 years). We specify the processes governing the present value of surpluses up to horizon T separately from the remaining value to capture how the cost releases may contain distinct information about the fiscal stance at different horizons.

We assume that bond investors model the level of realized aggregate surplus to GDP $\hat{S}^o_{t+1}$ up to horizon T as the sum of a persistent conditional mean χ_t and an orthogonal shock ϵ_{st+1} given by

$$\hat{S}^o_{t+1} = \chi_t + \epsilon_{st+1} \quad \text{with} \quad \chi_{t+1} = \mu_\chi + \rho_\chi(\chi_t - \mu_\chi) + \epsilon_{\chi t+1}, \tag{6}$$

where the latent process χ_t is not observable by bond investors but $\hat{S}^o_{t+1}$ is observable. We also assume that bond investors do not observe the parameters μ_χ and ρ_χ.

We similarly specify the model of the log inflation and growth-adjusted return, $\hat{r}^o_{gt+1}$,

as the sum of a persistent conditional mean h_t and an orthogonal shock $\epsilon_{r,t+1}$ as follows

$$\hat{r}^o_{gt+1} = h_t + \epsilon_{rt+1} \quad \text{with} \quad h_{t+1} = \mu_h + \rho_h(h_t - \mu_h) + \epsilon_{ht+1}, \tag{7}$$

where the latent process h_t is not observable by bond investors while $\hat{r}^o_{gt+1}$ is observable. We also assume bond investors do not observe the parameters μ_h and ρ_h.

The bond investor uses the model for surpluses and government returns with the dynamic government budget identity to link the observable aggregate market value of public debt to the latent states. We can separate the cash flow and discount rate terms up to horizon T in the present value relation presented in equation (2) according to

$$\hat{b}^o_t = \alpha^\star + \mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \gamma \hat{S}^o_{t+j} - \mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \hat{r}^o_{gt+j} + \mathbb{E}_t \nu^T \hat{b}_{t+T}, \tag{8}$$

where $\hat{b}^o_t$ is the observable log market value of government debt to GDP ratio and $\mathbb{E}_t \nu^T \hat{b}_{t+T} = \mathbb{E}_t \sum_{j=T+1}^{\infty} \nu^{j-1}(\gamma \hat{S}_{t+j} - \hat{r}_{gt+j})$ is the expected value of debt to GDP at $t+T$ which is equal to the present value of future surplus to GDP for $j > T$ if we impose the transversality condition.

We assume that bond investors model the expected value of debt to GDP ($\psi_t \equiv \mathbb{E}_t \nu^T \hat{b}_{t+T}$) as a latent process given by

$$\psi_{t+1} = \mu_\psi + \rho_\psi(\psi_t - \mu_\psi) + \epsilon_{\psi t+1}, \tag{9}$$

where the parameters μ_ψ and ρ_ψ are unobservable to investors. We model the continuation value at horizon T directly rather than separately modeling the cash flows and returns beyond T to capture the notion that the cost releases have more precise information about the fiscal condition over the bill's forecast horizon.

Using the present value restriction and the processes for the latent states presented in equations (6), (7) and (9), we can express b^o_t in terms of the latent states according to

$$b^o_t = b_0 + b_\chi \chi_t + b_h h_t + \psi_t, \tag{10}$$

where the coefficients b_0, b_χ, b_h, and b_ψ are detailed in Appendix G.

The three shocks to the latent variables, $\epsilon_{\chi,t+1}$, $\epsilon_{h,t+1}$, and $\epsilon_{\psi,t+1}$, have zero mean and a variance-covariance matrix that allows for correlations among them. The orthogonal shocks to realized surplus ($\epsilon_{s,t+1}$) and returns ($\epsilon_{r,t+1}$) are assumed to be independent of the latent variable shocks and of each other.

We next model how bond investors use the incoming cost releases to update their beliefs about surplus policy. The CBO cost estimate for an arbitrary proposal z in month t gives annual nominal cash flow estimates starting in the next fiscal year up to the fiscal year at horizon T. We normalize these cash flows by nominal GDP projection for the closest month of the same year. We then sum all these normalized cash flows within each proposal and across proposals of month t to get a monthly observable CBO cost intensity measure that we denote as $\overline{\mathcal{V}}_t^o$.

We assume that the monthly cost intensity measure $\overline{\mathcal{V}}_t^o$ is a noisy signal about the persistent component in surplus policy χ_t, modeled as

$$\overline{\mathcal{V}}_t^o = c_0 + c_1 \chi_t + \epsilon_{ct}, \tag{11}$$

where the coefficients c_0 and c_1 are unobservable to investors and $\epsilon_{ct} \sim N(0, \sigma_c^2)$ is noise and independent to all other shocks. To relate to our previous analysis, the cash flow shock extracted from individual proposals in the context of our model is attributed to the innovation ($\epsilon_{\chi t}$) and from revisions in the policy parameters governing the surplus process.

To summarize the information structure, bond investors do not observe the vector of latent states $\mathcal{Z}_t \equiv [\chi_t, h_t, \psi_t]'$, and they do not know the value of the parameters

$$\Theta \equiv \left[\mu_\chi, \rho_\chi, \sigma_s^2, \sigma_\chi^2, c_0, c_1, \sigma_c^2, \mu_h, \rho_h, \sigma_r^2, \sigma_h^2, \mu_\psi, \rho_\psi, \sigma_\psi^2, \sigma_{\chi h}, \sigma_{\chi\psi}, \sigma_{h\psi}\right]'.$$

They observe monthly surpluses, cost intensity measure, government returns adjusted for inflation and growth, and debt to GDP, summarized in the vector $\mathcal{Y}_t^o = [\hat{S}_t^o, \overline{\mathcal{V}}_t^o, \hat{r}_{gt}^o, b_t^o]$.

To estimate the model, we specify a prior distribution for the parameters Θ. We then employ a Metropolis–Hastings algorithm to sample from the posterior distribution

of $(\Theta, \mathcal{Z}_{0:T})$, where $\mathcal{Z}_{0:T}$ represents the sequence of latent states from time 0 to T. Appendix G provides the prior distribution specification and a detailed description of the state-space representation and estimation procedure.

4.2 Updating of states and parameters

The model is estimated both with and without the monthly CBO cost intensity measure as an observable variable. This approach allows us to isolate the impact of the CBO measure on the latent states and parameters. We attribute the differences in these two sets of estimates to the information contained in the cost releases.

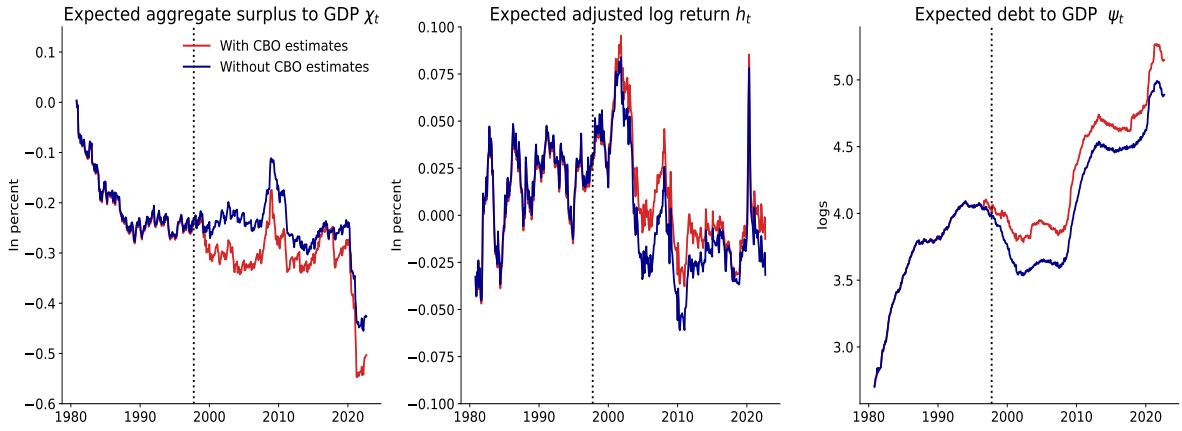
We begin our analysis by assessing the impact of CBO cost releases on the latent states by estimating the model with fixed parameters over the full sample 1980-2022. Given the parameter values, we recursively filter the sequence of latent states, reflecting new information in observable data. We later recursively estimate the parameters and latent states, allowing investors to update their beliefs about the parameters governing the latent states with the incoming data.

Figure 11 plots the mean estimates of the latent states conditional on data available up to time t but with the parameter estimates computed using the entire sample. The red line refers to the estimated states using CBO cost intensity data, the blue line corresponds to the estimates without using CBO data, and the vertical black line denotes the start of our CBO cost release data in 1997.

The left panel of Figure 11 displays the series for the latent component in surplus to GDP χ_t. Prior to the introduction of the CBO cost release data in 1997, both lines are closely aligned and show an initial downward trend embodying the large deficits unfolding during this period. The estimated χ_t that integrates CBO data exhibited a steeper decline after 1997, implying that the inclusion of the cost intensity measure lowers the conditional mean of surpluses throughout the 1997 to 2022 period. We later show the wedge between the two estimated paths of χ_t is driven by the arrival of large negative cost releases.

The center panel plots the latent component of the inflation and growth-adjusted government discount rate h_t. The estimated path of h_t using cost release data is slightly

Fig. 11. **State estimates**



Notes: This figure depicts the evolution of the latent states χ_t, h_t, and ψ_t. We plot the mean of the posterior distribution of the states conditional on data available up to time t and calculated using the entire sample for parameter estimation. In each panel, the latent states conditioned on the CBO cost estimates are marked with red lines, whereas the dark blue lines indicate state estimates that do not incorporate the CBO information. The vertical black dotted line in each panel signifies the point at which the CBO cost estimates become available.

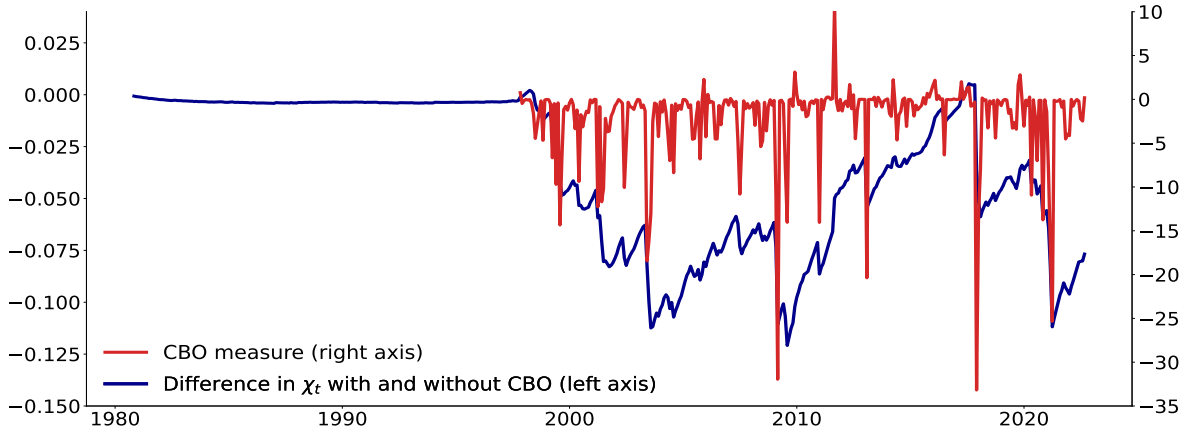
higher, which is consistent with our evidence in Section 2.1.3 showing how the daily convenience yield and nominal term premia responses increase nominal government discount rates on large negative cost release days. The differences in the estimated h_t are muted when compared to the other latent states, which could be due to expected inflation rising on these days (documented in Section 2.1.3), which provides an offsetting force to the nominal discount rate.

The right panel shows the estimated path of the expected value of debt to GDP at horizon T. The estimated ψ_t illustrates the investor expecting a higher future debt burden when the CBO cost release data is used. The CBO cost releases reveal information about the drift toward larger future deficits through χ_t, which are expected to be financed through additional government borrowing.

We next examine how the differences in the estimated latent states relate to the CBO cost measure $\overline{\mathcal{V}}_t^o$. This figure assumes that the signal $\overline{\mathcal{V}}_t^o$ only contains news about the Gaussian cash flow shock $\epsilon_{\chi t}$ and not any changes to the policy parameters. We relax the assumption of fixed parameters later on when we allow for investor learning.

Figure 12 plots the difference in the estimates of χ_t with and without using the cost releases (blue line), and the CBO cost intensity measure $\overline{\mathcal{V}}_t^o$ (red line). This figure

Fig. 12. **Impact of CBO cost estimates on expected aggregate surplus**



Notes: The blue line displays the difference in the χ_t estimate with and without the inclusion of CBO cost estimates. The CBO cost measure ($\overline{\mathcal{V}}_t^o$) is shown in red and plotted on the right y-axis.

visualizes how the conditional mean of surpluses tends to decline when there are large negative values in the CBO measure (i.e., months with a high intensity of large negative proposals).

Table 6 formalizes the statistical association between the differences in estimated latent states with and without CBO cost data and the cost intensity measure. The first column runs the regression

$$\Delta\chi_t = a + b\overline{\mathcal{V}}_t^o + e_t, \tag{12}$$

where $\Delta\chi_t$ is defined as the difference in the estimated χ_t expressed in basis points and $\overline{\mathcal{V}}_t^o$ is expressed in percent. The slope coefficient in this regression is 0.147 with a t-statistic of 3.9, interpreted as a decrease of 0.147 basis points in the conditional mean of surplus to GDP for each 1% increase in the CBO measure. The constant term is -5.343 with a t-statistic of -28, reflecting the large decline in $\Delta\chi_t$ induced by the CBO measure.

Column 2 of Table 6 regresses the difference in the persistent component of real discount rates with and without cost release data (denoted as Δh_t) on the cost intensity measure $\overline{\mathcal{V}}_t^o$. The slope coefficient estimate is positive (0.008) but not statistically significant (t-statistic of 0.792). The positive but muted response is consistent with Figure 12 showing a smaller wedge between the two estimated series for h_t. This could

Table 6. **Impact of CBO cost estimates on the state variables**

	Difference in state estimates with and without CBO		
	$\Delta\chi_t$ (1)	Δh_t (2)	$\Delta\psi_t$ (3)
Constant	-5.343	1.301	0.215
t-statistic	[-28.044]	[24.176]	[60.661]
$\overline{\mathcal{V}}_t^o$	0.147	0.008	-0.002
t-statistic	[3.915]	[0.792]	[-3.549]
R^2 in %	4.907	0.211	4.069
Observations	299	299	299

Notes: Column 1 presents regression results for the equation:

$$\Delta\chi_t = a + b\overline{\mathcal{V}}_t^o + \epsilon_t,$$

where $\Delta\chi_t$ denotes the difference in the χ_t estimate with and without the inclusion of CBO cost estimates. The variable $\overline{\mathcal{V}}_t^o$ denotes the CBO cost measure. In columns 2 and 3 we replace $\Delta\chi_t$ with Δh_t and $\Delta\psi_t$, respectively. $\Delta\chi_t$ and Δh_t are in basis points, $\Delta\psi_t$ is in logs, and $\overline{\mathcal{V}}_t^o$ is in percent. t-statistics are in squared brackets.

reflect how the opposing effects of nominal discount rates and expected inflation on large negative proposal days mute the response of real discount rates.

Column 3 of Table 6 considers the difference in the expected debt-to-GDP with and without cost release data, denoted as $\Delta\psi_t$. We regress $\Delta\psi_t$ on the cost intensity measure, yielding a slope coefficient estimate that is negative (-0.002) and statistically significant (t-statistic of -3.5). This regression result highlights how a high intensity of large negative proposals generates expectations of higher debt a decade from now (T). When viewed in conjunction with the regression evidence for $\Delta\chi_t$ and the present value restrictions, the higher debt expectations reflect the imperfect long-run future tax or spending offsets, implying that investors expect only part of the fiscal expansion will be backed by future surpluses. Investors price in these revisions to the unbacked portion of deficits.

The sustained impact of the cost releases on the latent states suggests that investors are revising their beliefs about the stance of policy characterized by the structural parameters governing these processes. For instance, observing a high concentration of large negative cost releases that predict sustained deficits leads investors to infer that the unconditional mean μ_χ is lower and the persistence parameter ρ_χ is higher for the expected surplus process. We allow investors to recursively update the parameters governing the latent states in our next procedure.

Table 7. **Impact of CBO cost estimates on key model parameters**

	Difference in parameter estimates with and without CBO					
	$\Delta\mu_\chi$ (1)	$\Delta\rho_\chi$ (2)	$\Delta\mu_h$ (3)	$\Delta\rho_h$ (4)	$\Delta\mu_\psi$ (5)	$\Delta\rho_\psi$ (6)
Constant	-3.0993	0.0112	1.5113	0.0028	0.0023	-0.0012
t-statistic	[-26.1538]	[39.1102]	[15.5908]	[8.3550]	[16.0954]	[-11.0344]
$\overline{\mathcal{V}}_t^o$	0.0599	0.0000	-0.0191	-0.0000	-0.0001	-0.0001
t-statistic	[2.6002]	[0.6431]	[-1.0119]	[-0.3765]	[-2.7218]	[-2.6945]
R^2 in %	2.4430	0.1529	0.3778	0.0525	2.6704	2.6186
Observations	299	299	299	299	299	299

Notes: Column 1 presents regression results for the equation:

$$\Delta\mu_\chi = a + b\overline{\mathcal{V}}_t^o + \epsilon_t,$$

where $\Delta\mu_\chi$ denotes the difference in the μ_χ estimate with and without the inclusion of CBO cost estimates. The variable $\overline{\mathcal{V}}_t^o$ denotes the CBO cost measure. In columns 2 to 6 we replace $\Delta\mu_\chi$ with $\Delta\rho_\chi$, $\Delta\mu_h$, $\Delta\rho_h$, $\Delta\mu_\psi$, and $\Delta\rho_\psi$, respectively. The variables $\Delta\mu_\chi$ and $\Delta\mu_h$ are in basis points and $\overline{\mathcal{V}}_t^o$ is in percent. t-statistics are in squared brackets.

We start the parameter learning in 1997, coinciding with the availability of CBO cost estimates. Bond investors are initially endowed with informative beliefs about the parameter values based on parameter estimates using maximum likelihood on data from October 1980 to January 1997. They center their initial beliefs around these parameter estimates. From January 1997 onward, bond investors observe new data each month and apply Bayes' Law to iteratively update their initial beliefs about the states and parameters. This recursive updating process results in a time series of evolving parameter estimates and latent states extending to December 2022.

To evaluate the impact of the CBO measure on the recursive parameter estimates, we estimate the model including and excluding the CBO measure from the observable vector. Revisions in the latent states in the current procedure can be due to parameter learning. We then regress the differences in parameter estimates on the CBO cost intensity measure according to

$$\Delta\Theta_t^i = a + b\overline{\mathcal{V}}_t^o + e_t, \tag{13}$$

where $\Delta\Theta_t^i$ denotes the difference in posterior means for parameter i at time t between model estimations with and without the CBO measure. Table 7 presents the results,

and Figure B.9 in the Appendix illustrates the evolution of the mean of the posterior distribution of the parameters.

Columns 1 and 2 of Table 7 demonstrate that negative CBO cost releases lead to a sustained reduction in the unconditional mean estimate μ_χ and a rise in the persistence parameter ρ_χ of the latent surplus process χ_t, although the impact on persistence parameter is not statistically significant. The continual trend of revising the persistence upwards and the mean downwards reflects investors' learning about policymakers' predilection toward running large deficits over the last two decades. The parameter learning is gradual because the policy drift is persistent and constitutes a substantial departure from fiscal policy in the previous decades, including a reversal of the budget consolidations of the 1990s.

Columns 3 and 4 indicate that including the CBO cost intensity measure in the estimation results in growth and inflation-adjusted government discount rates with a higher unconditional mean μ_h and persistence ρ_h. However, the parameter revisions related to the discount rate do not significantly correlate with the CBO measure, indicated by the insignificant coefficient on $\overline{\mathcal{V}}_t^o$. The insignificant relations are consistent with our previous analysis documenting the muted responses of the estimated h_t to the cost releases.

Columns 5 and 6 demonstrate that incorporating the CBO cost releases in the estimation corresponds to a statistically significant increase in both the unconditional mean μ_ψ and the persistence ρ_ψ of the latent process governing the expected future debt-to-GDP ratio ψ_t. Overall, Table 7 highlights that the cost releases allow investors to learn about the unobservable parameters governing future surplus and debt policy jointly with the latent states. We next examine the implications of parameter learning on Treasury values.

We compute the aggregate Treasury value in the model using equation (10) for two sets of parameters and latent states. The first set comes from the recursive model estimation that does not incorporate the CBO cost estimates. The second set of parameters and latent states adjusts the first set with the predicted changes in parameters and states, calculated using the regressions from equations (12) and (13). We attribute the differences in Treasury values implied by the two estimated sets to the information contained in

Table 8. **Model-implied changes in debt values**

A. Large negative proposal periods			
	Posterior		
	5%	50%	95%
Mean bps	-2.04	-1.56	-1.25
Cumulative change in %	-25.72	-23.31	-15.10
B. Large positive proposal periods			
	Posterior		
	5%	50%	95%
Mean bps	0.09	0.11	0.12
Cumulative change in %	1.23	1.15	1.68

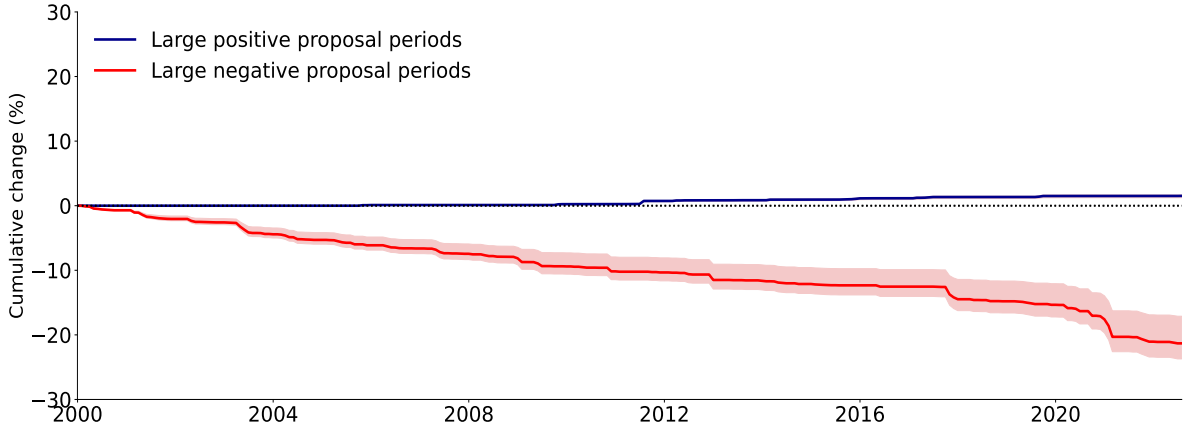
Notes: This table displays the 5%, 50%, and 95% percentiles for the model-implied average and cumulative changes in Treasury values. In Panel A, the estimates are presented for periods when the CBO measure is negative and falls below its median value. Conversely, Panel B provides estimates for periods where the CBO measure is positive and exceeds its median value.

the cost releases. The recursive parameter estimates reinforce the impact of the negative cash flow shocks, helping to quantitatively explain the observed Treasury value responses to large negative cost releases.

Table 8 presents the implied changes in Treasury values from the model, attributing to periods with large negative cost releases and large positive cost releases. We define 'large' analogously to Section 2.1.2 by selecting the cost releases that are above the median in magnitude for the positive and negative categories separately. The table reports the posterior distribution of the mean Treasury value response at the 5th, 50th, and 95th percentiles. To align our estimates with the daily frequency event study evidence presented in Table 2, we adjust the average monthly change by dividing it by five to reflect the fact that, on average, there are five large negative proposals occurring each month.

Panel A shows that the average model-implied change in Treasury values is negative in periods of large negative cost releases. The posterior median is -1.56 bps, similar to the -1.84 bps average daily change in actual data that falls within the 90% credible intervals of the model's posterior distribution. The cumulative change in periods with large negative proposals implied by the model is -23.31%, in line with the -21% cumulative change observed in the actual data. The red line in Figure 13 illustrates how the cumulative

Fig. 13. **Model-implied cumulative change in debt values**



Notes: This figure displays the model-implied cumulative change in Treasury values for the large negative proposal periods (red line) and the large positive proposal periods (blue line). The light-shaded areas correspond to 90% credible intervals.

changes in large negative periods from the model exhibit a smooth downward trend like in the actual data (Figures 3 and 4).

Panel B of Table 8 presents the model-implied change in Treasury values in periods with large positive cost releases. The posterior median of the average change in these periods is positive but relatively small and insignificant like in the actual data. The cumulative change is also small over the sample period due to a combination of the small effects and fewer positive proposals.

4.3 Quantifying the effects of surplus news on Treasury values

This section decomposes the Treasury value response into surplus news, discount rate news, and news about future debt expectations at a 10-year horizon according to the intertemporal budget identity presented in equation (8). We use this decomposition to isolate the contribution of surplus news on the realized Treasury value to GDP using our recursive model estimates. We focus our analysis on the periods with large negative proposals since the pricing effects are concentrated there.

We impute the impact of the large negative cost releases on surplus news by first calculating the surplus contribution ($\mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \gamma \hat{S}^o_{t+j}$) under the two sets of recursive parameter and state estimates like in Table 8, with one set incorporating the cost

Table 9. **Decomposition in the model-implied changes in debt values**

A. Effect of cash flow news			
	Posterior		
	5%	50%	95%
Mean bps	-2.83	-2.74	-2.62
Cumulative change in %	-38.49	-37.29	-35.61
B. Effect of expected value of debt to GDP news			
	Posterior		
	5%	50%	95%
Mean bps	1.07	1.19	1.36
Cumulative change in %	14.48	16.18	18.56

Notes: This table decomposes the model-implied Treasury value response into surplus news and news coming from the future value of debt.

releases and the other excluding them, and then taking the difference in the imputed surplus contributions on the large negative proposal periods. We back out the remaining contributions to the present value from discount rates and future expected debt as a residual between the Treasury value and surplus contributions. We also take the difference in this residual term under the two sets of parameters and states.

Table 9 presents the results for how the cost releases affect surplus news and the residual term implied by the model. Panel A documents that the posterior median of the average surplus news of large negative cost releases is -2.74 bps. Panel B reports that the posterior median of the average change in the residual term is 1.19 bps, which is mostly driven by expectations of a higher future debt burden, given that the real discount rate effects are negligible. The small real discount rate effects are consistent with how the nominal discount rate and expected inflation both respond positively on large negative days, leading to offsetting effects on the real discount rate.

The future debt expectation response partially counteracts the negative impact of surplus news on Treasury values. The debt expectation term captures investor expectations about long-run tax and spending offsets to fiscal actions over the next decade. The combined effect delivers the -1.56 bps model-implied average Treasury change that matches the empirical evidence reported in Table 8. Our model interprets the negative Treasury responses as revisions in investor expectations about the portion of

the fiscal expansion over our sample that is unbacked by long-run future surpluses. Our calculations highlight how the majority (57%) of the surplus news from large negative cost releases is unbacked and passed through to Treasury values.

We also use our model to decompose the news content for each individual period with large negative cost releases. Figure B.10 in Appendix B illustrates how surplus news over the decade and expected future debt news vary with the cost intensity measure. Periods with cost releases of larger negative proposals generate larger revisions in the surplus process over the next decade, along with updated expectations of larger proportional offsets from long-run surpluses. The expected offsets to the fiscal expansion over the next decade are consistently and considerably smaller than the surplus news in each period, leading investors to devalue Treasurys steadily to price in the unbacked portion of the fiscal expansion. Running regressions with model-implied data suggests that a 1% increase in the present value of deficits scaled by GDP over the 10-year budgeting horizon corresponds to a 3.39 bps decline in Treasury values, and assuming a Treasury portfolio duration of 4 years, this implies a 0.85 bps rise in nominal yields, both inline with the empirical estimates.

The model estimation implies that the negative Treasury value responses to large negative cost releases reflect investors updating their beliefs about the aggregate surplus process that reinforces the effects of the cash flow shocks. When investors observe periods with a high concentration of proposals related to spending increases or tax cuts, we show that the cost releases provide valuable signals about a drift toward a more profligate stance in fiscal policy.

5 Conclusion

We document that revisions in CBO cost projections about legislative proposals contain valuable news about the deficit impact of the individual bill and the aggregate fiscal stance. We find the largest negative Treasury value responses on days with large cost releases associated with major net spending bills. The Treasury response is related to an increase in expected inflation and nominal term premia, along with a decrease in convenience yields.

We exploit a subset of the cost releases pertaining to emergency proposals to extract deficit news. Emergency proposals are unfunded and have a high ex-ante probability of passing, allowing us to better isolate the cash flow news component. The Treasury value responses are magnified by a factor of three for cost revisions relating to emergency spending proposals.

We then allow for the possibility that the cost releases contain news about the additive cash flow shock as well as information about the aggregate fiscal stance, including long-run fiscal offsets. To this end, we develop a present-value model in which Bayesian investors use the incoming cost releases as signals about the size of Congress' legislative wish list to learn about the policy parameters and states governing surpluses, discount rates, and expected future Treasury supply. An increasing frequency and size of spending proposals in our sample corresponded to a sequence of deficit shocks and caused investors to revise their beliefs about the loosening of fiscal policy, reinforcing the decline in Treasury values.

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Online Appendix

Can U.S. Treasury Markets Add and Subtract?

Roberto Gómez-Cram Howard Kung Hanno Lustig

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Appendix A Data

This section describes the data sources and construction of the variables used in our main empirical tests.

A.1 Measuring aggregate Treasury values

We compute a daily series of marketable debt held by the public as in Hall and Sargent (2011). Let B_t denote the market value of government debt at time t. We calculate B_t by separating all coupon and principal payments from outstanding treasuries held by the public, pricing each maturity as zeros, and then aggregating ($B_t = \sum_{j=1}^{n} q_{t+j}^t f_{t+j}^t$, where f_{t+j}^t represents the total nominal debt payment committed for j years from time t). This calculation includes all principal and coupon payments guaranteed by the government to be paid at time $t+j$. The price of a one-dollar zero-coupon bond maturing at time $t+j$ is denoted by q_{t+j}^t.

We use the daily prices and quantities of US Treasuries obtained from the Center for Research in Security Prices (CRSP) to help construct the series for B_t. To compute the nominal payments f_{t+j}^t for each Treasury note and bond, we use the outstanding face value (tdpubout) with pertinent bond characteristics such as coupon rates and maturity dates.

While CRSP does not provide this variable for Treasury bills (tdpubout is missing for bills), we follow Hall and Sargent (2011) and derive tdpubout for bills as a residual. We acquire a monthly series of face values of public debt that mature within one year from Table FD-5 of the Treasury Bulletin. We then subtract the tdpubout value for bonds and notes maturing within one year and assume that tdpubout for Treasury bills remains constant within each month and allocate it to each specific bill proportionally, based on the daily series of the total amount outstanding (tdtotout) for which we have CRSP observations. Finally, we obtain the day of coupon and principal payment from treasurydirect.gov.

We fit a zero-coupon forward curve using coupon bond prices to compute q_{t+j}^t, following the approach of Gürkaynak, Sack, and Wright (2007). We extend the yield curve to maturities of less than one year by incorporating market yields on US Treasury

securities at constant maturities of one month, three months, and six months and linear interpolating for the remaining maturities.

A.2 Controlling for macroeconomic announcements

We use real-time data from the Bloomberg Professional Service to account for macroeconomic news. Specifically, we control for macroeconomic news releases by computing the difference between the realized value and the expected value of macroeconomic indicator k at time t, denoted A_{kt} and E_{kt} respectively. We standardize this difference by dividing it by the sample standard deviation of $A_{kt} - E_{kt}$, denoted $\hat{\sigma}_k$, following the approach in Balduzzi, Elton, and Green (2001), and Bianchi, Gómez-Cram, Kind, and Kung (2023):

$$S_{kt}^{macro} = \frac{A_{kt} - E_{kt}}{\hat{\sigma}_k}.$$

This standardization allows us to compare indicators with different units of measurement but it does not affect the statistical significance of our estimates, as $\hat{\sigma}_k$ is constant for any given indicator.

To obtain the expected value E_{kt} for each indicator, we use the median forecast from the most recent weekly survey of economists conducted by Bloomberg prior to the announcement. Bloomberg collects forecasts from major consulting firms and investment banks and reports the median forecast shortly before each release. We provide a list of the 50 macroeconomic indicators used as controls in Table A.1.

Table A.1. **Macroeconomic announcements**

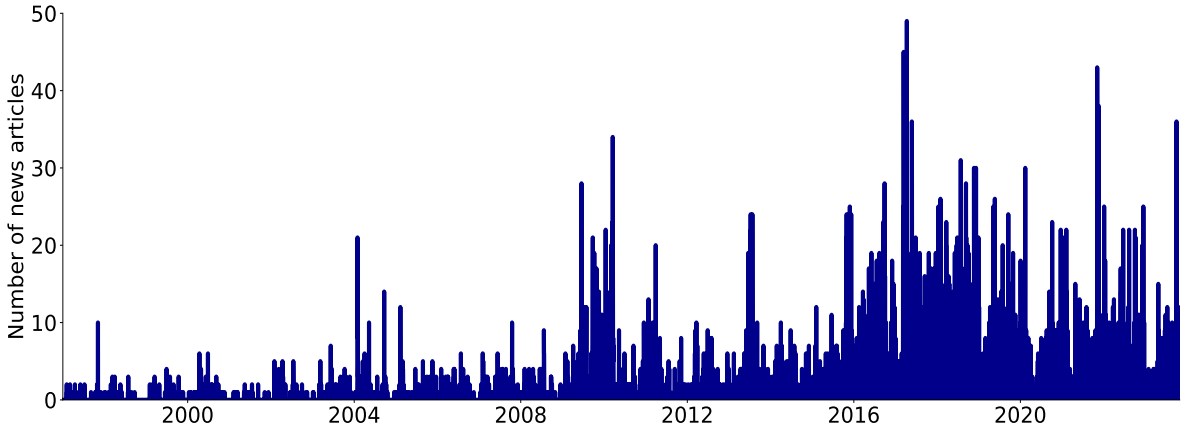
Event	Ticker	Relevance	Count	Time
Change in Nonfarm Payrolls	NFP TCH Index	99.213	95	08:30:00
Initial Jobless Claims	INJCJC Index	98.425	413	08:30:00
FOMC Rate Decision (Upper Bound)	FDTR Index	97.638	126	14:00:00
GDP Annualized QoQ	GDP CQOQ Index	96.850	94	08:30:00
CPI MoM	CPI CHNG Index	96.063	95	08:30:00
ISM Manufacturing	NAPMPMI Index	95.276	190	10:00:00
U. of Mich. Sentiment	CONSSENT Index	94.488	190	10:00:00
Conf. Board Consumer Confidence	CONCCONF Index	93.701	95	10:00:00
Durable Goods Orders	DGNOCHNG Index	92.913	139	08:30:00
Retail Sales Advance MoM	RSTAMOM Index	92.126	95	08:30:00
New Home Sales	NHSLTOT Index	91.339	95	10:00:00
Industrial Production MoM	IP CHNG Index	90.551	95	09:15:00
Markit US Manufacturing PMI	MPMIUSMA Index	90.000	111	09:45:00
Unemployment Rate	USURTOT Index	89.291	95	08:30:00
Housing Starts	NHSPSTOT Index	88.976	95	08:30:00
Existing Home Sales	ETSLTOTL Index	88.189	95	10:00:00
ADP Employment Change	ADP CHNG Index	87.402	95	08:15:00
PPI Final Demand MoM	FDIDFDMO Index	86.614	82	08:30:00
Personal Spending	PCE CRCH Index	85.827	95	08:30:00
Personal Income	PITLCHNG Index	85.827	95	08:30:00
Factory Orders	TMNOCHNG Index	85.039	95	10:00:00

The table lists the macroeconomic announcements we use as controls in our analysis. We identified the top 20 macroeconomic announcements based on their relevance score, which is a metric calculated by Bloomberg. The relevance score is determined by the number of "alerts" set by all users for a particular event relative to all alerts set for other U.S. economic events. We also include the count and time of each announcement. Count represents the number of announcements within our sample period. Time denotes the Eastern Time (ET) at which the announcement was most commonly released during our sample period, but we always use the actual release time in our analysis.

Appendix B Additional analysis

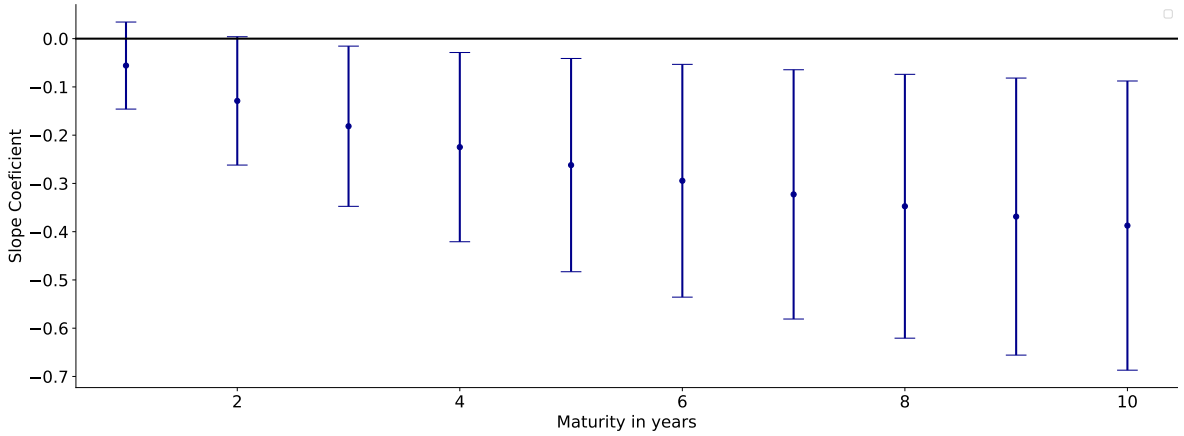
B.1 Additional tables and figures

Fig. B.1. **News media coverage of CBO cost esimtates**



Notes: This figure shows the count of news media articles in the LexisNexis database that mention both "Congressional Budget Office" and "cost estimate". The data covers the period from 1997 to 2022.

Fig. B.2. **Yield response across maturities**

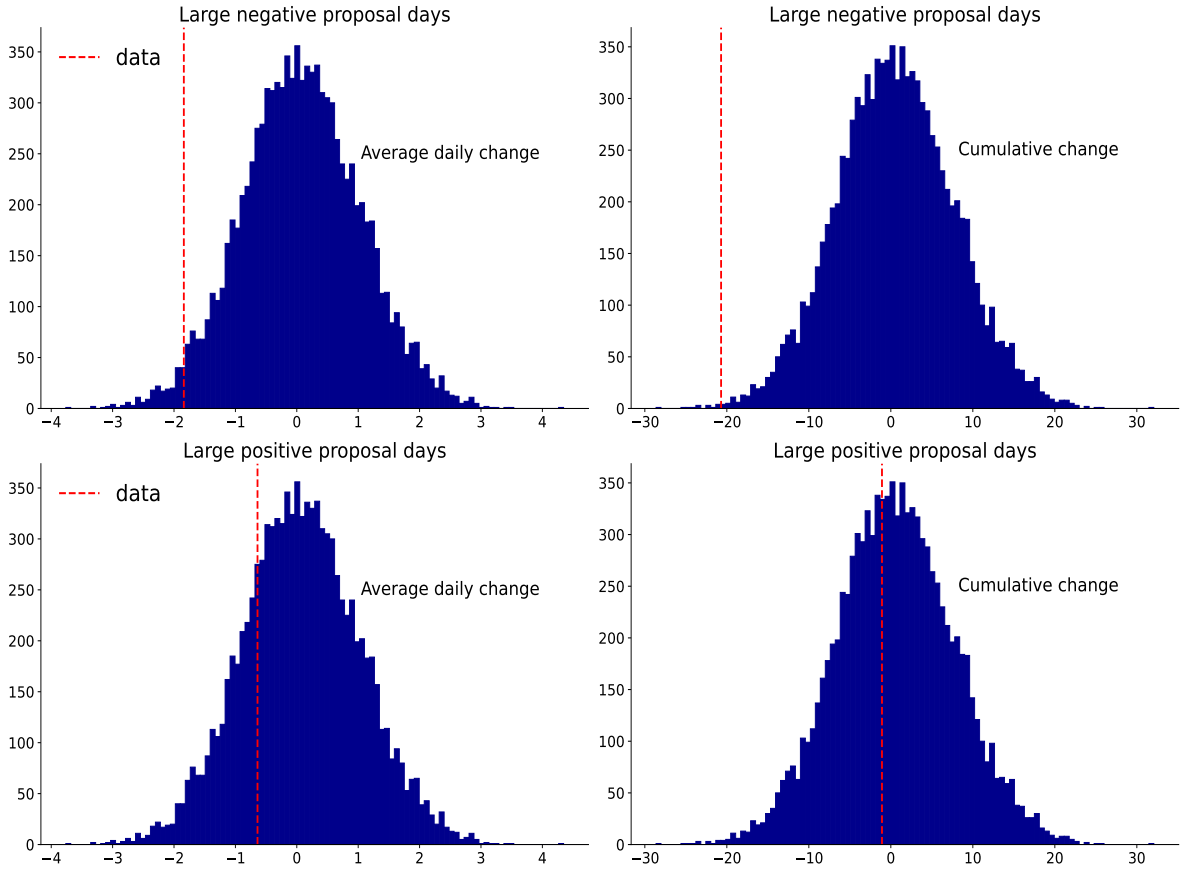


Notes: This figure plots regression coefficients across maturities from the specification:

$$\Delta y^{(h)}_{t-1,t+1} = a + b \cdot \texttt{cbo}^{(z)}_{t+\Delta t} + \epsilon_{t+h},$$

where $\Delta y^{(h)}_{t-1,t+1}$ denotes the change in the h-year nominal yield from day $t-1$ to day $t+1$, and $\texttt{cbo}^{(z)}_{t+\Delta t}$ measures the aggregate surplus of legislative proposals announced on the same day. Yield changes are in basis points, while $\texttt{cbo}^{(z)}_{t+\Delta t}$ is expressed as a percentage of GDP. The bars represent 95% confidence bands computed using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$.

Fig. B.3. **Changes in Treasury values on random days**



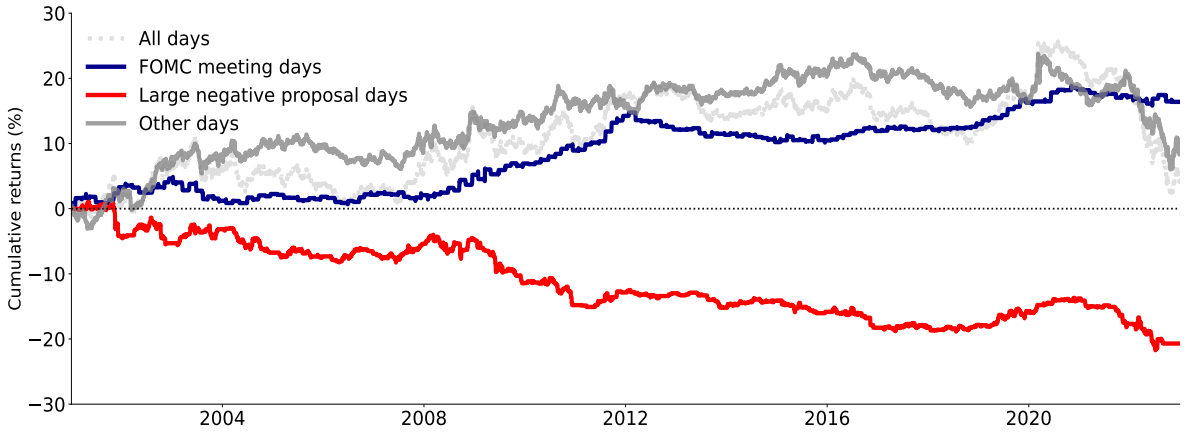
Notes: We generate 10,000 samples. Each sample randomly selects without replacement 1,125 days and 170 days, corresponding to the number of observations in our actual sample for large negative and positive proposals, respectively. Subsequently, we compute the average daily and cumulative changes in Treasury values for each sample. The actual realizations are denoted by the red vertical lines. The top panel shows the actual realizations and simulated statistics for large negative proposal days, while the bottom panel presents them for days with large positive proposals.

Table B.1. **Large negative proposal days, excluding large macro news days**

	Large negative proposal days	Other days	All days
Mean bps	-3.08	0.54	0.07
t-statistic	[-2.81]	[1.36]	[0.20]
p-value	(0.01)	(0.93)	–
Cumulative change in %	-21.97	26.02	4.06
p-value	(0.00)	(0.99)	–
Observations	713	4,784	5,497

Notes: This table presents the average daily and cumulative changes in Treasury values, organized across three different sets of days. Column 1 reports changes on days with large negative proposals, specifically excluding those that overlap with FOMC meeting days and large news from the top 50 macroeconomic indicators. For each indicator, we determine the news component by calculating the deviation of actual values from median forecasts and standardizing this difference using its standard deviation. The large macro-news is then classified as the days where the absolute value of the news component exceeds its median absolute value, as calculated over a rolling 3-month window. Column 2 reports changes on other trading days and column 3 reports changes on all trading days. *t*-statistics are in squared brackets. We report the percentage of simulated changes in Treasury values that fall below the actual realizations in parentheses.

Fig. B.4. **Bond Returns around Deficit Projections and FOMC meeting days**



Notes: This figure shows the cumulative change in Treasury values on four different sets of days. The light gray line displays the cumulative change using all trading days. The red line shows the cumulative change using the large negative proposal days that do not coincide with FOMC meeting days. The dark blue line shows cumulative change in a 3-day window centered on FOMC meeting days. The dark gray lines show the cumulative change using all remaining trading days. The sample period runs from January 2000 to December 2022.

Table B.2. **Treasury value and bond yield responses around large cost releases**

A. Large negative proposals	Treasury values		10-Year bond yields	
	(1)	(2)	(3)	(4)
$\texttt{cbo}^{(z)}_{t+\Delta t}$	1.52	1.33	-0.36	-0.32
t-statistic	[3.01]	[2.47]	[-2.35]	[-1.99]
Constant	1.11	0.95	-0.19	-0.18
t-statistic	[0.54]	[0.53]	[-0.52]	[-0.52]
R^2 in %	0.29	3.72	0.39	2.38
Observations	1,385	1,385	1,385	1,385
Controls	No	Yes	No	Yes
B. Large positive proposals	**Treasury values**		**10-Year bond yields**	
	(1)	(2)	(3)	(4)
$\texttt{cbo}^{(z)}_{t+\Delta t}$	3.08	2.78	-0.60	-0.50
t-statistic	[0.72]	[0.69]	[-0.46]	[-0.44]
Constant	-5.94	-5.26	0.84	0.75
t-statistic	[-2.47]	[-1.88]	[1.30]	[1.02]
R^2 in %	0.35	15.75	0.21	15.71
Observations	229	229	229	229

Notes: This table presents regression results from the specification:

$$\Delta z_{t-1,t+1} = a + b \cdot \texttt{cbo}^{(z)}_{t+\Delta t} + \epsilon_{t+1},$$

where $\Delta z_{t-1,t+1}$ denotes either the two-day change in Treasury portfolio value (following Hall and Sargent (2011)) or the 10-year nominal yield. $\texttt{cbo}^{(z)}_{t+\Delta t}$ measures the aggregate surplus of proposals announced on day t. Panel A uses days with large deficit-increasing proposals, while Panel B uses days with large deficit-decreasing proposals. Column (2) includes controls for macroeconomic news coinciding with the $t-1$ to $t+1$ window and lagged weekly Treasury value changes. Value and yield changes are in basis points, while $\texttt{cbo}^{(z)}_{t+\Delta t}$ is in percent of GDP. t-statistics in brackets use Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$.

Table B.3. **Changes in treasury valuations to alternative classifications of large proposals**

A. Size of the rolling window

	Window in days						
	60	90	120	150	180	210	360
Mean bps	-2.79	-3.08	-2.44	-2.37	-1.85	-2.07	-2.03
t-statistic	[-2.53]	[-2.81]	[-2.23]	[-2.14]	[-1.67]	[-1.85]	[-1.83]
p-value	0.01	0.01	0.02	0.03	0.06	0.05	0.04
Cumulative change in %	-19.80	-21.97	-17.21	-16.60	-12.81	-14.22	-14.11
p-value	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Observations	710.00	713.00	706.00	700.00	691.00	688.00	695.00

B. Threshold for selecting the large negative proposals

	`Large` proposals are those that exceed the following percentiles in absolute value						
	90%	75%	60%	50%	40%	25%	10%
Mean bps	-5.44	-2.36	-1.81	-3.08	-2.31	-1.23	-0.57
t-statistic	[-1.89]	[-1.52]	[-1.44]	[-2.81]	[-2.34]	[-1.38]	[-0.72]
p-value	0.03	0.08	0.09	0.01	0.02	0.09	0.23
Cumulative change in %	-6.91	-8.67	-10.09	-21.97	-19.54	-13.07	-7.47
p-value	0.00	0.02	0.03	0.00	0.00	0.02	0.15
nObs	127	367	559	713	845	1,063	1,312

Notes: This table presents robustness tests for alternative classifications of large negative proposals. In our benchmark analysis, we select `large` negative proposals by identifying all proposals with negative cash flow contributions and ranking them based on the absolute value of their cash flow contribution within a 3-month rolling window. We then define `large` proposals as those exceeding the median in absolute value. Panel A presents the average daily and cumulative changes in Treasury values on days with large negative proposals, where each column varies the rolling window from 60 to 360 days and defines `large` proposals as those exceeding the median in absolute value. Panel B presents the average daily and cumulative changes in Treasury values on days with large negative proposals, using a 3-month rolling window and defining `large` proposals as those exceeding different percentiles, ranging from 90% (largest 10% of the bills) to 10% (all bills except the smallest 10%). In both panels, we control for macro announcements by excluding large negative proposals that overlap with FOMC meeting days and large news from the top 50 macroeconomic indicators. For each macroeconomic indicator, we determine the news component by calculating the deviation of actual values from median forecasts and standardizing this difference using its standard deviation. Large macro-news is then classified as days where the absolute value of the news component exceeds its median absolute value, calculated over a rolling 3-month window. In parentheses, we report the percentage of simulated Treasury value changes that fall below the actual realizations. To determine these percentiles, we generate 10,000 samples, each of which randomly selects without replacement the corresponding number of observations in the actual sample for large negative proposals. For each of these samples, we calculate the average daily and cumulative changes in Treasury values.

Table B.4. **Changes in nominal discount rate components**

A. Composite term premia	Large negative proposal days (1)	Other days (2)	All days (3)
Mean bps	0.18	-0.06	-0.01
t-statistic	[1.82]	[-1.16]	[-0.25]
p-value	(0.95)	(0.13)	–
Cumulative change in %	2.05	-2.70	-0.65
p-value	(0.99)	(0.03)	–
Observations	1,125	4,371	5,496
B. Composite convenience yield	**Large negative proposal days (1)**	**Other days (2)**	**All days (3)**
Mean bps	-0.09	0.02	-0.00
t-statistic	[-1.63]	[0.19]	[-0.01]
p-value	(0.13)	(0.45)	–
Cumulative change in %	-0.81	0.75	-0.05
p-value	(0.10)	(0.45)	–
Observations	924	3,830	4,754
C. Credit risk	**Large negative proposal days (1)**	**Other days (2)**	**All days (3)**
Mean bps	-0.03	-0.00	-0.01
t-statistic	[-0.51]	[-0.11]	[-0.28]
p-value	(0.32)	(0.68)	–
Cumulative change in %	-0.12	-0.04	-0.17
p-value	(0.32)	(0.68)	–
Observations	484	2,646	3,130
D. Nominal short rate	**Large negative proposal days (1)**	**Other days (2)**	**All days (3)**
Mean bps	0.11	-0.17	-0.11
t-statistic	[0.74]	[-2.56]	[-1.82]
p-value	(0.65)	(0.21)	–
Cumulative change in %	0.57	-5.65	-5.08
p-value	(0.88)	(0.00)	–
Observations	1,119	4,377	5,496

Notes: Panel A presents the average daily and cumulative changes in the composite nominal term premia, categorized across three distinct sets of days. Column 1 reports changes on days with large negative proposals that do not coincide with FOMC meeting days. Column 2 reports changes on other trading days, and column 3 reports changes across all trading days. Panels B, C and D use the same day classifications, but compute changes in the composite convenience yields, expected default loss, and nominal short rate, respectively. t-statistics are presented within square brackets. We report the percentage of simulated changes that fall below the actual realizations in parentheses.

Table B.5. **Changes in inflation expectations**

Changes in 10-year inflation swaps	Large negative proposal days (1)	Other days (2)	All days (3)
Mean bps	0.21	-0.05	-0.00
t-statistic	[1.52]	[-0.75]	[-0.06]
p-value	(0.95)	(0.05)	–
Cumulative change in %	1.65	-1.81	-0.16
p-value	(0.95)	(0.05)	–
Observations	800	3,635	4,435

Notes: This table presents the average daily and cumulative changes in 10-year inflation swaps categorized across three distinct sets of days. Column 1 reports changes on days with large negative proposals that do not coincide with FOMC meeting days. Column 2 reports changes on other trading days, and column 3 reports changes across all trading days. *t*-statistics are presented within square brackets. We report the percentage of simulated changes that fall below the actual realizations in parentheses.

Table B.6. **Treasury value changes on large proposal days and FOMC meeting days**

	Deficit proposal days (1)	FOMC meeting days (2)	Other days (3)	All days (4)
Mean bps	-1.84	3.09	0.22	0.07
t-statistic	[-2.20]	[2.36]	[0.49]	[0.20]
p-value	(0.02)	(0.98)	(0.64)	(0.50)
Cumulative change in %	-20.70	16.39	8.36	4.06
p-value	(0.00)	(1.00)	(0.74)	(0.55)
Observations	1,125	530	3,842	5,497

Notes: This table presents the average daily and cumulative changes in Treasury values, organized across four different sets of days. Column 1 reports changes on days with large negative proposals, specifically excluding those that overlap with FOMC meeting days. Column 2 reports changes in a 3-day window centered on FOMC meeting days. Column 3 reports changes on other trading days and column 4 reports changes on all trading days. *t*-statistics are in squared brackets. We report the percentage of simulated changes in Treasury values that fall below the actual realizations in parentheses.

Table B.7. **Changes in Treasury values around large proposal days**

	Days around large negative proposal days				
	-2	-1	0	1	2
Mean bps	0.56	0.22	-1.84	-0.58	-0.56
t-statistic	[0.67]	[0.26]	[-2.20]	[-0.71]	[-0.63]
p-value	(0.70)	(0.56)	(0.02)	(0.24)	(0.25)
Cumulative change in %	6.19	2.44	-20.70	-6.53	-6.13
p-value	(0.79)	(0.60)	(0.00)	(0.16)	(0.17)
Observations	1,104	1,120	1,125	1,116	1,093

Notes: This table presents the average daily and cumulative changes in Treasury values around the large negative proposal dates. The numbers at the top of each column represent the business days before, on, or after the release date of the CBO cost estimates. *t*-statistics are in squared brackets. We report the percentage of simulated changes in Treasury values that fall below the actual realizations in parentheses.

Table B.8. **Changes in Treasury values around different stages of the bill**

	Different stages of the bill			
	CBO Report	Introduced	Vote	Became Public Law
Mean bps	-1.84	-0.14	-1.01	-0.09
t-statistic	[-2.20]	[-0.21]	[-1.31]	[-0.05]
p-value	(0.02)	(0.41)	(0.12)	(0.43)
Cumulative change in %	-20.70	-1.98	-12.87	-0.29
p-value	(0.00)	(0.36)	(0.03)	(0.45)
Observations	1,125	1,430	1,275	320

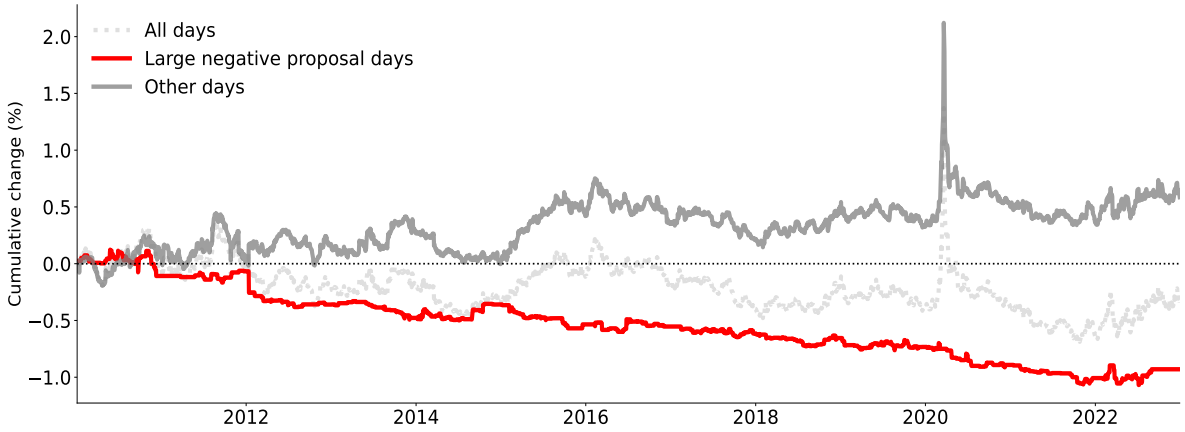
Notes: This table presents the average daily and cumulative changes in Treasury values on four specific days corresponding to key stages of bills with large negative proposals. The initial date marks the bill's introduction in either the House or the Senate. The second date aligns with the release of the cost estimate report by the CBO. The third date corresponds to the voting on the bill in either the House or the Senate. The final date signifies when the bill is enacted as public law. *t*-statistics are in squared brackets. We report the percentage of simulated changes in Treasury values that fall below the actual realizations in parentheses.

Table B.9. **Changes in inflation expectations on large negative proposal days**

	A. Inflation swap tenors			
	1 year	3 years	5 years	10 years
Mean bps	0.42	0.22	0.21	0.21
t-statistic	[1.13]	[1.07]	[1.19]	[1.52]
p-value	(0.88)	(0.88)	(0.90)	(0.95)
Cumulative change in %	3.38	1.77	1.64	1.65
p-value	(0.88)	(0.88)	(0.90)	(0.95)
Observations	800	800	800	800

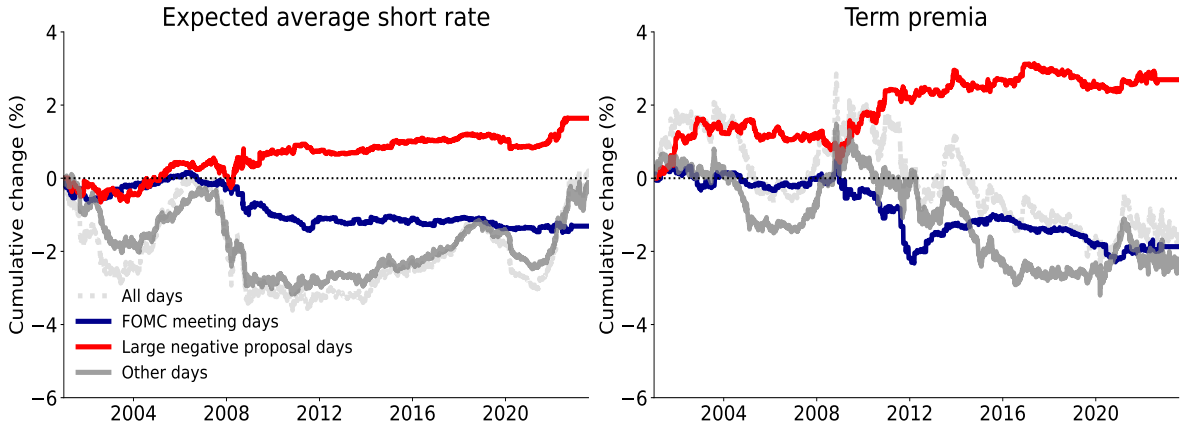
Notes: This table presents the average daily and cumulative changes in inflation swaps with different tenures on days with large negative proposals that do not coincide with FOMC meeting days. Each column shows results using four different tenors: 1, 3, 5, and 10 years. *t*-statistics are presented within square brackets. We report the percentage of simulated changes that fall below the actual realizations in parentheses.

Fig. B.5. **Changes in the convenience yields on large negative proposal days after 2009**



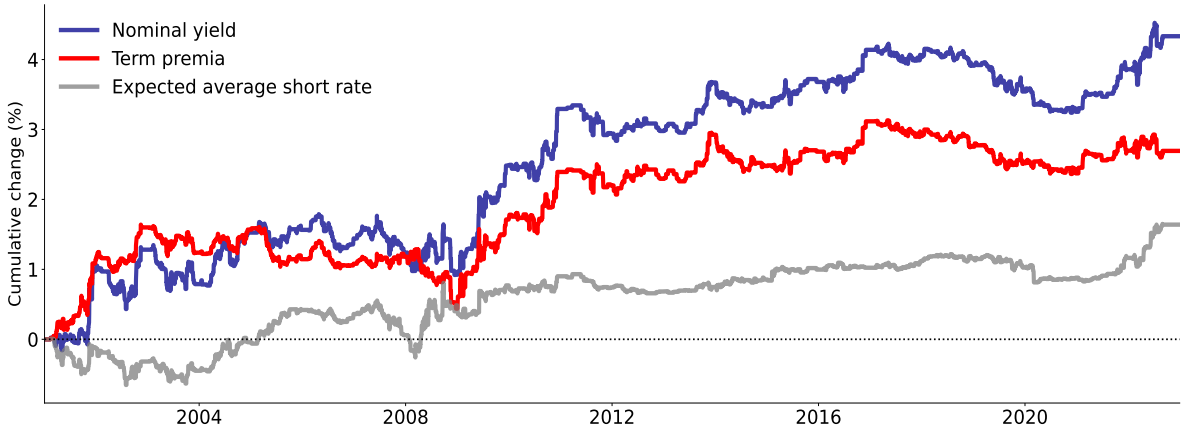
Notes: The light gray lines show the cumulative change in the convenience yields over the sample period after 2009. The red line shows the cumulative change on large negative proposal days that do not coincide with FOMC meeting days. The dark gray line denotes the cumulative changes around the remaining days.

Fig. B.6. **Changes in expected short rates and term premia on large negative proposal days**



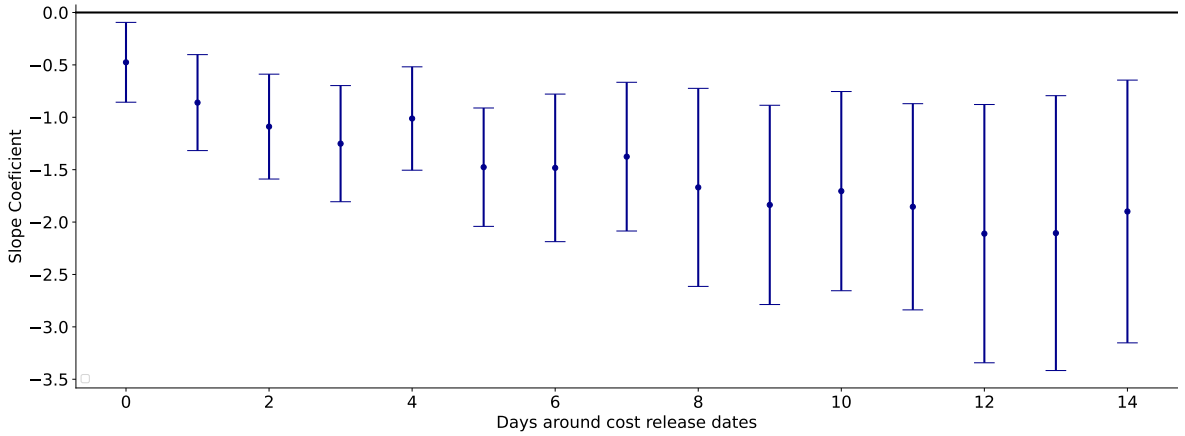
Notes: The figure shows cumulative changes in the 10-year expected average short rate (left panel) and 10-year term premia (right panel) over our sample period. The light gray lines denote the cumulative over the whole sample. The red lines depict the cumulative changes on large negative proposal days that do not coincide with FOMC meeting days, while the dark blue lines depict changes on FOMC meeting days. The dark gray lines denote the cumulative changes on the remaining days.

Fig. B.7. **Decomposition of the 10-year nominal yield on large negative proposal days**



Notes: The dark blue line depicts the cumulative changes in the 10-year nominal yield on large negative proposal days that do not coincide with FOMC meeting days. The red and dark gray lines denote cumulative changes in the 10-year expected average short rate and 10-year term premia on these same days, respectively.

Fig. B.8. **10-Year nominal yield response to cost estimates of emergency bills**



Notes: This figure hows the estimated response of the 10-Year nominal yield to CBO cost releases of emergency bills. Each point represents the coefficient b from the regression:

$$\Delta y_{t-1,t+h} = a + b \cdot \texttt{cbo}^{(em)}_{t+\Delta t} + \epsilon_{t+h},$$

where $\Delta y_{t-1,t+h}$ denotes the cumulative change in the value of the 10-year nominal yield from day $t-1$ to day $t+h$, and $\texttt{cbo}^{(em)}_{t+\Delta t}$ measures the aggregate surplus of emergency legislative proposals announced on the same day. Treasury value changes are in basis points, while $\texttt{cbo}^{(em)}_{t+\Delta t}$ is expressed as a percentage of GDP. The bars represent 95% confidence bands computed using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$.

Table B.10. **Changes in long term yields on large negative proposal days and FOMC meeting days**

A. 10-year nominal yield	Large negative proposal days (1)	FOMC meeting days (2)	Other days (3)	All days (4)
Mean bps	0.38	-0.60	-0.06	-0.02
t-statistic	[2.16]	[-1.99]	[-0.68]	[-0.30]
p-value	(0.93)	(0.09)	(0.39)	(0.50)
Cumulative change in %	4.33	-3.18	-2.52	-1.37
p-value	(0.99)	(0.00)	(0.13)	(0.35)
Observations	1,128	532	3,986	5,646
B. 10-year expected average short rate	Large negative proposal days (1)	FOMC meeting days (2)	Other days (3)	All days (4)
Mean bps	0.15	-0.25	-0.00	0.00
t-statistic	[1.29]	[-1.28]	[-0.05]	[0.07]
p-value	(0.79)	(0.17)	(0.46)	(0.50)
Cumulative change in %	1.64	-1.31	-0.12	0.21
p-value	(0.99)	(0.01)	(0.44)	(0.54)
Observations	1,128	532	3,986	5,646
C. 10-year term premia	Large negative proposal days (1)	FOMC meeting days (2)	Other days (3)	All days (4)
Mean bps	0.24	-0.35	-0.06	-0.03
t-statistic	[1.59]	[-1.22]	[-0.70]	[-0.38]
p-value	(0.85)	(0.20)	(0.40)	(0.50)
Cumulative change in %	2.69	-1.87	-2.40	-1.57
p-value	(0.99)	(0.01)	(0.13)	(0.31)
Observations	1,128	532	3,986	5,646

Notes: Panel A presents the average daily and cumulative changes in the 10-year nominal yield, categorized across four distinct sets of days. Column 1 reports changes on days with large negative proposals that do not coincide with FOMC meeting days, while column 2 reports changes on FOMC meeting days. Column 3 reports changes on other trading days and column 4 reports changes on all trading days. Panels B, and C use the same-day classifications, but compute changes in the 10-year expected average short rate and the 10-year term premia, respectively. t-statistics are presented within square brackets. We report the percentage of simulated changes that fall below the actual realizations in parentheses.

Table B.11. **Changes in nominal yields for different maturities on large negative proposal days**

A. Nominal yields				
	Maturity			
	1 year	3 years	5 years	10 years
Mean bps	0.15	0.32	0.38	0.38
t-statistic	[1.09]	[1.76]	[2.09]	[2.16]
p-value	(0.78)	(0.88)	(0.92)	(0.93)
Cumulative change in %	1.66	3.57	4.30	4.33
p-value	(0.98)	(0.99)	(0.99)	(0.99)
Observations	1,128	1,128	1,128	1,128
B. 10-year expected average short rate				
	Maturity			
	1 year	3 years	5 years	10 years
Mean bps	0.11	0.16	0.17	0.15
t-statistic	[0.88]	[1.12]	[1.20]	[1.29]
p-value	(0.71)	(0.75)	(0.77)	–
Cumulative change in %	1.24	1.81	1.88	1.64
p-value	(0.94)	(0.97)	(0.98)	–
Observations	1,128	1,128	1,128	1,128
C. Nominal term premia				
	Maturity			
	1 year	3 years	5 years	10 years
Mean bps	0.04	0.16	0.22	0.24
t-statistic	[0.58]	[1.64]	[1.86]	[1.59]
p-value	(0.63)	(0.84)	(0.89)	–
Cumulative change in %	0.42	1.76	2.43	2.69
p-value	(0.81)	(1.00)	(1.00)	–
Observations	1,128	1,128	1,128	1,128

Notes: Panel A table presents the average daily and cumulative changes in nominal yields with different maturities on days with large negative proposals that do not coincide with FOMC meeting days. Each column shows results using four different maturities: 1, 3, 5, and 10 years. Panels B and C present the same results for the expected average short rate and the nominal term premia, respectively. t-statistics are presented within square brackets. We report the percentage of simulated changes that fall below the actual realizations in parentheses.

Table B.12. **Treasury value responses around major spending bills**

	(1)	(2)
$\texttt{cbo}^{(z)}_{t+\Delta t}$	3.10	3.00
t-statistic	[3.68]	[3.34]
Constant	2.87	0.18
t-statistic	[0.48]	[0.06]
R^2 in %	1.43	57.89
Observations	130	130
Controls	No	Yes

Notes: This table presents regression results around major spending bills using the following equation:

$$\Delta b_{t-1,t+1} = a + b \cdot \texttt{cbo}^{(z)}_{t+\Delta t} + \epsilon_{t+1},$$

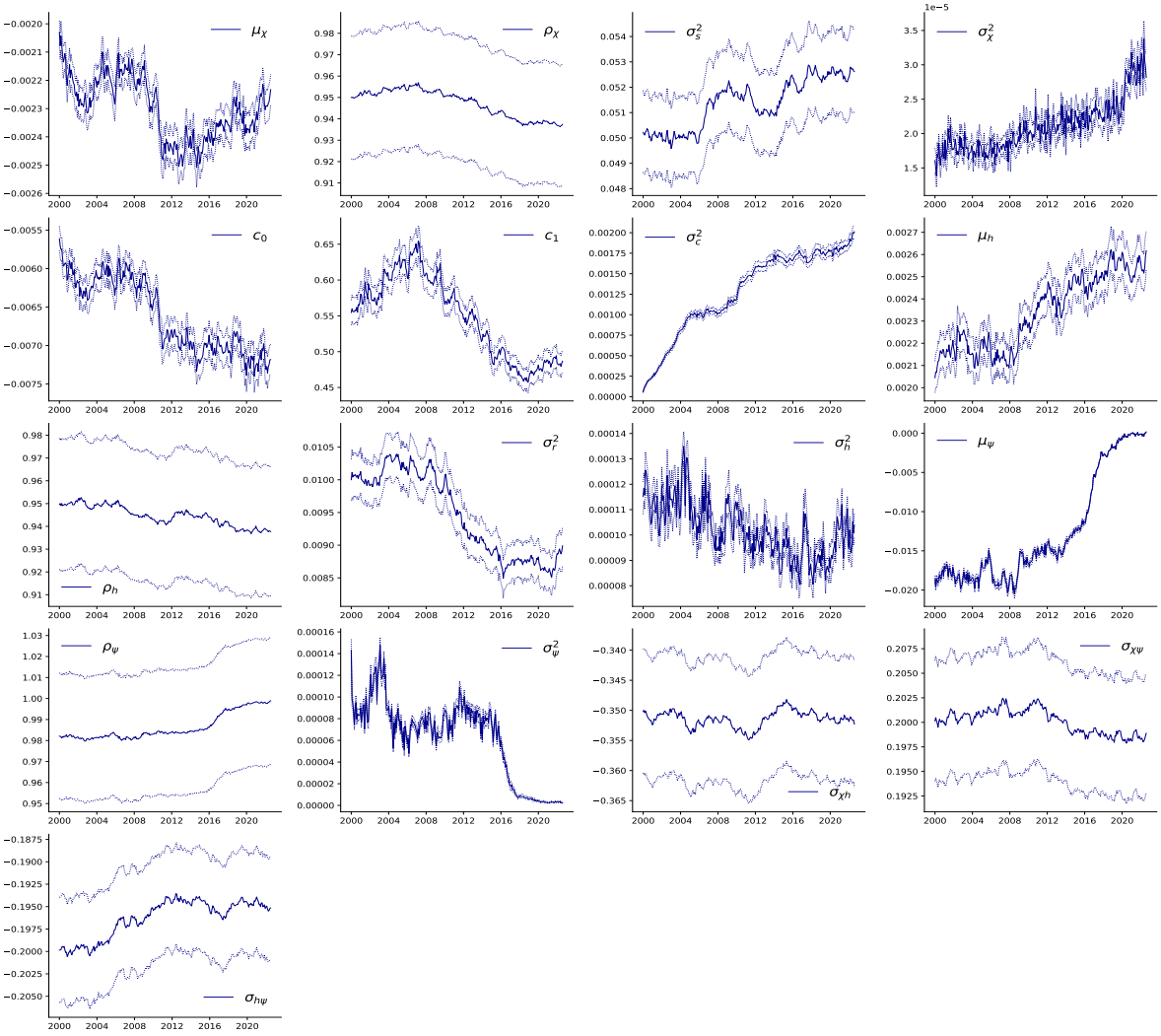
where $\Delta b_{t,t+1}$ is the daily change in the value of the government debt portfolio computed using procedures similar to Hall and Sargent (2011). $\texttt{cbo}^{(z)}_{t+\Delta t}$ denotes the aggregate surplus of each proposal, where we sum the cash flow contributions of cost releases reported on the same day. In column (2), we control for macroeconomic news coinciding with the measurement window from day $t-1$ to $t+1$ and the cumulative Treasury value changes realized over the previous week. Treasury value changes are measured in basis points, while $\texttt{cbo}^{(z)}_{t+\Delta t}$ is expressed as a percentage of GDP. t-statistics are reported in squared brackets using Newey-West standard errors with lag length $L = \lceil 1.3 \times T^{1/2} \rceil$.

Table B.13. **Anomalies in consensus forecasts about the budget**

	Bias	Autocorrelation	Mincer-Zarnowitz	Coibion-Gorodnichenko
	(1)	(2)	(3)	(4)
a	-1.14	-0.80	-0.02	-1.09
t-statistic	[-1.94]	[-1.30]	[-2.68]	[-1.94]
b	–	0.19	0.89	1.22
t-statistic	–	[1.97]	[8.10]	[3.43]
Observations	266	242	266	266

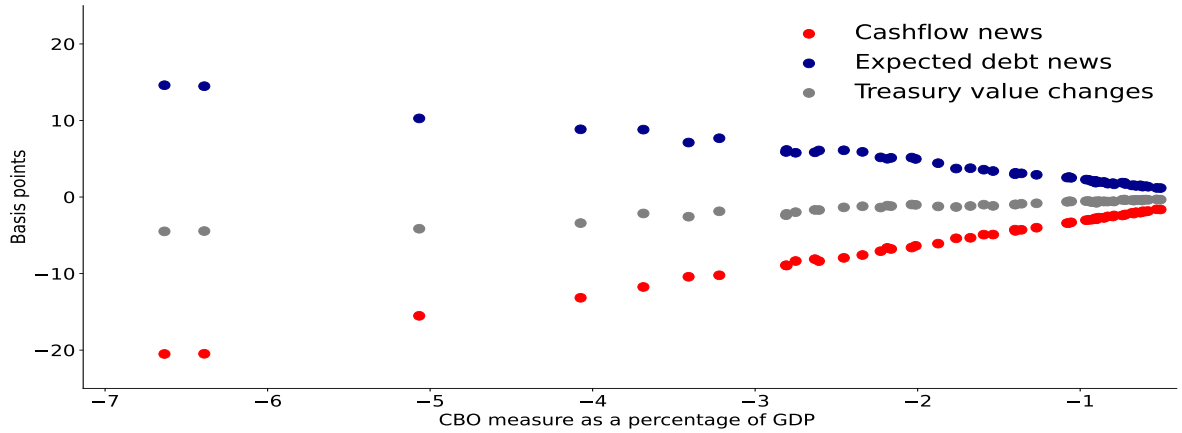
Notes: This table presents four different tests of forecast rationality using the Economic Consensus forecast about the budget. The t-statistics presented in brackets use Newey-West standard errors with the lag length selected as $L = \lceil 1.3 \times T^{1/2} \rceil$. The sample spans from January 2000 to February 2023.

Fig. B.9. **Evolution of the parameter estimates**



Notes: Each panel plots the evolution of beliefs about the model parameters. The blue solid lines are the posterior median estimates, and the dotted blue lines are the 5th and 95th percentiles of the posterior distribution.

Fig. B.10. **Budgetary effect at different horizons**



Notes: This figure displays how surplus news over the decade and expected future debt news vary with the cost intensity measure. The x-axis shows the CBO cost intensity measure with large negative cost releases, while the y-axis shows the effect on surplus news over the decade (red dots), the effect on expected future debt news (blue dots), and the effect on treasury values (gray dots.) We show posterior median estimates.

B.2 Decomposition of the effects by maturity

In this section, we show that the effect of the cashflow contributions on the value of the government bond portfolio is primarily due to its impact on debt over 5 years, with only minimal effects observed for shorter maturities.

Given the values of f_{t+j}^t and q_{t+j}^t for each maturity at time $t+j$, we can compute the value-weighted average return on the nominal portion of debt as:

$$r_t = \sum_j^n r_{t-1,t}^j \omega_{t-1}^j \tag{B.1}$$

where $r_{t-1,t}^j = q_{t+j-1}^t / q_{t+j-1}^{t-1}$ and the weight, ω_{t-1}^j, depends on the market value of government debt outstanding for that specific maturity j on the previous day $t-1$ and it is given by:

$$\omega_{t-1}^j = \frac{q_{t+j-1}^{t-1} f_{t+j-1}^{t-1}}{\sum_{j=1}^n q_{t+j-1}^{t-1} f_{t+j-1}^{t-1}}. \tag{B.2}$$

An advantage of expressing the returns as in equation B.1 is that it allows for a decomposition of returns by maturity. Specifically, we decompose the bond return into four distinct maturity groups. These segments comprise treasuries maturing within a year, represented by $\sum_{j=0}^{1y} r_t^j \omega_{t-1}^j$, those with maturities spanning from 1 to 4 years, $\sum_{j=1y}^{4y} r_t^j \omega_{t-1}^j$, bonds and notes maturing between 4 and 10 years, $\sum_{j=4y}^{10y} r_t^j \omega_{t-1}^j$, and finally, bonds with maturities extending beyond 10 years, articulated by $\sum_{j=10y}^{30y} r_t^j \omega_{t-1}^j$. Cumulatively, these segments represent the aggregate return r_t.

Table B.14 presents the average daily and cumulative returns on the government debt portfolio on large negative proposal days. We find the effect of the cash flow projections on the government bond portfolio is primarily due to its impact on debt over 5 years, with only minimal effects observed for shorter maturities.

Table B.14. **Decomposition of the effects by maturity**

		Decomposition of the nominal returns, $r_{t,t+1}$, by maturity of obligation			
Coefficient	$r_{t,t+1}$ (1)	Below 1 y (2)	1 y to 4 y (3)	5 y to 10 y (4)	Above 10 y (5)
Mean bps	-1.84	-0.01	-0.25	-0.73	-0.83
t-statistic	[-2.20]	[-0.57]	[-1.53]	[-2.19]	[-2.16]
p-value	(0.02)	(0.18)	(0.06)	(0.02)	(0.03)
Cumulative return in %	-20.70	-0.15	-2.80	-8.16	-9.31
p-value	(0.00)	(0.11)	(0.01)	(0.00)	(0.00)
Observations	1,125	1,125	1,125	1,125	1,125

Notes: This table presents the average daily and cumulative returns on the government debt portfolio by maturity brackets. The column labeled with "Below 1 y" is $\sum_{j=0}^{1y} r_t^j \omega_{t-1}^j$; column labeled "1 y to 4 y" is $\sum_{j=1y}^{4y} r_t^j \omega_{t-1}^j$; column labeled "5 y to 10 y" is $\sum_{j=4y}^{10y} r_t^j \omega_{t-1}^j$; column labeled "Above 10 y" is $\sum_{j=10y}^{30y} r_t^j \omega_{t-1}^j$. t-statistics are in squared brackets. We report the percentage of simulated changes in Treasury values that fall below the actual realizations in parentheses.

Supplemental Appendix (Not for publication)

Can U.S. Treasury Markets Add and Subtract?

Roberto Gómez-Cram Howard Kung Hanno Lustig

Appendix C Selected CBO cost estimates

We use two examples to illustrate the informational content and highlight the different formats in cost releases.

Panel A of Figure C.11 presents an example of a bill with a small budgetary impact, S. 284, related to human rights. The first item that we collect is the date of the cost release in the top right corner. The cost estimates for small bills are typically presented in text format. We highlighted the text containing the cost estimates in red, which says *"seven additional staff to implement the bill's provisions at an annual cost of about $200,000 per person"* plus an additional 500K in administrative costs over 5 years.

Larger bills (e.g., those above the median in size) usually contain a detailed table at the end of the cost release, outlining the projected cash flows linked to the proposal. Panel B of Figure C.11 displays the CBO cost estimate for the Tax Cuts and Jobs Act. The text provides an overview of the proposal, while the accompanying table (highlighted in red) specifies the net increase in deficits from the proposal for the upcoming year and the subsequent decade if enacted.

Fig. C.11. **Examples of CBO cost estimates**

Panel A: **CBO Cost estimate for S.284**

CONGRESSIONAL BUDGET OFFICE
COST ESTIMATE

September 1, 2015

S. 284
Global Magnitsky Human Rights Accountability Act

As reported by the Senate Committee on Foreign Relations
on July 29, 2015

S. 284 would require the Departments of State and Treasury to impose sanctions on persons responsible for human rights violations or significant corruption in foreign countries. Those persons would be ineligible for entry into the United States, have any existing visas revoked, and have their assets frozen if they fall under U.S. jurisdiction. The legislation also would require periodic reports to the Congress on the implementation of the bill.

Based on information from the Department of State, CBO expects the department would hire seven additional staff to implement the bill's provisions at an annual cost of about $200,000 per person. CBO further estimates that other administrative costs to the Department of Treasury would be less than $500,000 over the next five years.

Panel B: **CBO Cost estimate for H.R.1**

CONGRESSIONAL BUDGET OFFICE
COST ESTIMATE

November 13, 2017

H.R. 1

A bill to provide for reconciliation pursuant to titles II and V of the Concurrent Resolution on the Budget for Fiscal Year 2018

As ordered reported by the House Committee on Ways and Means on November 9, 2017

SUMMARY

H.R. 1, the Tax Cuts and Jobs Act, would amend numerous provisions of U.S. tax law. The bill would modify the individual income tax brackets and tax rates in effect under current law. The bill also would increase the standard deduction and the child tax credit. Deductions for personal exemptions and certain itemized deductions would be repealed, along with the individual and corporate alternative minimum tax (AMT) and, starting in 2025, the estate tax. H.R. 1 would replace the structure of corporate income tax rates, which has a top rate of 35 percent under current law, with a single 20 percent rate, and would establish a maximum tax rate of 25 percent for qualified business income of an individual from certain pass-through entities. Among other changes, the bill would also substantially alter the current system under which U.S. corporations are subject to taxation on their worldwide income.

	By Fiscal Year, in Billions of Dollars											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018-2022	2018-2027
CHANGES IN REVENUES												
Tax Reform for Individuals	-64.2	-134.3	-124.5	-123.8	-123.3	-88.9	-69.1	-70.4	-88.8	-88.4	-569.6	-975.9
Business Tax Reform	-124.3	-129.3	-116.3	-101.6	-89.0	-24.8	2.4	-27.0	-55.0	-80.4	-560.4	-744.5
Taxation of Foreign Income and Foreign Persons	70.7	42.2	24.4	27.2	27.6	28.6	28.3	28.1	10.4	-7.2	191.9	279.3
Exempt Organizations	0.3	0.4	*	0.1	0.2	0.2	0.5	0.5	0.5	0.5	1.1	2.7
Total Estimated Changes in Revenues	**-117.6**	**-221.0**	**-216.5**	**-198.2**	**-184.5**	**-84.9**	**-37.9**	**-68.8**	**-132.9**	**-175.4**	**-937.1**	**-1,438.4**
On-Budget	-116.7	-220.6	-216.3	-198.2	-185.0	-88.8	-43.0	-73.0	-136.6	-178.7	-936.0	-1,457.7
Off-Budget[a]	-0.9	-0.4	-0.2	*	0.5	3.9	5.1	4.2	3.7	3.3	-1.1	19.3
CHANGES IN DIRECT SPENDING												
Tax Reform for Individuals												
Estimated Budget Authority	-11.7	3.6	3.4	3.1	2.5	3.5	-3.4	-4.3	-4.8	-4.2	1.6	-12.2
Estimated Outlays	-11.7	3.6	3.4	3.1	2.5	3.5	-3.4	-4.3	-4.8	-4.2	1.6	-12.2
Business Tax Reform												
Estimated Budget Authority	2.2	2.3	1.7	1.9	1.8	-0.1	-0.1	-0.1	-0.1	-0.1	10.1	9.7
Estimated Outlays	2.2	2.3	1.7	1.9	1.8	-0.1	-0.1	-0.1	-0.1	-0.1	10.1	9.7
Taxation of Foreign Income and Foreign Persons												
Estimated Budget Authority	0.3	0.1	0.1	0.1	0.1	*	0	0	0	0	0.8	0.9
Estimated Outlays	0.3	0.1	0.1	0.1	0.1	*	0	0	0	0	0.8	0.9
Total Changes in Direct Spending												
Estimated Budget Authority	-9.2	6.0	5.2	5.1	4.4	3.4	-3.5	-4.4	-4.9	-4.3	12.5	-1.6
Estimated Outlays	-9.2	6.0	5.2	5.1	4.4	3.4	-3.5	-4.4	-4.9	-4.3	12.5	-1.6
NET INCREASE OR DECREASE (-) IN THE DEFICIT FROM CHANGES IN DIRECT SPENDING AND REVENUES												
Impact on Deficit	**108.4**	**227.0**	**221.7**	**203.3**	**188.9**	**88.3**	**34.4**	**64.4**	**128.0**	**171.1**	**949.6**	**1,436.8**
On-Budget Deficit	107.5	226.6	221.5	203.3	189.4	92.2	39.5	68.6	131.7	174.4	948.5	1,456.1
Off-Budget Deficit	0.9	0.4	0.2	*	-0.5	-3.9	-5.1	-4.2	-3.7	-3.3	1.1	-19.3

Notes: These figures show examples of the CBO cost releases. Panel A displays the cost estimates for a smaller bill, S. 287, while Panel B features the cost estimates for a larger bill, H.R. 1.

Appendix D CBO's aggregate surplus projections and bill-level estimates

This section relates the bill-level cost estimates with the CBO's aggregate surplus projections.

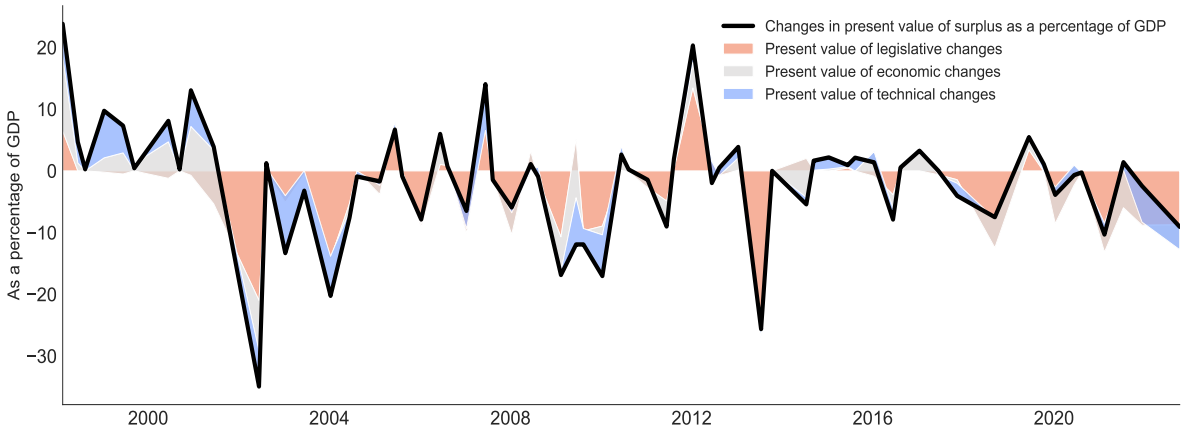
One of CBO's mandated obligations is to produce the annual Budget and Economic Outlook, presenting baseline projections of the surplus or deficit for the upcoming decade. This report is typically published at the beginning of the year and undergoes revisions in March and July. The baseline projections are not intended as forecasts of budgetary or economic outcomes; rather, they represent the CBO's assessment of how the budget and the economy would evolve under existing laws. Hence, the baseline serves as a reference point for evaluating the potential effects of proposed legislation.

Figure D.12 shows the changes in the present value of the CBO's surplus projection between two consecutive reports, where negative values indicate an increase in deficits. The changes in the present value of the surplus have been scaled by Gross Domestic Product (GDP). The black line in the figure reveals significant revisions in the CBO's 10-year cumulative projections between consecutive reports, with a standard deviation of 9.3%, despite an average time gap of 140 days between reports.

Figure D.12 further breaks down the revisions in the expected future surpluses into three distinct components. The red-shaded area represents revisions attributed to legislative changes resulting from laws enacted since the agency published its prior baseline projections. This category accounts for the majority of changes in the CBO baseline projections, contributing to 56% of the variance in surplus changes.

The remaining 44% of the variance in surplus changes is equally accounted for by the second and third categories, namely economic changes and technical changes. Economic changes arise from revisions made to the agency's economic forecast, which includes adjustments to incorporate the macroeconomic effects of recently enacted legislation. Technical changes serve as a residual category, capturing revisions to projections that are neither legislative nor economic in nature.

Fig. D.12. **Changes in expected surplus or deficits [-] as a percentage of GDP**



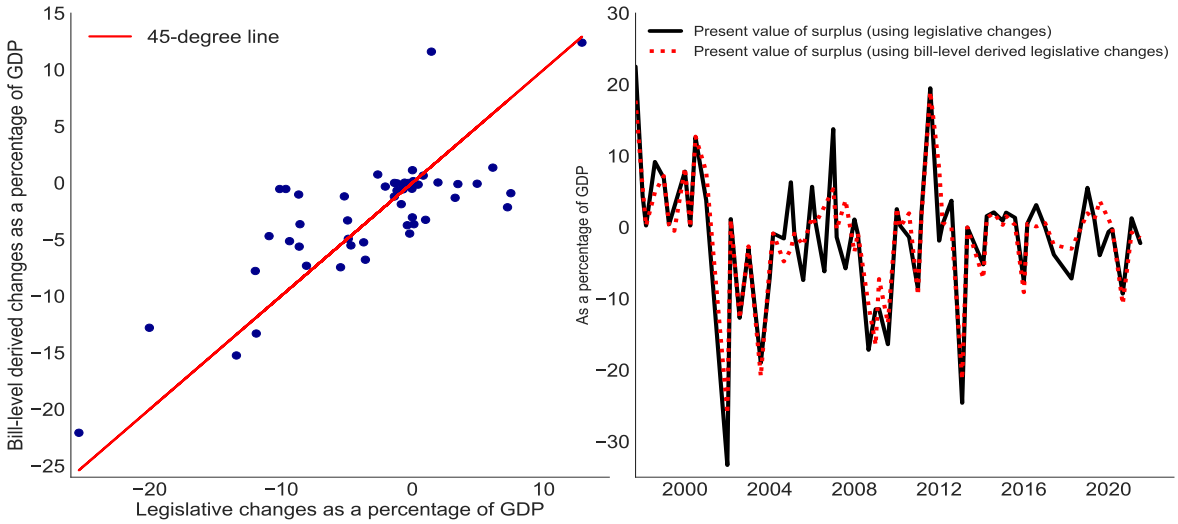
Notes: The figure shows changes in the present value of the CBO's surplus projection between two consecutive Budget and Economic Outlook reports, where negative values indicate an increase in deficits. The changes in the present value of the surplus have been scaled by GDP. The figure further breaks down the revisions in the expected future surpluses into three distinct components. The red-shaded area represents revisions attributed to legislative changes. The gray-shaded area denotes economic changes, while the blue-shaded area denotes technical changes.

Next, we use the cost estimates for proposed legislation to reconstruct the aggregate legislative changes and capture the timing of public cost estimate disclosures.

We can evaluate the significance of cost estimates at the bill level by combining the estimates for all bills enacted between two successive Budget and Economic Outlook reports. This aggregated series of cost estimates should closely align with the legislative changes depicted in Figure D.12, as both series track the modifications to the deficit arising from recently enacted laws. Creating these cost estimates from scratch has the advantage of pinpointing the exact moment of their public release.

To illustrate this relationship, the left panel of Figure D.13 presents a binned scatter plot between the present value of legislative changes and the present value of bill-derived changes, both scaled by GDP. The figure depicts the two series closely tracking each other, aligning near the 45-degree line represented by the red line. Furthermore, as seen in the right panel of Figure D.13, both legislative changes (represented by the black straight line) and bill-derived cost estimates (represented by the red dotted line) produce a series of changes in the present value of the CBO surplus projection that closely follow each other with a correlation above 90%.

Fig. D.13. **Bill-level expected changes in surplus or deficit [-] versus legislative changes**



Notes: The left panel shows a binned scatter plot between the present value of legislative changes and the present value of bill-derived changes, both scaled by GDP. The bill-derived changes are computed by combining the estimates for all bills enacted between two successive Budget and Economic Outlook reports. The right panel shows the present value of the CBO surplus projection using the legislative changes series (illustrated by the black line) and the bill-derived changes (represented by the red dotted line).

Appendix E Linearized Budget Identity

We describe the linearization of the budget identity introduced in the main text in Section 1.2. We start with the budget identity at time t,

$$B_t + S_t = R_{gt} B_{t-1}, \tag{E.1}$$

where B_t is the market value of the aggregate Treasury portfolio held by the public, R_{gt} is the corresponding gross portfolio return and S_t is the aggregate surplus.

We normalize the variables in the identity by nominal GDP (Y_t)

$$\hat{B}_t + \hat{S}_t = R_{gt}/(\Pi_t \Delta \hat{Y}_t)\hat{B}_{t-1}, \tag{E.2}$$

where $\hat{B}_t \equiv B_t/Y_t$ is debt to GDP, $\hat{S}_t \equiv S_t/Y_t$, $\Pi_t \equiv P_t/P_{t-1}$ is inflation, and $\Delta\hat{Y}_t \equiv \hat{Y}_t/\hat{Y}_{t-1}$ is real GDP growth. Taking logs of the equation above at $t+1$, we have:

$$\log\left(e^{b_{t+1}} + \hat{S}_{t+1}\right) = \tilde{r}_{gt+1} - \pi_{t+1} - \Delta y_{t+1} + b_t, \tag{E.3}$$

where $\pi_t \equiv \log(\Pi_t)$, $\Delta y_t \equiv \log(\Delta Y_t)$, and $b_t \equiv \log(\hat{B}_t)$. Define the growth and inflation-adjusted bond return as above $\hat{r}_{gt+1} \equiv \tilde{r}_{gt+1} - \pi_{t+1} - \Delta y_{t+1}$, and rewrite:

$$\log\left(e^{b_{t+1}} + \hat{S}_{t+1}\right) = \hat{r}_{gt+1} + b_t, \tag{E.4}$$

Take a first-order Taylor expansion of the term on the left around the steady state, linearizing log debt to GDP and the level of surplus to GDP:

$$\log\left(e^{b_{t+1}} + \hat{S}_{t+1}\right) = \log\left(e^{b} + \hat{S}\right) + \left(\frac{e^b}{e^b + \hat{S}}\right)(b_{t+1} - b) + \left(\frac{1}{e^b + \hat{S}}\right)(\hat{S}_{t+1} - \hat{S}) \tag{E.5}$$

Our process specified for $\hat{S}_t$ implies the steady state value $\hat{S} = \mu$. Collecting the constant terms:

$$\log\left(e^{b_{t+1}} + \hat{S}_{t+1}\right) = \alpha + \nu b_{t+1} + \gamma \hat{S}_{t+1} \tag{E.6}$$

where the coefficients depend on the parameters of the log steady state debt to GDP ratio (b) and the steady state level of the surplus to GDP ratio μ:

$$\alpha \equiv \log\left(e^b + \mu\right) - \left(\frac{e^b}{e^b+\mu}\right) b - \left(\frac{1}{e^b+\mu}\right)\mu \tag{E.7}$$

$$\nu \equiv \left(\frac{e^b}{e^b+\mu}\right) \tag{E.8}$$

$$\gamma \equiv \left(\frac{1}{e^b+\mu}\right) \tag{E.9}$$

Note that $\nu = e^{-\hat{r}_g}$. Using this approximation, we can then write the linearized budget equation as:

$$\alpha + \nu b_{t+1} + \gamma \hat{S}_{t+1} = \hat{r}_{gt+1} + b_t. \tag{E.10}$$

Assume that $\nu < 1$. We can iterate the linearized identity forward and impose the transversality condition to obtain:

$$b_t = \alpha \sum_{j=1}^{\infty} \nu^{j-1} + \sum_{j=1}^{\infty} \nu^{j-1} \gamma \hat{S}_{t+j} - \sum_{j=1}^{\infty} \nu^{j-1} \hat{r}_{gt+j}, \tag{E.11}$$

where the constant term can be simplified using the sum of a geometric series to express the equation above as:

$$b_t = \alpha^\star + \sum_{j=1}^{\infty} \nu^{j-1} \gamma \hat{S}_{t+j} - \sum_{j=1}^{\infty} \nu^{j-1} \hat{r}_{gt+j}, \tag{E.12}$$

where $\alpha^\star \equiv \alpha/(1-\nu)$. This is the same as equation (2) in the main text.

We relate the market value of debt to the expected cash flows of individual proposals and enacted bills by using an identity that decomposes the expected aggregate surplus at horizon j into the contributions from current proposals and enacted bills, and future proposals as

$$\mathbb{E}_t \hat{S}_{t+j} = \underbrace{\mathbb{E}_t \sum_{k \in N_t} \mathbb{1}^{(k)}_{\geq t} \hat{S}^{(k)}_{t+j}}_{\text{current policy}} + \underbrace{\mathbb{E}_t \sum_{l \in N_{>t}} \iota^{(l)}_{>t} \hat{\mathcal{S}}^{(l)}_{t+j}}_{\text{future policy}}, \tag{E.13}$$

where N_t is the set of current bills enacted or proposed before or at t, $\mathbb{1}_{\geq t}^{(k)}$ is an indicator variable that takes on the value of 1 if the bill k is enacted, $\hat{S}_{t+j}^{(k)} \equiv S_{t+j}^{(k)}/(Y_{t+j})$ is the cash flow contribution of bill k at time $t+j$ normalized by nominal GDP conditional on being enacted, $N_{>t}$ corresponds to the set of new legislation proposed or amended after t, $\iota_{>t}^{(l)}$ is an indicator variable that is equal to 1 if the future proposed bill or amendment l is enacted in the future, and $\hat{\mathcal{S}}_{t+j}^{(l)} \equiv \mathcal{S}_{t+j}^{(l)}/(Y_{t+j})$.

We can plug equation (E.13) into equation (E.12) to obtain a present value relation linking the cash flow contribution from current policy (enacted and proposed bills today), cash flow contribution from future policy (future proposals), and government discount rates according to

$$b_t = \alpha^\star + \underbrace{\gamma \mathbb{E}_t \sum_{k \in N_t} \sum_{j=1}^{T} \nu^{j-1} \mathbb{1}_{\geq t}^{(k)} \hat{S}_{t+j}^{(k)}}_{\substack{\text{cash flow contribution from} \\ \text{current policy}}} + \underbrace{\gamma \mathbb{E}_t \sum_{l \in N_{>t}} \sum_{j=1}^{\infty} \nu^{j-1} \iota_{>t}^{(l)} \hat{\mathcal{S}}_{t+j}^{(l)}}_{\substack{\text{cash flow contribution from} \\ \text{future policy}}} - \underbrace{\mathbb{E}_t \sum_{j=1}^{\infty} \nu^{j-1} \hat{r}_{gt+j}}_{\text{discount rates}}, \quad \text{(E.14)}$$

where T corresponds to the time horizon of the CBO forecasts.

Suppose that the CBO cost estimate of a current proposal z is released at time $t+\Delta t$, providing cash flow projections $\{\widetilde{\mathbb{E}}_{t+\Delta t} S_{t+j}^{(z)}\}_{j=1}^{T}$ conditional on the proposed legislation being enacted, where $\widetilde{\mathbb{E}}_{t+\Delta t}[\cdot]$ is the CBO's expectation operator, which could be different than the bond investor's expectations. The cost estimate could contain direct news about the cash flows of proposal z or convey new information about the stance of aggregate surplus policy or discount rates. Any new information relevant to bond investors would be reflected in the change in the Treasury portfolio value based on equation (E.14), rewritten in news terms as

$$\begin{aligned} \Delta b_{t+\Delta t} \;=\; & \gamma(\mathtt{cf}_{t+\Delta t}^{(z)} - \mathtt{cf}_t^{(z)}) + \Delta \mathtt{CF}_{t+\Delta t}(\mathtt{current\ bills} \backslash z) + \Delta \mathtt{CF}_{t+\Delta t}(\mathtt{future\ bills}) \\ & - \Delta \mathtt{DR}_{t+\Delta t}, \end{aligned} \quad \text{(E.15)}$$

where $\Delta b_{t+\Delta t} \equiv b_{t+\Delta t} - b_t$ and we separated out the cash flow component of proposal z

from equation (E.14), which we define as

$$\Delta \mathtt{cf}_t^{(z)} \equiv \mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \mathbb{1}_{\geq t}^{(z)} \hat{S}_{t+j}^{(z)}, \tag{E.16}$$

and $\mathtt{CF}_{t+\Delta t}(\mathtt{current\ bills} \backslash z)$ is cash flow news from current policy, $\Delta \mathtt{CF}_{t+\Delta t}(\mathtt{future\ bills})$ is cash flow news from future policy, and $\Delta \mathtt{DR}_{t+\Delta t}$ is government discount rate news. Equation (E.15) is the same as equation (4) in the main text.

Appendix F Expected nominal return decomposition

We provide the derivations for the approximate expected nominal return decomposition introduced in Section 2.1.3. We assume that the representative bond investor has preferences defined over the real balances of government bonds:

$$U_t = E_t \sum_{t=0}^{\infty} \beta^t u(C_t^\star) \tag{F.1}$$

$$C_t^\star = C_t + \theta_t \frac{B_t}{P_t} \tag{F.2}$$

where β is the time discount factor, c_t is real consumption, B_t is the total nominal market value of the government bonds, P_t is the price level, and θ_t is a parameter capturing the preference for government bonds that can depend on budget news.

The representative investor holds the entire government bond portfolio, modeled as perpetual nominal debt with a geometrically decaying coupon rate ϕ. The nominal coupons at time $t+j$ would be $(1-\phi)^{j-1}\upsilon F_t$, where υ is the current coupon at time t. We can choose ϕ to match the average maturity of the government bond portfolio. Define $B_t = Q_t F_t$, where Q_t is the nominal bond price, and F_t is the face value of debt. The budget equation of the household is given by $P_t C_t + Q_t F_t = D_t + (\upsilon + (1-\phi)Q_t)F_{t-1}(1-\delta_t)$, where δ_t is the default rate on outstanding debt, and D_t is the income earned by the household. We can write the budget constraint of the household in terms of the market value of debt and the bond portfolio return:

$$P_t C_t + B_t = D_t + (1 + r_{gt}) B_{t-1}(1-\delta_t), \tag{F.3}$$

where $(1 + r_{gt}) \equiv (\upsilon + (1-\phi)Q_t)/Q_{t-1}$ is the holding period return. The investor maximizes lifetime utility by choosing a sequence of consumption and bond holdings. We assume complete markets so that the household can trade a full set of Arrow securities, implying that the intertemporal marginal rate of substitution is equal to the state prices.

The Lagrangian is given by:

$$\mathcal{L}_t = E_t\left[\sum_{t=0}^{\infty}\beta^t\Big(u(C_t^\star)+\lambda_t(D_t+(1+r_{gt})B_{t-1}(1-\delta_t)-P_tC_t-B_t)\Big)\right]. \tag{F.4}$$

The corresponding first-order conditions are with respect to C_t and B_t:

$$u'(C_t^\star)-\lambda_t P_t = 0 \tag{F.5}$$

$$\frac{u'(C_t^\star)}{P_t}\theta_t-\lambda_t+E_t\Big[\beta\lambda_{t+1}(1+r_{gt+1})(1-\delta_{t+1})\Big]=0 \tag{F.6}$$

Combining these equations gives us the following Euler equation:

$$1-\theta_t = E_t\Big[M_{t+1}^{\$}(1+r_{gt+1})(1-\delta_{t+1})\Big] \tag{F.7}$$

where $M_{t+1}^{\$}\equiv M_{t+1}/\Pi_{t+1}$ is the one-period nominal stochastic discount factor and $M_{t+1}\equiv\beta u'(C_{t+1})/u'(C_t)$ is the real stochastic discount factor and $\Pi_{t+1}\equiv P_{t+1}/P_t$ is gross inflation. The Euler equation can also be expressed equivalently in terms of the bond price:

$$Q_t = \frac{E_t\Big[M_{t+1}^{\$}(\upsilon+(1-\phi)Q_{t+1})(1-\delta_{t+1})\Big]}{1-\theta_t} \tag{F.8}$$

Using the assumption $1-\theta_t\approx e^{-\theta_t}$ and letting $\mathbb{1}_{\{\chi_{t+1}=1\}}$ denote the default indicator function, we can write

$$Q_t = \Big(E_t\left[M_{t+1}^{\$}(\upsilon+(1-\phi)Q_{t+1})(1-\mathbb{1}_{\{\chi_{t+1}=1\}})\right]\Big)e^{\theta_t} \tag{F.9}$$

$$+ \Big(E_t\left[M_{t+1}^{\$}(\upsilon+(1-\phi)Q_{t+1})(1-\delta_{t+1})\mathbb{1}_{\{\chi_{t+1}=1\}}\right]\Big)e^{\theta_t} \tag{F.10}$$

where χ_t is equal 1 if there is default and 0 if there is no default. Assume that the realized default event is uncorrelated with the stochastic discount factor, let $\gamma_t\equiv E_t[\mathbb{1}_{\chi_{t+1}=1}]$ denote the conditional probability of default next period, and assume that the loss rate

is predetermined so that we can write:

$$\begin{aligned} Q_t &= \left\{(1-\gamma_t)E_t\left[M^{\$}_{t+1}(\upsilon+(1-\phi)Q_{t+1})\right]+\gamma_t E_t\left[M^{\$}_{t+1}(\upsilon+(1-\phi)Q_{t+1})\right](1-\delta_{t+1})\right\}e^{\theta_t} \\ &\approx e^{-\gamma_t\delta_{t+1}+\theta_t}E_t\left[M^{\$}_{t+1}(\upsilon+(1-\phi)Q_{t+1})\right]. \end{aligned} \tag{F.11}$$

Note that Q_{t+1} depends on γ_{t+1} and δ_{t+2}.

Rearrange the equation above:

$$1 = E_t\left[M^{\$}_{t+1}(1+r_{gt+1})\right]e^{-\gamma_t\delta_{t+1}+\theta_t}, \tag{F.12}$$

or,

$$1 = E_t\left[e^{m^{\$}_{t+1}+r_{gt+1}}\right]e^{-\gamma_t\delta_{t+1}+\theta_t}. \tag{F.13}$$

Assuming the $m^{\$}_{t+1}$ and r_{gt+1} are jointly lognormal, we can express the Euler equation as:

$$1 = e^{E_t\left[m^{\$}_{t+1}\right]+E_t[r_{gt+1}]+1/2\mathrm{Var}_t(m^{\$}_{t+1}+r_{gt+1})-\gamma_t\delta_{t+1}+\theta_t}. \tag{F.14}$$

Take logs of both sides of the equation above and expand the conditional variance of the sum to get:

$$\begin{aligned} 0 = E_t\left[m^{\$}_{t+1}\right]+E_t\left[r_{gt+1}\right]+\frac{1}{2}\mathrm{Var}_t(m^{\$}_{t+1})+\frac{1}{2}\mathrm{Var}_t(r_{gt+1}) \\ +\mathrm{Cov}_t(m^{\$}_{t+1},r_{gt+1})-\gamma_t\delta_{t+1}+\theta_t \end{aligned} \tag{F.15}$$

Substitute in the log nominal short rate, $i_t \equiv -E_t[m^{\$}_{t+1}] - 1/2\mathrm{Var}_t[m^{\$}_{t+1}]$:

$$0 = -i_t + E_t\left[r_{gt+1}\right]+\frac{1}{2}\mathrm{Var}_t(r_{gt+1})+\mathrm{Cov}_t(m^{\$}_{t+1},r_{gt+1})-\gamma_t\delta_{t+1}+\theta_t. \tag{F.16}$$

Rearranging, and substituting, we get:

$$E_t[r_{gt+1}] = \underbrace{i_t}_{\substack{\text{nominal}\\ \text{short rate}}} - \underbrace{\theta_t}_{\substack{\text{convenience}\\ \text{yield}}} + \underbrace{\gamma_t\delta_{t+1}}_{\substack{\text{expected}\\ \text{default loss}}} \underbrace{-\frac{1}{2}\mathrm{Var}_t(r_{gt+1})-\mathrm{Cov}_t(m^{\$}_{t+1},r_{gt+1})}_{\text{bond risk premium}} \tag{F.17}$$

The risk premium term also embeds credit risk premia (covariance risk with future default events).

Appendix G Learning about future surpluses

Section G.1 describes the state-space representation for the learning model. Section G.2 presents the assumed distribution of initial beliefs and describes the algorithm used for posterior inference.

G.1 State-space representation of the learning model

Below we describe the state-space representation for the learning model. To do so, we first need to express the vector of observables, $\mathcal{Y}_t^o$, as a function of the latent states. The link between these observables and states can be expressed as follows:

$$\mathcal{Y}_t^o = A_t\left(D + Z z_t + u_t,\right) \quad u_t \sim N(0, \Sigma_u), \tag{G.1}$$

where D and Z is a function of the parameter vector Θ. The matrix A_t serves as a selection matrix that accounts for the differences in data availability due to the CBO cost estimates beginning in 1997, while other observable variables date back to 1980. The state vector z_t comprises the latent states, their lags, and the orthogonal shocks.

The state vector follows a vector autoregressive process of the form:

$$z_t = \Phi_0 + \Phi z_{t-1} + \omega_t, \quad \omega_t \sim N(0, \Sigma_\omega), \tag{G.2}$$

where Φ_0, Φ, and Σ_ω is a function of the parameter vector Θ.

Section G.1.1 below provides the details for the measurement equation, while Section G.1.2 provides the details for the state-transition equation.

G.1.1 Measurement equation

The vector of observables is given by:

$$y_t^o = [\hat{S}_t^o,\ \overline{\mathcal{V}}_t^o,\ b_t^o,\ \hat{r}_{gt}^o],$$

where $\hat{S}_{t+j}^o$ denotes the realized surplus to GDP ratio, $\overline{\mathcal{V}}_t^o$ denotes the CBO bill-level cost estimates released during month t providing annual cost projections for the next year

and the following decade, $\hat{r}^o_{gt}$ is the return on the government bond portfolio adjusted for both growth and inflation, and b^o_t is the realized debt-to-GDP ratio.

Next, we describe the link between the observables and the latent states.

- *Realized surplus.* We assume agents employ the following model to learn about surplus to GDP:

$$\hat{S}^o_{t+1} = \chi_t + \sigma_s \epsilon_{s,t+1}, \qquad \epsilon_{s,t+1} \sim N(0,1), \tag{G.3}$$

  where $\hat{S}^o_{t+1}$ represents the observed monthly surplus normalized by the GDP of the preceding year. The conditional mean for $\hat{S}^o_{t+1}$ is given by χ_t, which is not observed by the agents. We define the law of motion for χ_t in Section G.1.2.

- *Bill-level cost estimates.* The CBO cost estimate for an arbitrary proposal z in month t gives annual nominal cash flow estimates starting in the next fiscal year up to the fiscal year T. We normalize these cash flows by CBO's nominal GDP projection with the closest month of the same year. We then sum all these normalized cash flows within each proposal and across proposals of month t to get a monthly observable CBO cost intensity measure that we denote as $\overline{\mathcal{V}}^o_t$.

  We assume that the monthly cost intensity measure $\overline{\mathcal{V}}^o_t$ is a noisy signal about the persistent component in surplus policy χ_t, modeled as

$$\overline{\mathcal{V}}^o_t = c_0 + c_1 \chi_t + \epsilon_{c,t} \tag{G.4}$$

  where the coefficients c_0 and c_1 are unobservable to investors and $\epsilon_{c,t} \sim N(0, \sigma_c^2)$ is independent to all other shocks.

- *Realized return on the government bond portfolio.* From equation (7) in the main text it directly follows that:

$$\hat{r}^o_{gt+1} = h_t + \epsilon_{r,t+1}. \tag{G.5}$$

- *Contemporaneous debt-to-GDP ratio.* From equation (8) in the main text we have:

$$\hat{b}_t^o = \alpha^\star + \mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \gamma \hat{S}_{t+j}^o - \mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \hat{r}_{gt+j}^o + \mathbb{E}_t \nu^T \hat{b}_{t+T}$$

Using equations (6) and (6) in the main text we can express

$$\mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \gamma \hat{S}_{t+j}^o = b_{0,\chi} + b_\chi \chi_t$$

where $b_{0,\chi} = \gamma \left(\frac{1-\nu^T}{1-\nu} - \frac{1-(\nu\rho_\chi)^T}{1-\nu\rho_\chi} \right) \mu_\chi$ and $b_\chi = \gamma \frac{1-(\nu\rho_\chi)^T}{1-\nu\rho_\chi}$.

Using equations (7) and (7) in the main text we can express

$$-\mathbb{E}_t \sum_{j=1}^{T} \nu^{j-1} \hat{r}_{gt+j}^o = b_{0,h} + b_h h_t$$

where $b_{0,h} = -\left(\frac{1-\nu^T}{1-\nu} - \frac{1-(\nu\rho_h)^T}{1-\nu\rho_h} \right) \mu_h$ and $b_h = -\frac{1-(\nu\rho_h)^T}{1-\nu\rho_h}$.

We also assume that $\mathbb{E}_t \nu^T \hat{b}_{t+T} = \psi_t$ is a latent state that follows an AR(1) process given by:

$$\psi_{t+1} = \mu_\psi + \rho_\psi(\psi_t - \mu_\psi) + \epsilon_{\psi t+1}. \tag{G.6}$$

Hence, the expression for b_t^o is given by

$$b_t^o = b_0 + b_\chi \chi_t + b_h h_t + \psi_t. \tag{G.7}$$

with $b_0 = \alpha^\star + b_{0,\chi} + b_{0,h}$.

Finally, we can write equations (G.3), (G.4), (G.5) , and (G.7) as follows

$$y_t^o \quad = \quad A_t \left(D + Z z_t + \Sigma_u u_t, \right) \qquad u_t \sim N(0, I), \tag{G.8}$$

- Prior to January 1997:

$$y_t^o = \begin{bmatrix} \hat{S}_{t+1}^o \\ \hat{r}_{gt+1}^o \\ b_t^o \end{bmatrix}, \quad A_{t+1} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{G.9}$$

- From January 1997 to Decemeber 2022:

$$y_t^o = \begin{bmatrix} \hat{S}_t^o \\ \overline{\mathcal{V}}_t^o \\ \hat{r}_{gt}^o \\ b_t^o \end{bmatrix}, \quad A_{t+1} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{G.10}$$

If we define the vector of states as

$$z_t = \begin{bmatrix} \chi_{t+1} & \chi_t & \epsilon_{s,t+1} & \tilde{\epsilon}_{c,t+1} & h_{t+1} & h_t & \epsilon_{r,t+1} & \psi_{t+1} & \psi_t \end{bmatrix}'_{9\times 1} \tag{G.11}$$

Then, the coefficient matrices D, Z, and Σ_u are given by:

$$D = \begin{bmatrix} 0 \\ c_0 \\ 0 \\ b_0 \end{bmatrix}_{4\times 1}, \qquad \Sigma^u = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}_{4\times 4}.$$

$$Z = \begin{bmatrix} 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ c_\chi & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ b_\chi & 0 & 0 & 0 & b_h & 0 & 0 & 1 & 0 \end{bmatrix}_{4\times 9}.$$

G.1.2 State-transition equation

Given the state vector z_t in equation (G.11) and the law of motion for the state variables, we write the state-transition equation as

$$z_t = \Phi_0 + \Phi z_{t-1} + \omega_t, \quad \omega_t \sim N(0, \Sigma^\omega). \tag{G.12}$$

and the matrices Φ are given by Σ^ω :

$$\Phi_0 = \begin{bmatrix} \mu_\chi(1-\rho_\chi) \\ 0 \\ 0 \\ 0 \\ \mu_h(1-\rho_h) \\ 0 \\ 0 \\ \mu_\psi(1-\rho_\psi) \\ 0 \end{bmatrix}_{4\times 1}, \Phi = \begin{bmatrix} \rho_\chi & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \rho_h & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_\psi & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix}_{9\times 9}, \Sigma_\omega = \begin{bmatrix} \sigma_\chi^2 & 0 & 0 & 0 & \sigma_{\chi,h} & 0 & 0 & \sigma_{\chi,\psi} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \sigma_s^2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \sigma_c^2 & 0 & 0 & 0 & 0 & 0 \\ \sigma_{\chi,h} & 0 & 0 & 0 & \sigma_h^2 & 0 & 0 & \sigma_{h,\psi} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \sigma_r^2 & 0 & 0 \\ \sigma_{\chi,\psi} & 0 & 0 & 0 & \sigma_{h,\psi} & 0 & 0 & \sigma_\psi^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}_{9\times 9}.$$

G.2 Prior Distribution and posterior inference

Define the parameter vector, Θ, as:

$$\Theta = \left[\mu_\chi, \rho_\chi, \sigma_s^2, \sigma_\chi^2, c_0, c_1, \sigma_c^2, \mu_h, \rho_h, \sigma_r^2, \sigma_h^2, \mu_\psi, \rho_\psi, \sigma_\psi^2, \sigma_{\chi h}, \sigma_{\chi\psi}, \sigma_{h\psi}\right]'.$$

Let $p(\Theta)$ denote the joint prior distribution on the parameter vector Θ, and let $p(y|\Theta)$ denote the likelihood function of the data given the parameter vectors. Our goal is to sample from the posterior distribution of the parameters given the data y^o, where Bayes' theorem provides the link:

$$p(\Theta|y^o) = \frac{p(y^o|\Theta)p(\Theta)}{p(y^o)}.$$

G.2.1 Prior Distribution

We assume the following distribution for the priors:

$$\begin{aligned}
\Theta_i &\sim \mathcal{N}(\mu_{\Theta_i}, \sigma^2_{\Theta_i}) \qquad \text{for} \qquad \Theta_i \in \{\mu_\chi, \mu_h, \mu_\psi, \sigma_{\chi h}, \sigma_{\chi\psi}, \sigma_{h\psi}, c_0, c_1\}, \\
\Theta_i &\sim \mathcal{N}^{\mathcal{T}}(\mu_{\Theta_i}, \sigma^2_{\Theta_i}) \qquad \text{for} \qquad \Theta_i \in \{\rho_\chi, \rho_h, \rho_\psi\}, \\
\Theta_i &\sim \mathcal{IG}(\alpha_{\Theta_i}, \beta_{\Theta_i}) \qquad \text{for} \qquad \Theta_i \in \{\sigma^2_\chi, \sigma^2_s, \tilde{\sigma}^2_c, \sigma^2_r, \sigma^2_h, \sigma^2_\psi\},
\end{aligned}$$

where $\mathcal{N}$ denotes the normal distribution, $\mathcal{N}^{\mathcal{T}}$ is the truncated (outside of the interval $(-1, 1)$) normal distribution, and $\mathcal{IG}$ is the inverse gamma distribution. We start the initial beliefs at the maximum likelihood estimates using data from 1980 to December 1997.

G.2.2 Posterior inference

We now describe the Metropolis–Hastings algorithm that we use for Bayesian inference. We start with an initial guess of the parameters $\Theta^{(0)}$, and states $\psi^{(0)}_{1:T}$, $\chi^{(0)}_{1:T}$, and $h^{(0)}_{1:T}$, where the subscript $\{1:T\}$ denotes the sequence of latent states from time 1 to time T.

Given a draw $\Theta^{(k)}$, $\psi^{(k)}_{1:T}$, $\chi^{(k)}_{1:T}$, and $h^{(k)}_{1:T}$, we generate the next draw $k+1$ as follows:

1. Draw $\Theta^{(k+1)} \mid \psi^{(k)}_{1:T}, \chi^{(k)}_{1:T}, h^{(k)}_{1:T}, y^o_{1:T}$. Since there is no close-form expression for the posterior of $\Theta^{(k+1)}$, we use a standard random-walk Metropolis–Hastings algorithm, where we target a 30% acceptance rate over the burn-in period.

2. Given $\Theta^{(k+1)}, y^o_{1:T}$ obtain $\psi^{(k)}_{1:T}, \chi^{(k)}_{1:T}, h^{(k)}_{1:T}$ via the Kalman filter using the state-space representation described in Section G.1.

We iterate over these steps to generate 25,000 draws from the posterior distribution of the parameters and states for each time period T.