Government Debt in Mature Economies.

Safe or Risky?

Prepared for Economic Policy Symposium 2024.*

Roberto Gómez-Cram   Howard Kung   Hanno Lustig

August 20, 2024

Abstract

Governments and central banks can protect either taxpayers or bondholders from government spending shocks. When they choose to insulate taxpayers, government bond yields need to increase in response to unfunded fiscal expansions as the government debt is marked to market. The risks of unfunded spending shocks are then borne by bondholders who demand a bond risk premium. This risky debt regime is a better fit for the recent experience of the U.S. and other mature economies. We provide high-frequency evidence from the COVID episode that links U.S. Treasury yield increases to bad news about future government surpluses. In this risky debt regime, large-scale asset purchases in response to large government spending provide temporary price support to government bonds, a net loss for taxpayers.

*Federal Reserve Bank of Kansas City Economic Policy Symposium August 22-24, 2024. Gomez-Cram: Stern School of Business, New York University and London Business School, rg4811@stern.nyu.edu. Kung: London Business School and CEPR, hkung@london.edu. Lustig: Stanford Graduate School of Business, NBER and CEPR, hlustig@stanford.edu. We thank Miguel Chumbo, Changyong Kim, and Luca Mecca for excellent research assistance. We thank Zhengyang Jiang, Luis Garicano, Thilo Kind, Arvind Krishnamurthy, Amit Seru, Lira Mota, Stijn Van Nieuwerburgh, and Mindy Xioalan for helpful suggestions and conversations.

1 Introduction

Central bankers have increasingly invoked market dysfunction to explain the rationale for large-scale asset purchases in domestic bond markets. In early March of 2020, the yields on long-dated U.S. Treasurys spiked. Other sovereign debt markets in advanced economies witnessed similar yield dynamics. Central banks in these countries subsequently intervened in their domestic government bond markets to ensure their smooth functioning. These interventions were not limited to 2020. In 2022, the ECB pre-emptively rolled out its Transmission Protection Instrument, giving itself a license to buy government bonds issued by member countries that experience unwarranted increases in borrowing costs. In September of 2022, the U.K. experienced a disruption in gilt markets, which triggered an intervention by the Bank of England.[1]

Central banks and governments have a legitimate interest in maintaining well-functioning government bond markets. We analyze what smooth market functioning in government debt markets entails when the economy is subject to government spending shocks. Bond investors need to mark down Treasury valuations when the government cash flows backing their claims are reduced or become riskier. Large-scale asset purchases by central banks after spending increases may impede this mark-to-market process in the short run.

Central banks and governments can coordinate either on a safe (zero beta) debt regime that insures bondholders or a risky government debt regime that insures taxpayers against government spending shocks (Jiang, Lustig, Van Nieuwerburgh, and Xiaolan, 2020), henceforth JLVX (2020).[2] We illustrate this trade-off in a simple model featuring monetary and fiscal interactions. Following Leeper (1991), we consider two distinct monetary-fiscal policy regimes labeled as monetary dominance and fiscal dominance. Monetary dominance produces a safe debt regime, while fiscal dominance generates a risky debt regime. The safe debt regime rules out unfunded spending shocks because of the fiscal authority's commitment to pay for surprise spending with

[1]On September 23, 2022, Kwasi Kwarteng, then Chancellor of the Exchequer, released the Truss cabinet's first budget. The bond market responded to the tax plan by aggressively marking down U.K. gilt prices in the days following the announcement.

[2]Risky government debt simply means that the real return is risky and covaries negatively with the size of the spending shock. Risk does not specifically refer to sovereign default.

future taxation.

Using high-frequency evidence, we show that the risky debt regime is a better fit for the recent U.S. experience as well as the experience of other advanced economies. In this regime, large unfunded spending shocks trigger large adjustments in the valuation of the government debt portfolio, even in a well-functioning bond market.

We use COVID-19 as a case study. During COVID, the response of Treasury valuations to the central bank and government actions are broadly consistent with the predictions of the risky debt regime. In the U.S. and other advanced economies, the COVID pandemic was characterized by large increases in government spending that were not matched by increases in current or expected future taxes. During the initial months of the pandemic, from March to May 2020, investors revised their expectations of U.S. government deficits upward by more than 10% of GDP for the subsequent two-year period. Absent expectations of future tax or spending offsets to these fiscal expansions, Treasury investors require that the real value of Treasurys be marked down to reflect news about unfunded government spending throughout the pandemic (Corhay, Kind, Kung, and Morales, 2023).

Between March 2020 and October 2023, U.S. Treasury yields rose by 3.81 pps. The value of the entire portfolio of outstanding U.S. Treasurys was reduced by 26% in real terms. During this episode, the yield dynamics in the U.S. government bond market were quite similar to those in the U.K., France, and Germany. The COVID-19 bond market response in the U.S. sharply contrasts with the Global Financial Crisis (GFC) experience. Instead, the response is closer to that observed during large U.S. wars.

The aggregate market value of U.S. Treasurys was marked down primarily through three channels. The first channel operates through an increase in long-term expected inflation that was front-loaded to the start of the COVID sample period. When governments issue long-term debt, an increase in long-term inflation expectations helps to mark the debt to market in the risky debt regime (e.g., Cochrane, 2001; Lustig, Sleet, and Yeltekin, 2008; Corhay et al., 2023; Bianchi, Faccini, and Melosi, 2023a). The correlation between stock and bond returns also increased significantly, consistent with the predictions of the risky debt regime.

Second, the 'narrow convenience yield' channel operates through a decline in convenience yields on long-term Treasurys as a result of the increased supply of government debt at long maturities. The demand curve for the convenience services of Treasurys slopes downward (Krishnamurthy and Vissing-Jorgensen, 2012; Mian, Straub, Sufi, et al., 2021). As a result, the increase in the supply of Treasurys compresses the 'narrow' convenience yield on Treasurys. Towards the end of our sample, long-dated Treasurys no longer trade at a premium compared to AAA corporates.

Third, the 'broad convenience yield' channel operates through real risk-free interest rates. Over this sample, there was a sizeable increase in long-term real rates that was back-loaded, particularly after the quantitative tightening that started in March 2022 and the removal of the central bank's price support in bond markets. The increase in real rates is broadly consistent with the predictions of incomplete market models in which agents rely on government debt and other safe assets to self-insure against idiosyncratic risk. In these models, an increase in the supply of safe assets, including government debt, increases real rates (see, e.g., Aiyagari and McGrattan, 1998), as the broad convenience yield on safe assets, which measure the self-insurance benefit, declines.

We use high-frequency evidence to connect these yield dynamics to the release of fiscal news. Figure 1 plots the cumulative returns on the U.S. Treasury portfolio (blue line) against the returns realized on large deficit days (red line). We identify these days with news about fiscal expansions using the CBO's cost estimates of individual bills and Bloomberg news articles, following the approach developed in Gomez Cram, Kung, and Lustig (2023), henceforth GCKL(2023). Consistent with the risky debt view, increases in U.S. Treasury yields were concentrated on days with bad fiscal news throughout the COVID-19 period, starting in March 2020. Before the pandemic, U.S. Treasury investors similarly responded to adverse fiscal news by pushing up yields, as bond investors learned about the long-run stance of fiscal policy, but the effect of adverse fiscal news increased during COVID.

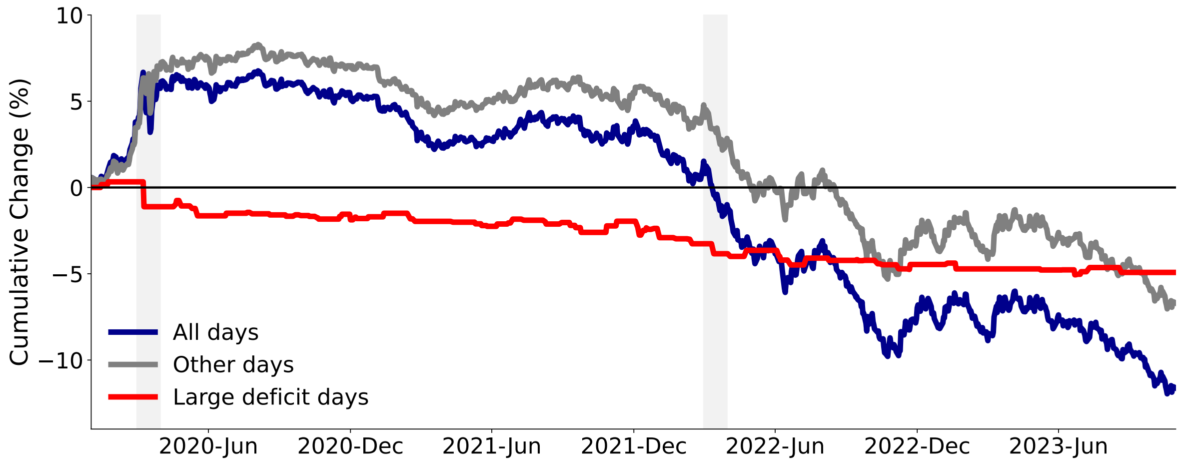
Governments and central bankers face a trade-off between insuring taxpayers and bondholders. In the face of large spending shocks, they determine whether bondholders or taxpayers absorb the fiscal costs. To help the reader, Table 1 provides an overview of the two distinct debt regimes.

Table 1. Taxonomy of Government Debt Regimes

Regime	**Safe**	**Risky**
Leading authority?	Central Bank	Government
Who bears g risk?	Taxpayers	Bondholders
Large $g \nearrow$ fully funded by future τ	Yes	No
Market Beta	Zero	Positive
Persistent Deficits?	No	Yes
High Debt/GDP $\Rightarrow$ High future s	Yes	Maybe
High Debt/GDP $\Rightarrow$ Low future returns	No	Yes
	Bond Market Response to Fiscal News	
Treasury Yields (ex CY)	No	Yes ✓
Term Premia	No	Yes ✓
Long-run Expected Inflation	No	Yes ✓
Narrow CY	Yes	Yes ✓
Broad CY	Yes	Yes ✓
	Bond Market Response in March of 2020	
	Anticipated	
	Flight to Safety	Mark-to-Market
Stock-Bond Correlation	Negative	Positive ✓
Yields	$\searrow$	$\nearrow$
	Actual: Yields $\nearrow$	
Interpretation	Market Dysfunction	Market functioning
Drivers	Dash for Cash	Flight from Maturity ✓
Causes	Market Micro-structure	Macro
	Plumbing	Fiscal News
	Large Scale Asset Purchases in March of 2020	
Objective	Liquidity Provision	Price Support ✓
Price Discovery	Improve	Impair
for Taxpayers	Create Value	Destroy Value ✓

g (τ) denotes government spending (tax revenue). s denotes primary surpluses. CY denotes convenience yield.

Fig. 1. **Cumulative Change in the Valuation of all U.S. Treasurys**



Notes: This figure shows the cumulative change in U.S. Treasury values on three different sets of days. The dark blue line displays the cumulative change using all trading days. The red line shows the cumulative change on 79 large deficit days (defined as above median CBO cost releases and/or Bloomberg News articles) that do not coincide with FOMC meeting days and large macroeconomic announcements. The gray line shows the cumulative change using all 843 remaining trading days. The gray-shaded areas denote March 2020 and March 2022. The sample period runs from January 01, 2020 to October 30, 2023.

To illustrate this trade-off, we analyze the interaction between monetary and fiscal policy in a stylized model adapted from Gomez Cram, Kung, Lustig, and Zeke (2024), henceforth GCKLZ (2024). The model features simple policy rules that determine inflation and the real value of government debt. The nominal short rate rule depends on the inflation gap, while a real tax revenue rule depends on debt relative to the target. The government finances a stochastic stream of expenditures through taxation and issuing nominal debt, implying that the value of government debt is backed by the present value of surpluses.

Under monetary dominance, the monetary authority targets inflation by adjusting the nominal short rate more than one-to-one to the inflation gap. The fiscal authority stabilizes debt by committing to adjust future taxes sufficiently to fully absorb surprise fiscal expansions today, insulating inflation from fiscal shocks. Higher government spending in this regime initially requires additional borrowing in real terms that is exactly offset by the higher present value of real future taxes through the fiscal rule. The real return on nominal government debt is protected against fiscal disturbances. Taxpayers are, therefore, insuring the bondholders in this safe debt regime.

Governments have an incentive to manufacture safe debt because it earns convenience yields, thus providing an extra source of revenue (Krishnamurthy and Vissing-Jorgensen, 2012). If debt is safe and has a zero beta, we would expect Treasury valuations to remain unchanged or even increase at the onset of the pandemic because of flight-to-safety in Treasury markets. In the safe debt view, the spike in yields at the start of March is indicative of Treasury markets malfunctioning (see, e.g., He, Nagel, and Song, 2022; Duffie, 2023). The safe debt view naturally leads to a focus on the market micro-structure of Treasury markets as the cause of the March 2020 spike in yields. As investors sold Treasurys, the ability of primary dealers to intermediate in Treasury markets was impaired. The Fed then intervened by using its balance sheet capacity to restore the normal functioning of Treasury markets. In the safe debt regime, the Fed acts as an unconstrained investor, providing liquidity to the bond market by buying underpriced Treasurys, a project that creates positive value for taxpayers.

What if the government wants to shield taxpayers and avoid raising taxes when it confronts large spending shocks? Under fiscal dominance, the fiscal authority pursues tax policies that are not constrained by debt stabilization.[3] Fiscal expansions are not fully offset by future taxation, which reduces the real fiscal backing for debt. Instead, in our stylized model, inflation increases to mark down the real value of nominal debt to align with the present value of surpluses.[4] The nominal revaluations lower bondholders' real returns in response to a surprise increase in government spending. Bondholders demand a risk premium on government debt when unexpected fiscal expansions are associated with high marginal utility states for bondholders, the empirically relevant case. When real bondholder returns are exposed to discount factor innovations, the stock-bond correlation will tend to be positive.[5]

Declines in the narrow and broad convenience yield can also mark the debt to market. Extending our simple framework into a general equilibrium model with

[3]The fiscal dominance regime builds on the seminal work of Sargent and Wallace (1981), followed by Leeper (1991), Sims (1994), Woodford (1995), and Cochrane (1998).

[4]Monetary policy passively adjusts the nominal short rate to stabilize fiscal inflation and the real value of debt.

[5]Under fiscal dominance, the government can partially insure the bondholders by distributing some of the risks to taxpayers through the fiscal rule, but, unlike under monetary dominance, it cannot provide full insurance. Fiscal dominance leads to a risky debt regime.

real and nominal frictions (GCKLZ (2024)), we show that the spending shocks have significant effects on real rates and convenience yields. Under fiscal dominance, the government shifts the burden to bondholders who experience negative returns after adverse aggregate shocks, leading to a risky debt regime.

Viewing the COVID period through the lens of the risky debt regime, we can think of central banks as effectively providing price support to the government debt market until they started shrinking their balance sheets, as they have done during wars (Hall and Sargent, 2022b). Taxpayers bear the costs of the price support in present-value terms. As long-dated Treasurys were marked to market when they ended the price support programs, central banks realized low returns on their purchases. Large-scale asset purchases thus have first-order implications for public debt management. In the risky debt regime, repricing in bond markets is inevitable. Large-scale asset purchases of long-dated Treasurys transfer part of these losses back from bondholders to taxpayers (see, e.g., Hall and Sargent, 2022b).

If debt is risky and has a positive beta, then Treasury valuations decrease at the onset of the pandemic as investors mark the Treasurys to market. In the risky debt view, the increase in yields at the start of March is indicative of Treasury markets repricing the real value of future surpluses. The Fed then intervened by using its balance sheet capacity to provide price support to government debt markets and pause the mark-to-market process.

The empirical evidence suggests that the risky debt view is a better fit for the COVID-19 pandemic evidence. First, we examine high-frequency evidence to connect Treasury valuations directly to fiscal news about individual spending and tax bills during COVID and its aftermath. Throughout the pandemic, we find that U.S. Treasurys were marked down significantly on days with adverse fiscal news, either in releases of CBO cost estimates for large bills or Bloomberg news articles. This was the case even prior to March 2022, when large-scale asset purchases were putting downward pressure on yields.

Second, the historical evidence for the U.S. and the U.K. supports the risky debt view. During wars marked by large increases in spending, bondholders are typically forced to bear a large share of the fiscal burden. Wars are punctuated by large, negative real returns on the portfolio of outstanding government bonds (Hall and Sargent, 2022b). During COVID, U.S. bondholders experienced real returns of -26%. As shown by Corhay et al. (2023), the real return on the nominal debt portfolio reflects the market's revaluation of the present discounted value (PDV) of surpluses. The spending bills in the U.S. were not perceived to be fiscally backed.

Third, the market reassessed its view on the riskiness of government debt. Consistent with the risky debt view, we observed a large increase in the U.S. stock-Treasury return correlation. The stock-bond correlation, which had been negative for the past two decades (Campbell, Pflueger, and Viceira, 2020), including the GFC, turned positive in March 2020. Starting in March 2020, long-dated U.S. Treasurys are perceived to be riskier by long-horizon investors. In a regime of fiscal dominance, bond returns largely absorb spending shocks. When large spending shocks occur in bad times, bonds become riskier, and their correlation with stocks increases.

Fourth, in addition to the price evidence above, the quantity evidence also lines up against the safe debt view. We document a flight from maturity in U.S. Treasury markets by private investors, especially foreign ones. The selling of Treasurys by private investors was concentrated at longer maturities without rebalancing to shorter maturities. In contrast, there was no flight from maturity in U.S. corporate bond markets. All else equal, long-horizon investors would reallocate their portfolio away from long-dated Treasurys, given the increased stock-bond correlation.[6]

The paper is organized as follows. Section 2 analyzes the effect of the policy stance on the riskiness of nominal government debt in a stylized model with monetary and fiscal rules and an exogenous real pricing kernel. Section 3 provides an overview of the fiscal response to COVID in the U.S., while section 4 describes the response of U.S. Treasury markets and other sovereign bond markets to COVID. The U.S. bond market's response to the COVID-19 pandemic was largely similar to that of other mature economies but notably different from its reaction during the GFC. While the safe debt regime summarized in Table 1 may have been a good description of the

[6]The increase in the expected return on long-dated Treasurys was delayed by the intervention of central banks. The large increase in the U.S. term premium of 170 bps was mostly back-loaded after March 2022.

U.S. bond market response during the GFC, it is not for the COVID sample. Section 5 evaluates the safe and risky debt regimes in light of the empirical evidence. We provide high-frequency evidence connecting U.S. Treasury yield increases to the release of bad fiscal news.

2 Theoretical Framework

This section examines how the joint monetary-fiscal stance affects the riskiness of government debt. We start by showing that the government budget equation implies a bondholders' return identity that says the real return on nominal government debt is equal to the return on a hypothetical claim delivering aggregate primary surpluses. We then build a simple frictionless model featuring monetary and fiscal policy rules along with an exogenous real pricing kernel. We use approximate analytical solutions to show how monetary dominance produces a safe debt regime while fiscal dominance generates a risky debt regime with respect to government spending shocks. We use this model to guide our subsequent empirical analysis.

2.1 Bondholders' Return Identity

The government budget identity implies a bondholders' return identity (see Corhay et al., 2023). This identity links the real bondholders' return to inflation and surplus policy, which is therefore affected by the joint monetary and fiscal stance.

We start with the consolidated government budget identity in nominal market values according to

$$R_{gt}^{\$}\mathcal{B}_{t-1} = P_t s_t + \mathcal{B}_t, \tag{1}$$

where $\mathcal{B}_t$ is the aggregate nominal market value of government debt held by the public, $R_{gt}^{\$}$ represents the corresponding nominal portfolio return on government debt, P_t denotes the price level, and s_t corresponds to real primary surpluses.

Rearranging the budget identity, we can express it equivalently in terms of returns as

$$R_{gt}^{\$}/\Pi_t = R_{st}, \tag{2}$$

where $\Pi_t \equiv P_t/P_{t-1}$ is the gross inflation rate, let $\tilde{\mathcal{B}}_t \equiv \mathcal{B}_t/P_t$ be real market value of nominal debt, and $R_{st} \equiv (\tilde{\mathcal{B}}_t + s_t)/\tilde{\mathcal{B}}_{t-1}$ is the gross return on a hypothetical claim to real surplus. Corhay et al. (2023) show that $\tilde{\mathcal{B}}_t$ is equal to the ex-surplus market value of a claim to aggregate real surpluses. Equation (2) says that the ex-post real return on nominal government debt needs to be equal to the return on real surplus. If the government engineers a safe return on surplus (e.g., through state-dependent tax or spending policies), then the real return on the aggregate public debt portfolio also needs to be safe.

2.2 *Simple Model*

This subsection aims to characterize how the policy stance plays a key role in determining the real bond risk premium on government debt in a model of monetary-fiscal interactions. The model is a simplified version of Leeper (1991) cast in partial equilibrium with an exogenous real pricing kernel. We use a risk-adjusted log-linear solution method to account for endogenous bond risk premia following Corhay et al. (2023) and GCKLZ (2024).

We analyze government debt valuation in two distinct policy regimes: monetary dominance and fiscal dominance. We show that monetary dominance implies safe government debt (risk-free), while fiscal dominance leads to risky government debt (non-zero real risk premium).

2.2.1 *Policy Rules and Government Spending*

The monetary authority follows a nominal interest rate rule specified as

$$i_t = i^{\star} + \rho_{\pi}(\pi_t - \pi^{\star}), \tag{3}$$

where i_t is the log nominal short rate, $i^\star$ is the risk-adjusted steady state for the short rate, ρ_π captures the monetary policy stance towards the inflation gap, π_t is log inflation, and $\pi^\star$ is the risk-adjusted inflation target set by the central bank.

The fiscal authority follows a real tax revenue rule according to

$$\tau_t = \tau^\star + \delta_b(b_{t-1} - b^\star), \tag{4}$$

where τ_t is the real tax revenue, $\tau^\star$ is the risk-adjusted steady-state tax revenue, δ_b captures the fiscal stance towards debt deviations from target, b_t is the log real market value of debt, $b^\star$ is the risk-adjusted log real value of debt.

Real government spending follows a stochastic process

$$g_t = g^\star + x_t, \quad x_t = \rho x_{t-1} + \sigma \epsilon_t, \tag{5}$$

where $g^\star$ relates to the government spending target, ρ captures the persistence of the spending shock, σ represents the volatility of the innovation, and $\epsilon_t \sim$ i.i.d. $N(0,1)$ is standard normal. Primary real surpluses are tax revenues minus government expenditures, $s_t = \tau_t - g_t$.

We assume that the government issues one-period nominal debt and raises taxes to finance expenditures according to the government budget equation

$$B_{t-1} = P_t s_t + Q_t B_t, \tag{6}$$

where B_{t-1} is the nominal face value of government debt and Q_t is the nominal bond price. We can express the budget equation as the bondholders' return identity from Section 2.1, expressed in logs as

$$r^{\$}_{gt} - \pi_t = r_{st}, \tag{7}$$

where $r^{\$}_{gt}$ is the log nominal government portfolio return, and r_{st} is the log return on real surplus. Given that we assumed that the government only issues one-period debt, the nominal return on the government portfolio is equal to the nominal short rate

($r^{\$}_{gt} = i_{t-1}$).

2.2.2 Real Pricing Kernel

We model investors' risk tastes in reduced form by specifying an exogenous real pricing kernel. To capture the notion that the spending shocks are priced, we assume that the pricing kernel depends on the spending innovations given by

$$-m_{t+1} = \frac{\lambda^2}{2} + \mu + \lambda\epsilon_{t+1}, \tag{8}$$

where m_{t+1} is the log real pricing kernel, and λ is the market price of government spending risk, μ is a mean parameter. The i.i.d. specification of the log real pricing kernel implies that the shadow real risk-free rate is constant $r_t = \mu$. When $\lambda < 0$, positive spending corresponds to high marginal utility states.

2.2.3 Return Approximation

To obtain approximate analytical solutions for the model, we use a Campbell and Shiller (1988) style approximation of the log return on surplus

$$r_{st+1} = \kappa_0 + \kappa_1 b_{t+1} + \kappa_2 s_{t+1} - b_t, \tag{9}$$

where κ_0, κ_1, and κ_2 are approximating constants that depend on the risk-adjusted steady state of the real value of debt, $b^\star$. To solve for these constants, we employ an iterative procedure following Campbell and Koo (1997). Additionally, we approximate around the level of the surplus to accommodate deficits.

We focus on bounded solutions for inflation and the real market value of debt as in Leeper (1991). The stability conditions depend on the policy parameters ρ_π and δ_b. The two determinacy regions are the regimes of monetary dominance and fiscal dominance, which we characterize next.

2.3 *Monetary Dominance and the Safe Debt Regime*

Monetary dominance relates to the standard textbook monetary model (e.g., Woodford (2015) and Galí (2015)). This regime is characterized by a monetary authority that determines inflation by adjusting the nominal short rate more than one-for-one with the inflation gap ($\rho_\pi > 1$). The fiscal authority adjusts real taxes sufficiently with respect to debt deviations ($\delta_b > s^\star$) to stabilize the real market value of debt. The Ricardian tax adjustments ensure that the intertemporal government budget equation holds, insulating inflation from fiscal shocks. We show that the real bond return in this regime is also protected from fiscal shocks, implying a *safe debt regime*.

We solve inflation forward in this regime using the Euler equation for nominal bonds and the interest rate rule

$$\exp(-i^\star - \rho_\pi(\pi_t - \pi^\star)) = \mathbb{E}_t\Big[\exp\left(m_{t+1} - \pi_{t+1}\right)\Big], \tag{10}$$

where the stability condition in the steady state for solving inflation forward is given by $\rho_\pi > 1$.[7] The inflation solution is independent of the fiscal disturbances, leading to the constant inflation policy anchored at the target $\pi_t = \pi^\star$.[8] Incorporating monetary policy shocks or persistent real discount factor shocks would generate inflation dynamics, but inflation would still be insulated from the spending shocks in this regime.

We solve for the real value of log debt backward in this regime by substituting the tax rule into the budget identity and using the linearized return on surplus to obtain

$$i^\star - \pi^\star \quad = \quad \kappa_0 + \kappa_1 b_t + \kappa_2\Big(s^\star + \delta_b(b_{t-1} - b^\star) - \rho x_{t-1} - \sigma\epsilon_t\Big) - b_{t-1}, \tag{11}$$

where the stability condition is given by $\delta_b > s^\star$.[9]

Solving the difference equation backward, we obtain the debt policy as

$$b_t = \Gamma_b + \left(\frac{1 - \kappa_2\delta_b}{\kappa_1}\right)b_{t-1} + \left(\frac{\kappa_2}{\kappa_1}\right)x_t, \tag{12}$$

[7]The two-sided condition is $\rho_\pi > 1$ and $\rho_\pi < -1$.

[8]The interest rate target is set to center inflation around the target ($i^\star = \mu + \pi^\star$).

[9]The two-sided stability condition is $2\exp(b^\star) + s^\star > \delta_b > s^\star$.

where the coefficient on the spending shock is positive ($\kappa_2/\kappa_1 > 0$). Therefore, a positive spending shock in this regime leads to an initial debt expansion.

We next show that the real bondholders' return is insulated from the spending shocks. Given that inflation is always anchored at the target, the nominal short rate is fixed at the steady state value $i_t = i^\star$, implying that the nominal government return on debt is also constant. Therefore, the real bondholders' return is given by

$$r^{\$}_{gt+1} - \pi_{t+1} = i^\star - \pi^\star, \tag{13}$$

which is risk-free and only depends on the interest rate and inflation targets.

The Ricardian tax policy ($\delta_b > s^\star$) insures bondholders against government spending risk by decomposing the bondholders' return identity into returns on tax and spending claims. The budget identity links the real bondholders' return to the return on surplus, highlighted in equation (7). The return on the surplus claim is equivalent to a portfolio consisting of a long position in the tax claim and a short position on the spending claim, allowing us to write

$$\frac{R^{\$}_{gt+1}}{\Pi_{t+1}} = R_{st+1} = \left(\frac{P_{\tau t}}{P_{st}}\right) R_{\tau t+1} - \left(\frac{P_{xt}}{P_{st}}\right) R_{xt+1}, \tag{14}$$

where $P_{\tau t}$ is the ex-tax market value of a hypothetical claim that delivers real tax revenues, P_{st} corresponds to the ex-surplus value of a hypothetical claim that delivers real surpluses, $R_{\tau t}$ is the gross return on the tax claim, P_{xt} denotes the gross ex-spending market value of a hypothetical claim on government spending, and R_{xt} is the gross return on the spending claim. The first equality of equation (14) is the budget identity, and the second equality is a replicating portfolio for the return on surplus.

The Ricardian tax rule under monetary dominance guarantees that the portfolio-weighted tax return fully hedges bondholders against the short position on the spending claim. We show the tax return's hedging properties by pricing the tax claim using the Euler equation according to

$$1 = \mathbb{E}_t\Big[\exp(m_{t+1} + r_{\tau t+1})\Big]. \tag{15}$$

Using a risk-adjusted approximation for the log return on the tax claim, like what we did for the return on surplus (outlined in Section 2.2.3), we obtain the solution for the log tax claim return as

$$r_{\tau t+1} = \bar{r}_{\tau} + \mathcal{E}_{\tau}\epsilon_{t+1}, \tag{16}$$

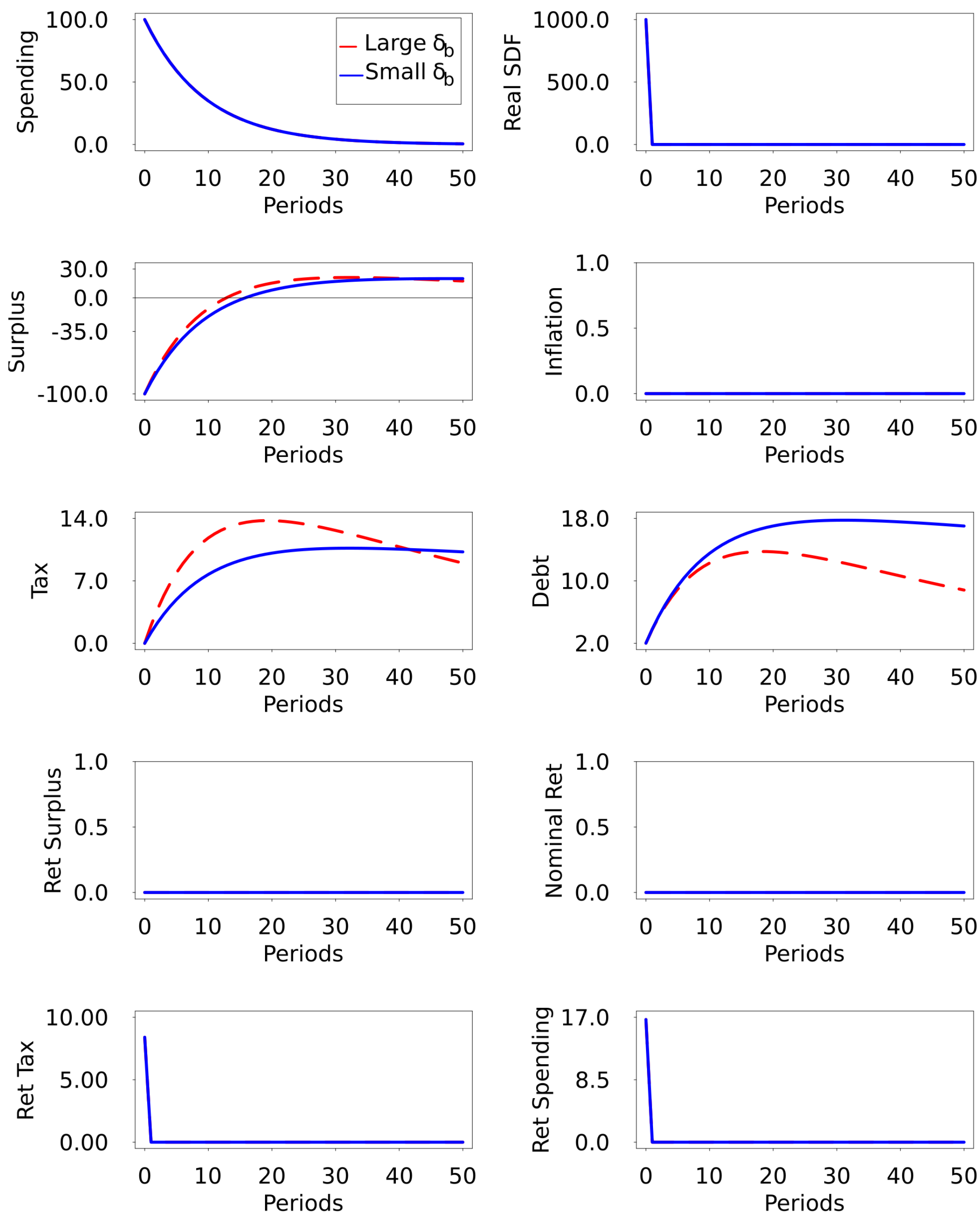
where we can express the coefficient on the spending innovation $\mathcal{E}_{\tau}$ as a function of the policy parameters and risky steady states and show that it is positive when the tax policy is Ricardian ($\delta_b > s^{\star}$). The tax claim is, therefore, a hedge asset against spending shocks from the bondholders' perspective. Moreover, the commitment by the fiscal authority to raise higher future taxes to fund current spending in present value terms makes the tax asset a perfect hedge against the short position in the government spending claim. The perfect insurance from the tax claim insulates the real bondholders' return against surprise government spending.

Figure 2 plots the impulse responses of model variables to a positive spending shock ($\epsilon_t > 0$) under monetary dominance under two parameterizations of the Ricardian tax rule in a qualitative exercise. We assume in this figure that the parameter related to the market price of spending risk is negative ($\lambda < 0$), implying that high government spending is associated with high marginal states. The parameterization of the pricing kernel is less important under monetary dominance since the return on surplus is risk-free.

Surplus declines initially because of the persistent spending shock but eventually turns positive as the shock decays because of the commitment to increase future taxes to fund the spending. The Ricardian tax policy insulates inflation from the fiscal shock. The monetary authority anchors inflation at the target by committing to the Taylor principle.

The persistent spending shock today is initially financed by a debt expansion backed by higher future taxes. Ricardian tax policy ensures that the increase in the real value of debt offsets the initial decline in surpluses, so the return on surplus is insulated from the spending shock. Stricter fiscal policy (large δ_b) front-loads the tax payments more compared to looser fiscal policy (small δ_b), allowing debt to return

Fig. 2. **Impulse Responses to a Spending Shock under Monetary Dominance**



Notes: This figure plots impulse responses to a positive spending shock ($\epsilon_t > 0$) under monetary dominance for two values of δ_b, labeled as large and small. The variables correspond bps deviations from the stochastic steady state for real government spending (g_t), the log real SDF (m_t), real surpluses (s_t), log inflation (π_t), real tax revenues (τ_t), log real value of debt (b_t), log return on real surplus (r_{st}), nominal return on government debt ($r^{\$}_{gt}$), log return on the real tax claim ($r_{\tau t}$), and the log return on the real spending claim (r_{xt}).

more quickly to the target. The nominal return on government debt is equal to the nominal short rate, which is constant because inflation is always anchored at the target.

The final row of Figure 2 illustrates the real tax asset acting as an insurance claim against the spending shock for bondholders. A levered long position in the tax asset with the proportional market weight (P_τ/P_s) perfectly hedges the short position on the spending asset with the proportional market weight ($-P_x/P_s$). The Ricardian tax policy under monetary dominance, therefore, produces a safe debt regime.

If the debt is truly risk-free, the debt/GDP ratio should be the best predictor of future primary surpluses, because higher surpluses is the only way to bring the debt/GDP ratio back down.[10]

2.4 *Fiscal Dominance and the Risky Debt Regime*

Fiscal dominance relates to the work of Sargent and Wallace (1981), Leeper (1991), Sims (1994), Woodford (1995), and Cochrane (1998). This regime is characterized by a monetary authority passively responding to the inflation gap ($\rho_\pi < 1$) and a non-Ricardian fiscal authority that does not fully fund surprise government spending by raising taxes ($\delta_b < s^\star$). Consequently, a positive spending shock lowers the real fiscal backing for government debt. Inflation increases to devalue debt under fiscal dominance to satisfy the intertemporal government budget equation, pinning down inflation. The value of debt is stabilized by the passive stance of monetary policy that prevents explosive interest rate paths.

The nominal revaluations expose the real bondholders' return to the spending shocks. When an increase in government spending is associated with high marginal utility states, government bonds command a real risk premium. We also illustrate how the sign of δ_b determines whether the tax claim is a hedge asset or a risky asset, but the fiscal authority cannot provide perfect insurance to bondholders against government spending shocks. However, they are able to perfectly insulate the tax claim from spending shocks $\delta_b = 0$ as a special case of non-Ricardian tax policy. Overall, fiscal dominance produces a *risky debt regime*.

[10] JLVX (2024c) find no evidence in post-war US data that the debt/GDP ratio predicts future surpluses.

We solve for the log real value of debt forward in this regime using the Euler equation for the return on real surplus and substituting in the approximated log return on surplus and tax rule to give us

$$1 = \mathbb{E}_t\Big[\exp\Big(m_{t+1} + \kappa_0 + \kappa_1 b_{t+1} + \kappa_2\Big(s^\star + \delta_b(b_t - b^\star) - \rho x_t - \sigma\epsilon_{t+1}\Big) - b_t\Big)\Big], \tag{17}$$

where the stability condition in the steady state for solving debt forward is given by the non-Ricardian tax rule ($\delta_b < s^\star$).

Using the method of undetermined coefficients, we obtain the solution for log debt as

$$b_t = A_0 + A_1 x_t, \tag{18}$$

where the coefficient on the spending shock is given by

$$A_1 = \frac{\rho}{(\delta_b - s^\star) + (\rho - 1)\tilde{\mathcal{B}}^\star} < 0, \tag{19}$$

since $\rho < 1$ and $\delta_b < s^\star$. A positive spending shock is not fully backed by future taxation, requiring a devaluation in the real value of debt.

Plugging in the log debt solution into the approximated log return on surplus yields

$$r_{st+1} = \bar{r}_s + \mathcal{E}_s\epsilon_{t+1}, \tag{20}$$

where we can express the coefficient on the spending innovation $\mathcal{E}_s$ as a function of the policy parameters and risky steady states and show that it is negative when the tax policy is non-Ricardian ($\delta_b < s^\star$). A positive spending shock reduces the realized return on surplus and, therefore, the real bondholders' return.

We next show how inflation responds to the spending shocks, providing nominal revaluations of debt to match the fiscal backing. Inflation is solved backward under fiscal dominance by using the budget equation expressed as the bondholders' return identity ($r^{\$}_{gt} - \pi_t = r_{st}$) and plugging in the solution for the return on surplus to obtain

$$\pi_t = \Gamma_\pi + \rho_\pi \pi_{t-1} - \Big(\kappa_1 A_1 - \kappa_2\Big)\sigma\epsilon_t, \tag{21}$$

where the stability condition is given by the passive monetary policy stance towards inflation ($\rho_\pi < 1$).[11] Inflation passes the spending shocks through to bondholders under fiscal dominance, making debt risky.

The sign of δ_b under fiscal dominance determines whether the tax rule amplifies or hedges spending shocks. We price the tax claim using the Euler equation as we did above in the monetary regime, yielding the following solution for the log return on the tax claim

$$r_\tau = \bar{r}_\tau + \mathcal{E}_\tau \epsilon_t, \tag{22}$$

where the coefficient on the spending innovation depends on the policy parameters and risky steady states, and we can show that it is signed by δ_b.

When $\delta_b > 0$, the coefficient is negative ($\mathcal{E}_\tau < 0$), making the tax claim risky from the bondholders' perspective as it reinforces the risk exposure to the short position on the spending claim. We can see this amplification effect under this parameterization by decomposing surpluses into the contribution from the tax rule and the spending shock according to

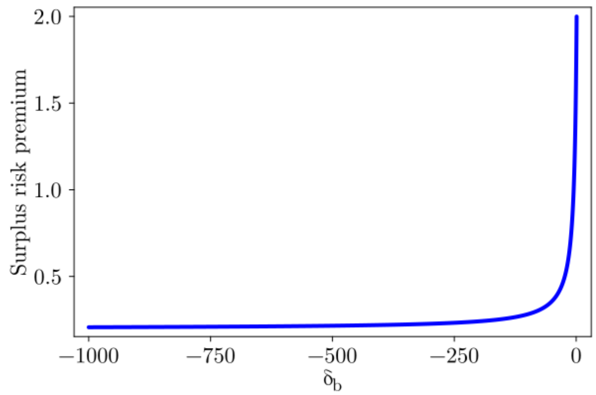
$$s_{t+1} = s^\star + \delta_b(b_t - b^\star) - g_{t+1}. \tag{23}$$

A persistent spending shock today will lower surpluses immediately. Given that the spending shock will not be fully funded in the future because the tax rule is non-Ricardian, the real value of debt gets devalued. When $\delta_b > 0$, future tax revenues are reduced through the feedback rule, amplifying the spending shock on surpluses.

When $\delta_b < 0$, the loading on the spending shock is positive ($\mathcal{E}_\tau < 0$), making the tax claim a hedge asset from the bondholders' perspective. A persistent spending surprise today leads to higher future tax revenues, which dampens the overall surplus

[11] The two-sided bound is $-1 < \rho_\pi < 1$.

Fig. 3. **Real Bond Risk Premium under Fiscal Dominance**



Notes: This figure illustrates how the real risk premium on government bonds varies with the tax rule coefficient on debt δ_b under fiscal dominance.

response to the spending shock. The non-Ricardian fiscal rule with $\delta_b < 0$ leans against fiscal inflation, offering bondholders partial insurance against spending risk. We show below how the hedging benefits are increasing as δ_b becomes more negative, but there are limits to how much the fiscal authority can insure bondholders under fiscal dominance.

A special case of non-Ricardian fiscal policy is when $\delta_b = 0$, making the tax claim independent of the spending shocks ($\mathcal{E}_\tau = 0$). The government, therefore, has the ability to fully insure taxpayers from spending risk under fiscal dominance.

We can compute the real risk premium on nominal government debt as the risk premium on the return to surplus, given by

$$\mathbb{E}_t[r_{st+1} - r_t] + \frac{1}{2}\text{Var}_t(r_{st+1}) = \lambda \left[\kappa_1 \left(\frac{\rho}{(\delta_b - s^\star) + (\rho - 1)\tilde{\mathcal{B}}^\star} \right) - \kappa_2 \right] \sigma, \tag{24}$$

which is positive under fiscal dominance when surprise increases in government spending are associated with high marginal utility states ($\lambda < 0$). Exposing real bondholder returns to pricing kernel innovations can also induce positive comovement with stock returns.

The risk premium increases as δ_b approaches the upper bound of $s^\star$. When δ_b is positive, increasing δ_b enhances the amplification effect from the tax rule, while making δ_b more negative enhances the hedging benefits of the tax rule to bondholders.

However, there are limits to the extent that the fiscal authority can provide insurance to bondholders against spending shocks. As $\delta_b \to -\infty$, the real risk premium on debt converges downward to a positive limit ($\to -\lambda\kappa_2\sigma > 0$). This limit reflects how there is a limit to the extent to which the government can provide insurance to bondholders under fiscal dominance.

Figure 4 plots the impulse response of model variables to a positive spending shock ($\epsilon_t > 0$) under fiscal dominance for three parameterizations of the non-Ricardian tax rule ($\delta_b > 0$, $\delta_b = 0$, and $\delta_b < 0$) in a qualitative exercise. We assume that $\lambda < 0$ so that high government spending is associated with high marginal utility states. We quantitatively explore these mechanisms in GCKLZ (2024).

Surplus declines but without the long-run reversals exhibited under monetary dominance. The spending shock is not fully funded by future taxation under fiscal dominance. Instead, inflation increases to mark down the real value of nominal government debt to align with the reduced fiscal backing. The real return to bondholders also falls to reflect the lower surpluses. Given that this is a high marginal utility state, bondholders need to be compensated with a risk premium.

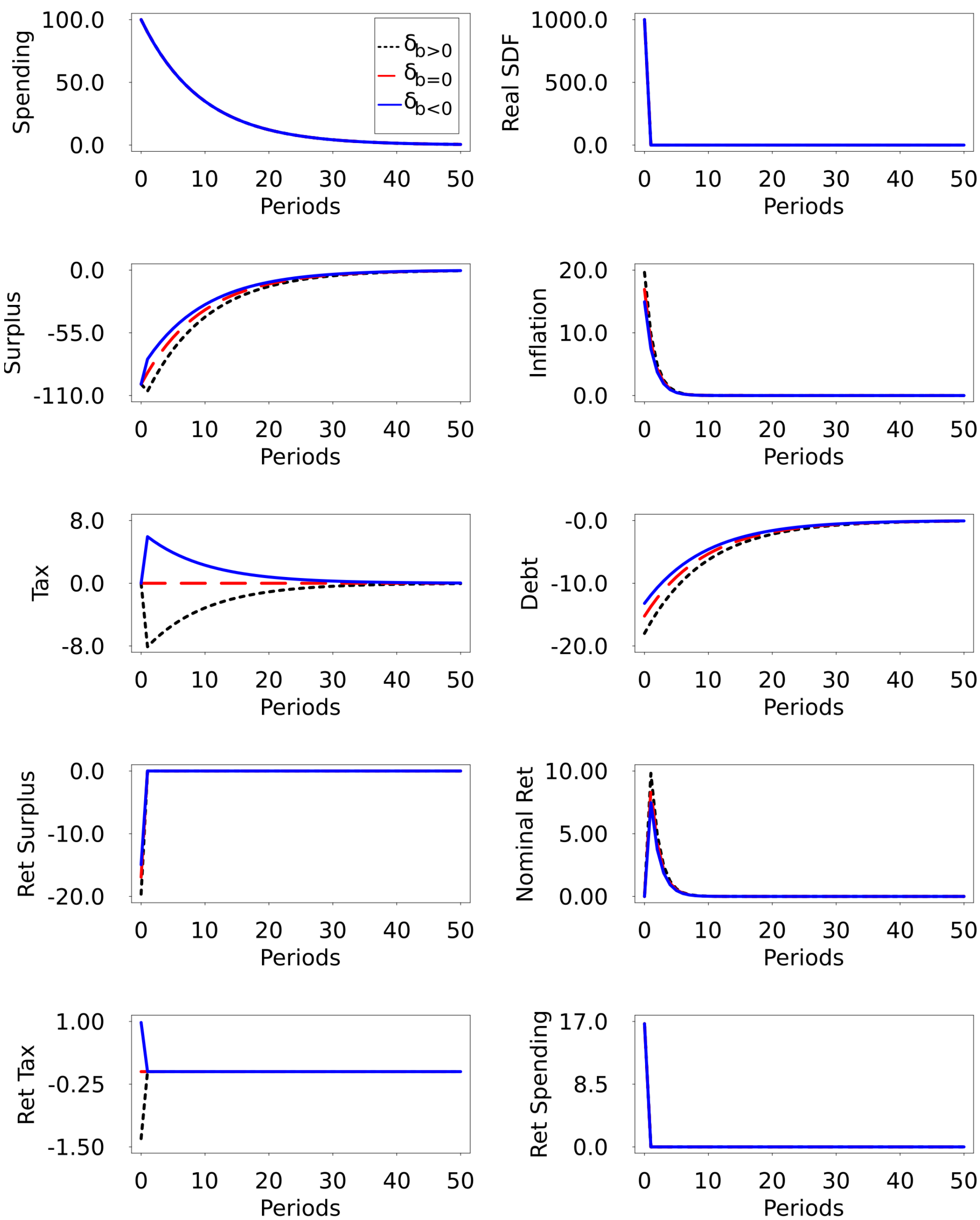
The tax response is dictated by the sign of δ_b. When $\delta_b < 0$, the government leans against fiscal inflation by partially funding the spending shock through higher future taxes. When $\delta_b > 0$, the tax rule reinforces the spending shock by lowering taxes. Taxes are independent of spending shocks when $\delta_b = 0$. The return on the tax claim naturally reflects the hedging properties of the tax rule.

When the tax rule leans against fiscal inflation ($\delta_b < 0$), the inflation, debt, and return responses to the spending shock are dampened. The government is offering partial insurance to bondholders through the tax rule by making the tax claim a hedge asset. However, the government cannot perfectly insure bondholders under fiscal dominance, as illustrated in Figure 3.

2.5 Extensions

Our model is frictionless and abstracts from monetary policy surprises to illustrate how fiscal dominance can lead to a risky debt regime through nominal revaluations.

Fig. 4. **Impulse Responses to a Spending Shock under Fiscal Dominance**



Notes: This figure plots impulse responses to a positive spending shock ($\epsilon_t > 0$) under fiscal dominance for $\delta_b > 0$, $\delta_b = 0$, and $\delta_b < 0$. The variables correspond bps deviations from the stochastic steady state for real government spending (g_t), the log real SDF (m_t), real surpluses (s_t), log inflation (π_t), real tax revenues (τ_t), log real value of debt (b_t), log return on real surplus (r_{st}), nominal return on government debt ($r^{\$}_{gt}$), log return on the real tax claim ($r_{\tau t}$), and the log return on the real spending claim (r_{xt})

This subsection highlights a few additional margins we find relevant to the Treasury market response during the COVID period.

In this stylized model, inflation does most of the work to mark the real value of nominal bonds to market, but there are other empirically relevant mechanisms we have left out. First, our simple model leaves out convenience yields on Treasurys. Krishnamurthy and Vissing-Jorgensen (2012) find evidence supporting a downward-sloping demand for the convenience services of Treasurys. They model this convenience service as a component in the utility function of the representative investor, where the marginal convenience benefit of Treasurys is declining with respect to supply. An expansion in the Treasury supply would, therefore, reduce the convenience benefits and lower Treasury valuations. This is the narrow convenience yield channel. Second, in models with heterogeneous agents and incomplete markets, an increase in the supply of debt will also increase the real rate. In these models, households use the debt to self-insure against household-specific shocks (see, e.g. Aiyagari and McGrattan, 1998; Reis, 2021; Brunnermeier, Merkel, and Sannikov, 2022). We call this the broad convenience yield channel. We explore these channels in GCKLZ (2024).

In our stylized model, monetary policy does not affect real interest rates. Hanson and Stein (2015) document how monetary policy shocks impact long-term real yields through real term premia. They interpret this evidence as being consistent with segmented markets featuring a set of yield-oriented investors.[12] This variation in real rates may impact valuations in other asset markets as well (Bianchi, Lettau, and Ludvigson, 2022).

Finally, we have specified a Full Information Rational Expectations model in which investors know the nature of the monetary-fiscal regime and all the underlying parameters. That assumption puts a heavy burden on bond market investors to have known the full extent of the large drift in U.S. fiscal policy over the past decades. It seems far more reasonable to assume that Treasury investors have been learning about the underlying parameters governing fiscal policy (see GCKL(2023)). Learning may

[12]When the Fed hikes interest rates, these investors would rebalance their portfolio towards short-term bonds and away from long-term bonds. The selling pressure on long-term bonds increases long-term real yields.

help to account for the change in yield dynamics from the GFC to COVID.

In fact, in much of the post-WW-II sample, U.S. Treasurys were priced as if the U.S. was in the safe debt regime, while the underlying cash flows, the primary surpluses, are risky and pro-cyclical. There is a disconnect between the market's pricing of all Treasurys and the model-implied pricing of a hypothetical claim to surpluses. JLVX (2024b) conclude that the post-WW-II valuation of U.S. Treasurys is hard to rationalize: Treasury yields seem too low, or equivalently, the valuation of all Treasurys seems too high relative to the underlying collateral, the PDV of surpluses, even when they include the seignorage from convenience on Treasurys. They refer to this as the U.S. debt valuation puzzle. Furthermore, the valuation of Treasurys seemed insensitive to the macro fundamentals, i.e., the PDV of future surpluses (JLVX (2024c)), which may be related to the unique role of the U.S. as the world's safe asset supplier. CJLVX (2022) find evidence of a similar valuation puzzle for the U.K. in the 19th century, which ended after WW-I, when the U.S. took over the role of hegemon in the international financial system. After that, U.K. debt was fully backed by surpluses, but this changed during COVID.

From a welfare perspective, it may be optimal for governments to engineer negative returns when the economy is hit by large shocks that require increases in government spending, e.g., during wars and COVID pandemics (Lucas and Stokey, 1983; Angeletos, 2002; Buera and Nicolini, 2004; Jiang, Sargent, Wang, and Yang, 2022a), thus shielding taxpayers from large tax increases in models with distortionary taxation.

3 Fiscal Policy Response to COVID-19

The U.S. federal government's fiscal response to the COVID-19 pandemic was unprecedented. Between March and July of 2020, in the first months of the COVID-19 pandemic, the U.S. federal government outspent all 29 countries in the sample of countries examined by Romer (2021). The U.S. federal government spent 11.9% of GDP in five months. Overall, the federal government implemented $5.88 trillion in new spending through legislation, with a net impact of $5.43 trillion on the budget. In addition, another $875 billion in administrative measures were undertaken, with a net impact of $232 billion on the budget. The total price tag of all these measures was $6.75 trillion. COVID-19 measures increased the deficit by $5.6 trillion or 26% of 2020 GDP.

The Coronavirus Aid Relief Economic Security (CARES) Act passed by Congress on March 25, 2020, was the first large bill in a series of them. It was signed into law by President Trump on March 27. The CARES Act would end up costing $2.09 trillion. The government would spend $481 billion on income support, mainly expanded unemployment benefits, $440 billion on business support in the form of the Paycheck Protection Program, $274 billion on stimulus checks, direct cash payments of $1,200 to Americans making less than $75,000. CARES was followed by the $900 billion Response & Relief Act in December of 2020 and the $2 trillion American Rescue Plan, signed into law by President Biden in March of 2021. In November of 2021, Congress passed an Infrastructure Investment and Jobs Act, which would cost $340 billion.

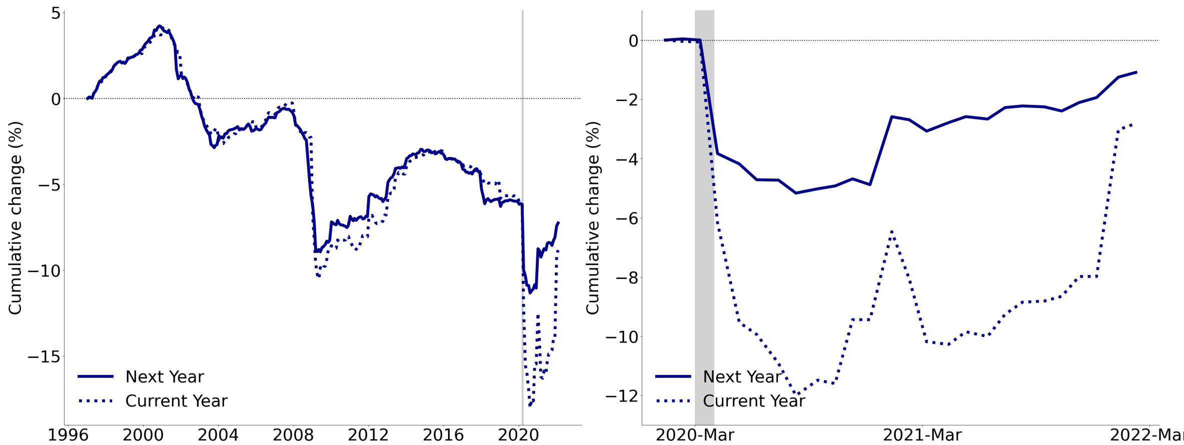
These large bills constitute a large and unexpected fiscal shock. Between March 09 and May 11, the respondents of the Consensus Economics survey revised their median estimate for the FY 2019/2020 deficit from $1.07 trillion (4.82% of 2020 GDP) to $3.15 trillion (14.31 % of GDP). At the same time, they revised their estimate for the FY 2020/2021 deficit from $1.08 trillion (4.92% of 2020 GDP) to $2.01 trillion (9.10% of 2020 GDP), shown in the right panel of Figure 5. Overall, between March and May, market participants inferred an increase in deficits of more than 10% of 2020 GDP over the next two years.

The left panel of Figure 5 extends the sample period back to 1997. Since 2001, analysts have consistently revised their forecasts downward for the current and next fiscal year, indicating a negative trend in the series. The 2020 revisions stand out as one of the largest declines, comparable in magnitude to those observed during the GFC.

The CBO released a long-term budget projection in January and September of 2020. We compare the PDV of primary surpluses between January and September.[13] The CBO released its September long-term budget projections before the $900 billion

[13] The Congressional Budget Office (CBO) releases budget projections for the federal government that are based on current law.

Fig. 5. **Cumulative Revisions in Consensus Forecasts for U.S. Budget**



Notes: This figure shows cumulative revisions in Consensus Economics forecasts for current and next fiscal year budget balances, expressed as a percentage of GDP. Forecasts are scaled by the most recent GDP value available at the time of each forecast. The left panel covers the sample period from January 1997 to February 2022, while the right panel focuses on the period from January 2020 to February 2022. The gray shaded area in both panels denotes March 2020.

Response & Relief Act and the $2 trillion American Rescue Plan were considered by Congress. We compared the CBO long-term budget projections released in January and September 2020. Just in the first six months of the pandemic, the fiscal COVID shock implies a drop in the PDV of projected surpluses over the next ten years which is equivalent to 18.94% of 2020 GDP.

The COVID-19 pandemic also led to unprecedented levels of public spending across other advanced economies. Figure A.1 in the Appendix illustrates this trend by plotting cumulative Consensus Economics budget revisions for the U.K., France, and Germany. In the initial months of the pandemic, all three countries experienced substantial downward revisions to their budget forecasts. Germany and the U.K. saw revisions of approximately 14% of GDP, while France's revisions were around 8% of GDP.

3.1 *Fiscal Backing of Government Debt*

The Treasury portfolio's valuation should equal the PDV of all future primary surpluses. The debt in January of 2020 is backed by primary surpluses ($\{\tau - g\}_{2020}^{2020+H}$), because the PDV of future debt, say $H = 200$ years from now, in 2020 dollars, is arbitrarily small. This is often referred to as the no-bubble condition or the transversality condition (TVC).[14]

If the government issues bonds that earn convenience yields, it will produce seigniorage revenue that equals the convenience yields collected on all the outstanding Treasurys. The present value of the seigniorage revenue $PV_{2020}(\{Seign\}_{2020}^{2020+H})$ should be added to the tax revenue.[15]

	Assets	Liabilities
Until 2020 + *H*	$PV_{Jan,2020}(\{\tau\}_{2020}^{2020+H})$	$PV_{Jan,2020}(\{g\}_{2020}^{2020+H})$
Until 2020 + *H*	$PV_{Jan,2020}(\{Seign\}_{2020}^{2020+H})$	
After 2020 + *H*	$PV_{Jan,2020}(\tilde{\mathcal{B}}_{2020+H}) \rightarrow \$0$	
		$\tilde{\mathcal{B}}_{Jan,2020} = PV_{Jan,2020}(\{\tau - g + Seign\}_{2020}^{2020+H})$

For the debt to be effectively risk-free (e.g., monetary dominance), investors have to anticipate a fiscal correction of exactly the same size to offset this increase in deficits, which could occur after 2029. In that case, they do not have to revise their debt valuation $\Delta PV_{Jan \rightarrow Sept,2020}(\{\tau - g + Seign\}_{2020}^{2020+H}) = 0$, for large H.[16] To rationalize Treasury valuations that are invariant to fiscal shocks, investors would have to believe in a future fiscal correction of $4 trillion. The arrival of COVID in early March of 2020 did not change the investors' perception of the PDV of future surpluses. In this case, the debt portfolio does not need to be marked to market. As of yet, there is no evidence of offsetting future surpluses. In June of 2024, the CBO projected a debt/GDP ratio of 122% for 2034, up from 97% today. In post-war U.S. data, JLVX (2024c) found no evidence that a high debt/GDP ratio predicts high future primary surpluses, in contrast with the predictions of risk-free debt.

[14]The transversality condition requires that the expected present-discounted value of debt in the far future, $E_t[M_{t+T}\tilde{\mathcal{B}}_{t+H}]$, goes to zero as the horizon H goes to infinity. The TVC is an optimality condition in an economy with long-lived investors. JLVX (2020) show that the TVC is satisfied as long as the GDP risk premium exceeds the gap between the growth rate and the risk-free rate.

[15]Given that convenience yields tend to increase in bad times for the global economy, this is a counter-cyclical source of revenue for the Treasury, which could render the Treasury portfolio safer. As the world's safe asset supplier, the U.S. may be able to relax this trade-off between insuring bondholders and taxpayers when the convenience yields on Treasurys increase in the face of adverse global shocks, as future seigniorage revenue increases. While this counter-cyclical convenience yield channel may have been potent during the GFC, there is less evidence of this during the pandemic.

[16]Alternatively, investors should be pricing in much larger convenience yields in the future. However, the convenience yields on long-dated Treasurys have disappeared by the end of COVID.

In the absence of any anticipations of a future fiscal correction (e.g., fiscal dominance with $\delta_b = 0$) not embedded in the Sept. 2020 CBO projections, the valuation of Treasurys should drop by 18.8%: $\Delta \log PV_{Jan\rightarrow Sept,2020}(\{\tau - g\}_{2020}^{2029}) = \Delta \log \tilde{\mathcal{B}}_{Jan\rightarrow Sept,2020}$.

4 Treasury Markets in the COVID-19 Pandemic

We analyze U.S. Treasury yield dynamics before and after March 2022 during the COVID-19 pandemic. We then compare these dynamics to sovereign debt markets in other advanced economies.

4.1 *Broad Trends from 2020-2023 in U.S. Treasury Markets.*

Between February 2020 and October 2023, the portfolio of marketable Treasurys experienced significant losses, declining 26% in real terms and 15% in nominal terms, as illustrated in the left plot of Panel A in Figure 6. During this period, the 10-year nominal Treasury yield increased by 381 bps, as shown by the dark blue line in the middle plot of Panel A of the same figure.

As explained in Section 2.1, the real return on the nominal government debt portfolio measures the real return on a claim to surpluses: $R^{real}_{March,2020\rightarrow Oct,2023}(\{\tau - g\}_{2020}^{\infty})$. During the COVID-19 pandemic, there is no evidence suggesting that the U.S. government insured bondholders. Instead, bondholders bore a significant share of the pandemic's burden, aligning with the Lucas and Stokey (1983) view.[17] This is evidenced by the 26% real-term value loss of the aggregate Treasury portfolio. The bond market effectively priced in a large unbacked fiscal expansion.[18]

We have observed similar patterns during wars in the U.S. and other countries. The COVID pandemic is comparable to wars from a fiscal and macroeconomic perspective (Hall and Sargent (2022b,a) and JLVX (2024a)). During large wars, governments ramp up spending. The increased spending is only partially offset by increased tax revenue.

[17] Their normative analysis envisions a world in which the government issues state-contingent debt which pays off only in peacetime, when government expenditures are low, but not in wartime.

[18] In a cross-country study, Barro and Bianchi (2023) infer that 80% of the spending was unbacked from the inflation response.

The U.S. and U.K. governments certainly seem to favor protecting their taxpayers over bondholders from the fallout of wars. In WW-I and WW-II, the cumulative real return on U.S. Treasurys (in logs) is -36% from 1914-1918 and -12% from 1939-1945, compared to -26% during COVID. The cumulative real return in logs on U.K. debt is -60% from 1914-1918, -11% from 1939-1945, and -40% from 2020-2022 (JLVX (2024a)).

Panel A of Table 2 decomposes the 10-year yield increase into its main drivers, which are also illustrated in the middle and right plots of Panel A in Figure 6. The most significant contributor was the increase in real rates, with the 10-year TIPS yield rising by 271 bps. Expected inflation increased by 104 bps, while the term premium grew by 170 bps. Conversely, the AAA-Treasury spread, our measure of Treasury convenience yields, declined by 68 bps.

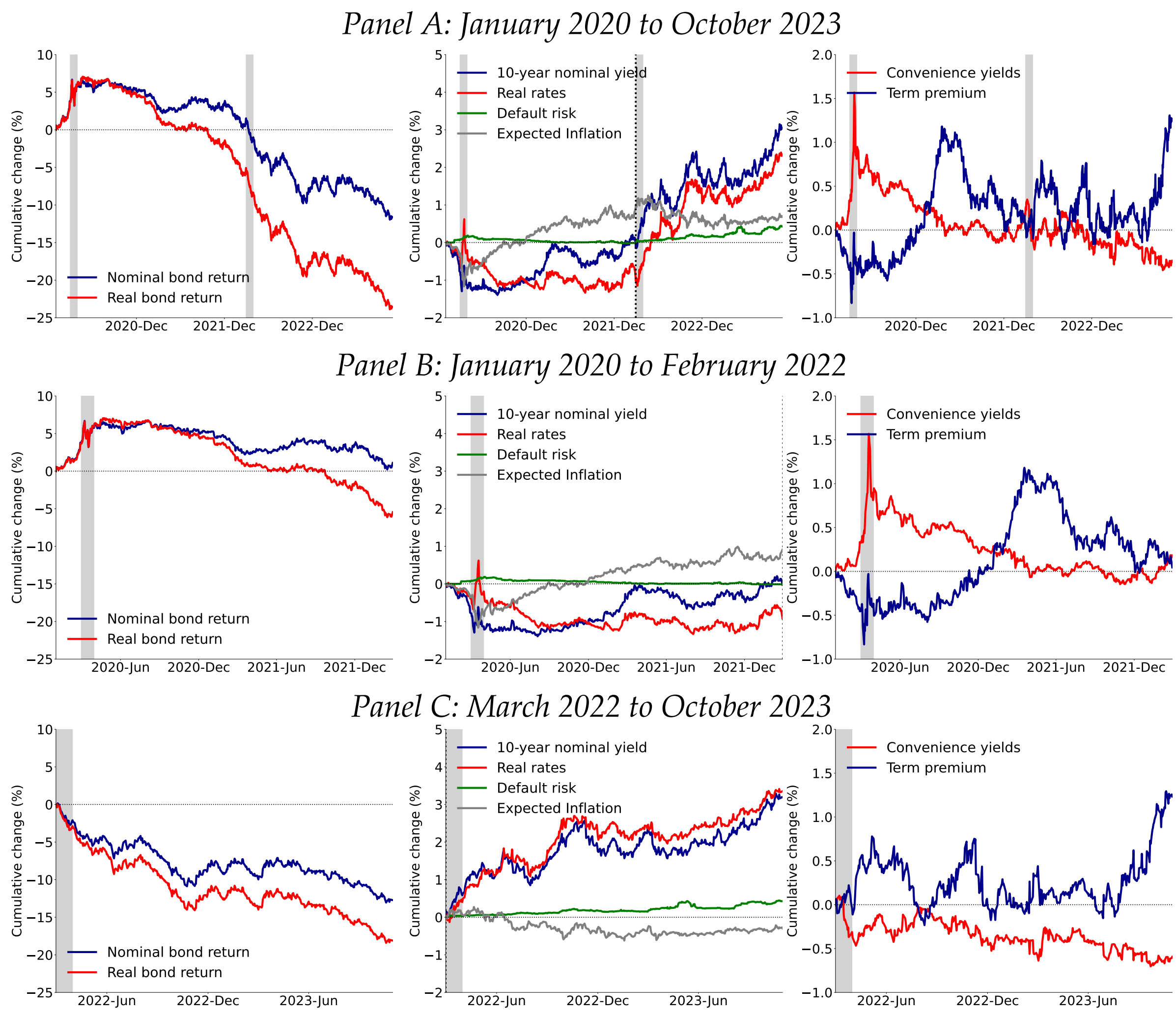
In March 2022, the Federal Reserve announced its intention to start tightening. Columns (2) and (3) of Table 2 split the sample at this date, while Panels B and C in Figure 6 plot the cumulative changes in the series before and after March 2022, respectively. After March 2022, Treasury investors incurred a 15.11% loss. The analysis reveals a different timing in the expected inflation and real rate responses. Expected inflation exhibited a front-loaded increase of 127 bps before March 2022 but subsequently decreased by 23 bps. Conversely, the entire 271 bps increase in real rates occurred after the March 2022 quantitative tightening announcement. In fact, real yields rose by 325 bps from March 2022 to the end of the sample period.

The large increase in real rates after March 2022 is consistent with the price support provided by the Fed to Treasurys before that date and the tightening of monetary policy afterward. In contrast, prior to March 2022, the real yield declined by 54 bps. The strong effects of monetary policy on long-term real yields accord with the evidence from Hanson and Stein (2015) and Nakamura and Steinsson (2018).

Over this entire period, Treasury convenience yields declined by 68 bps. Table 3 presents various measures of the convenience yield, including the 10-year AAA corporate-Treasury spread, its CDS-adjusted version,[19] and the 3-month GC Trea-

[19]The CDS-adjusted series comes from Mota (2023). For each senior corporate bond, Mota (2023) hedge its credit risk by matching it with a CDS of the same maturity, creating a synthetic risk-free bond if held to maturity. The CDS-bond basis is then calculated as the spread between this synthetic bond and a duration-matched U.S. Treasury bond, serving as a measure of the relative convenience yield of

Fig. 6. **Cumulative U.S. Treasury Returns and Changes in U.S. Treasury Yields**



Notes: The left panels present cumulative daily changes in nominal and real government debt portfolio returns, computed using methods similar to Hall and Sargent (2011). Real values are calculated by subtracting realized inflation over the period. The middle panels show cumulative daily changes in the 10-year nominal yield, real rates (10-year TIPS), default risk (10-year U.S. credit default swaps), and expected inflation (10-year inflation swaps). The right panels display cumulative daily changes in convenience yields (spread between long-term Aaa-rated corporate bonds and 10-year Treasury yields) and term premia (estimated using Adrian, Crump, and Moench (2013) methodology). Panel A covers January 1, 2020, to October 31, 2023. Panel B covers January 1, 2020, to February 28, 2022. Panel C covers March 1, 2022, to October 31, 2023. The gray-shaded areas denote March 2020 and March 2022.

sury spread for shorter maturities. The CDS-adjusted AAA-Treasury spread decreased by 32 bps over the entire sample, approaching zero by the end of the period. This indicates that investors became nearly indifferent between holding synthetic and actual Treasurys, effectively eliminating the convenience yield for longer-maturity Treasurys.

Treasuries. The final series represents the face-value weighted CDS-bond basis for the AAA/AA rating bucket. We are grateful to Lira Mota for providing us with this CDS-bond basis series.

Table 2. **U.S. Treasury Returns and Changes in U.S. Treasury Yields**

A. Cumulative changes from February 28, 2020, to October 30, 2023

		Break in March of 2022	
	February 28 2020 to October 30 2023 (1)	February 28 2020 to March 31 2022 (2)	March 31 2022 to October 30 2023 (3)
Nominal bond returns	-14.56	-3.93	-10.48
Real bond returns	-26.35	-11.12	-15.11
10-year nominal yield	3.81	0.74	3.07
Real yield	2.71	-0.54	3.25
Default risk	0.37	-0.05	0.42
Expected inflation	1.04	1.27	-0.23
Convenience yield	-0.68	-0.15	-0.53
Term premium	1.70	0.50	1.20

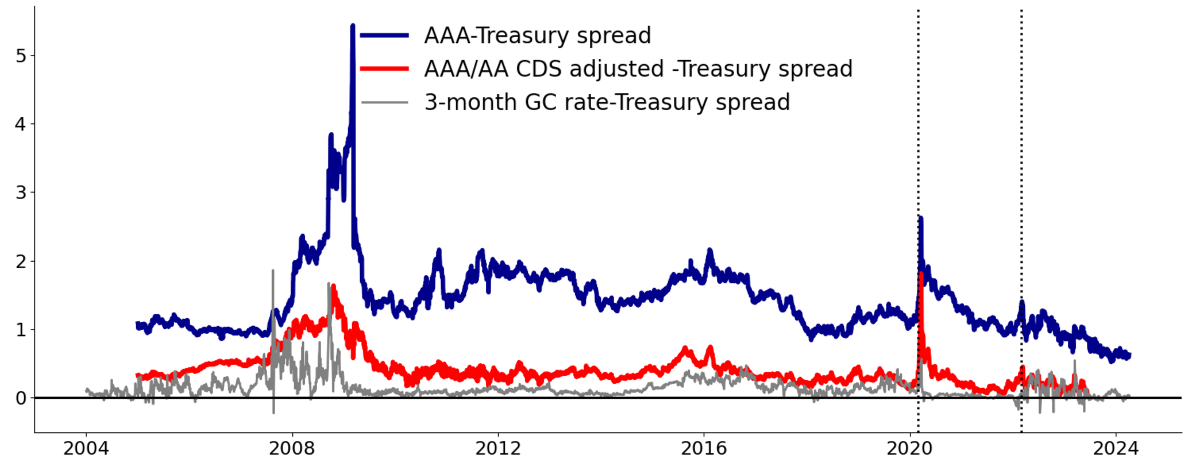
B. Cumulative changes from March 09, 2020, to March 31, 2020

		Break in March 18, 2020	
	March 09 2020 to March 31 2020 (1)	March 09 2020 to March 18 2020 (2)	March 19 2020 to March 30 2020 (3)
Nominal bond returns	0.01	-2.54	1.71
Real bond returns	0.24	-2.43	1.84
10-year nominal yield	0.17	0.68	-0.52
Real yield	0.34	1.10	-0.76
Default risk	0.07	0.06	0.01
Expected inflation	-0.10	-0.42	0.32
Convenience yield	0.37	0.62	-0.24
Term premium	0.47	0.76	-0.29

Notes: This table presents cumulative changes in the following variables: nominal government debt portfolio returns, computed using procedures similar to Hall and Sargent (2011); the 10-year nominal yield; convenience yields, proxied by the spread between long-term Aaa-rated corporate bonds and 10-year Treasury yields; real rates, measured via 10-year TIPS; default risk, gauged through 10-year U.S. credit default swaps; expected inflation, captured by 10-year inflation swaps; and term premia, estimated employing the methodology outlined in Adrian et al. (2013). All values are in percentage points.

Figure 7 illustrates the AAA-Treasury spread from before the GFC. During the GFC, the AAA-Treasury yield spread surged to over 300 bps. However, it has been trending downward since then, despite large Federal Reserve Treasury purchases. While it briefly spiked in early March 2020, the spread continued to decline during the COVID

Fig. 7. **Convenience Yield on U.S. Treasurys**



Notes: This figure shows two different measures of convenience yields. The blue line uses as a proxy for convenience yields the spread between 10-year AAA corporate and Treasurys. The red line is the CDS-adjusted version of the AAA/AA-Treasury spread as in Mota (2023). The gray line denotes the 3-month GC rate-Treasury spread. The vertical dotted lines denote March of 2020 and March of 2022.

episode, in contrast to what happened during the GFC, approaching zero by 2023.

Even if the debt has zero beta, the increased supply of debt would decrease convenience yields if investors derive utility from their holdings of Treasurys. Using variation in yields around CBO releases, GCKL(2023) estimate that a percentage point increase in the expected Treasury supply to GDP corresponds to a -7.56 bps (= -0.09/1.19 $\times$ 100 bps) response in the convenience yield on large negative legislative proposal days.

The news released in March represented an enormous fiscal shock. The 10.38% of GDP increase in Treasury supply implied by the Consensus forecast revision between March 9 and April 6 of 2020 translates into a 78 bps decrease in convenience yields. For comparison, Krishnamurthy and Vissing-Jorgensen (2012) estimate a smaller elasticity of -4.25 bps per percentage point increase in Treasury supply, implying a smaller decrease of 44 bps. However, the Fed started its large-scale asset purchases, absorbing much of the initial increase in supply. As reported in Table 2, the convenience yield decreased by 68 bps over the entire 2020-2023 sample.

Table 3. **Different Measures of Convenience yield**

A. Cumulative changes from February 28, 2020, to October 30, 2023

		Break in March of 2022	
	Feb. 28 2020 to Oct. 30 2023 (1)	Feb. 28 2020 to Mar. 31 2022 (2)	Mar. 31 2022 to Oct. 30 2023 (3)
10-year AAA-Treasury spread	-0.68	-0.15	-0.53
AAA/AA CDS adjusted -Treasury spread	-0.32	-0.03	-0.29
3-month GC rate-Treasury spread	-0.02	0.01	-0.03

B. Cumulative changes from March 09, 2020, to March 31, 2020

		Break in March 18, 2020	
	Mar. 09 2020 to Mar. 31 2020 (1)	Mar. 09 2020 to Mar. 18 2020 (2)	Mar. 19 2020 to Mar. 30 2020 (3)
10-year AAA-Treasury spread	0.37	0.62	-0.24
AAA/AA CDS adjusted -Treasury spread	0.22	0.74	-0.52
3-month GC rate-Treasury spread	-0.11	0.32	-0.43

Notes: This table presents cumulative changes in three measures of convenience yield. The first is the 10-year AAA corporate-Treasury spread. The second, AAA/AA CDS adjusted - Treasury spread, comes from Mota (2023) and is computed by hedging the credit risk for each senior corporate bond using a maturity-matched CDS. This convenience yield is calculated as the spread between the resulting synthetic corporate bond and a duration-matched U.S. Treasury bond, then aggregated at the AAA/AA rating bucket using face values as weights. The third measure is the 3-month GC rate-Treasury spread, denoting the difference between three-month General Collateral (GC) repo contract rates and the three-month Treasury Bill rate. The AAA/AA CDS adjusted - Treasury spread series covers February 28, 2020 to June 16, 2023. All values are in percentage points.

4.2 *Broad Trends from 2020-2023 in Other Advanced Economies.*

The U.S. bond market experience during COVID-19 was mirrored in other major economies. Table 4 shows similar sovereign bond yield dynamics in the U.K., Germany, and France from March 2020 to October 2023. These countries saw increases in nominal yields of 482 bps, 312 bps, and 400 bps, respectively, compared to 381 bps in the U.S. As in the case of the U.S., these increases were largely driven by rising 10-year real rates: 358 bps in the U.K., 192 bps in Germany, and 212 bps in France. Expected inflation also rose during this period by approximately 50 bps in the U.K., 135 bps in Germany, and 179 bps in France. Consequently, investors holding sovereign bonds have experienced real losses of 43% in the U.K., 32% in Germany, and 31% in France.

The timing of these changes was also similar across countries. Expected inflation

Table 4. **Cumulative Returns and Changes in Yields in other Countries**

A. United Kingdom

		Break in March of 2022	
	February 28 2020 to October 30 2023 (1)	February 28 2020 to March 31 2022 (2)	March 31 2022 to October 30 2023 (3)
Real Bond Return	-43.57	-14.07	-34.32
10-year nominal yield	4.82	1.74	3.08
Real yield	3.58	-0.19	3.78
Expected inflation	0.50	1.19	-0.69
Default risk	0.12	-0.10	0.22

B. Germany

		Break in March of 2022	
	February 28 2020 to October 30 2023 (1)	February 28 2020 to March 31 2022 (2)	March 31 2022 to October 30 2023 (3)
Real Bond Return	-32.24	-12.13	-22.89
10-year nominal yield	3.12	0.51	2.61
Real yield	1.92	-0.48	2.40
Expected inflation	1.35	1.31	0.04
Default risk	0.04	-0.08	0.12

C. France

		Break in March of 2022	
	February 28 2020 to October 30 2023 (1)	February 28 2020 to March 31 2022 (2)	March 31 2022 to October 30 2023 (3)
Real Bond Return	-30.94	-11.08	-22.33
10-year nominal yield	4.00	1.25	2.75
Real yield	2.12	-0.89	3.00
Expected inflation	1.79	1.31	0.48
Default risk	-0.02	-0.08	0.06

Notes: This table presents cumulative changes in the 10-year nominal yield, real rates, breakeven expected inflation, and credit default swaps for three countries. Panel A displays results for the United Kingdom, Panel B for Germany, and Panel C for France. All values are in percentage points.

increases were front-loaded in the first year of the pandemic, while real rate increases were heavily back-loaded. Before March 2022, real yields declined by 89 bps in France, 48 bps in Germany, and 19 bps in the U.K. After March 2022, real yields surged by 300 bps in France, 240 bps in Germany, and 378 bps in the U.K.

4.3 U.S. Treasury and Other Bond Markets in March 2020

This section analyzes the bond yield dynamics in the U.S. and other advanced economies in March 2020. The U.S. experience aligns closely with international trends, suggesting that impaired the functioning of U.S. Treasury markets alone cannot fully explain the spike in U.S. Treasury yields in early March.

Between March 9 and March 18, 2020, the nominal 10-year U.S. Treasury yield rose by 68 bps. Panel B of Table 2 decomposes this increase into its main drivers. The real yield increased by 110 bps, while expected inflation decreased by 42 bps.

Similar yield dynamics were observed in other advanced economies during this period. Table 5 presents a comparable decomposition for the U.K., Germany, and France. Their 10-year nominal yields increased by an average of 64 bps, with real 10-year yields rising even more sharply, averaging an 86 bps increase across the three countries. Conversely, the 10-year expected inflation decreased by an average of 18 bps in these nations.

There are two ways to view the response of Treasury markets to the COVID shock in March of 2020. Table 1 provides a taxonomy of government debt regimes.

First, we can adopt the safe or zero beta debt view. Viewed through this lens, Treasury markets were dysfunctional in March of 2020. The yield on the 10-year T-Note increased by 68 bps over the course of eight trading days between March 9 and March 18. A typical one-standard deviation movement in a single day would be five basis points. Treasury yields increased as stocks were declining in value and as the VIX peaked, a departure from the typical negative U.S. stock-bond correlation (Campbell et al., 2020).

These yield dynamics stood in sharp contrast to the GFC when flight-to-safety demand pushed up Treasury valuations (He and Krishnamurthy, 2020; He et al., 2022). Typically, during these episodes, Treasurys become more expensive relative to other securities. However, in early March 2020, Treasurys became cheaper. He et al. (2022) refers to a Treasury inconvenience yield. According to He et al. (2022); Duffie (2023), primary dealers had exhausted their balance sheet capacity as investors sold U.S. Treasurys in a dash for cash (Vissing-Jorgensen, 2021). This 'plumbing view' motivates

Table 5. **Cumulative Changes in Yields and Returns in other Countries during March 2020**

A. United Kingdom			
		Break in March 18, 2020	
	March 09 2020 to March 31 2020 (1)	March 09 2020 to March 18 2022 (2)	March 19 2022 to March 30 2023 (3)
10-year nominal yield	0.20	0.63	-0.43
Real yield	0.08	0.72	-0.64
Expected inflation	0.08	-0.10	0.18
Default risk	0.12	0.20	-0.08
B. Germany			
		Break in March 18, 2020	
	March 09 2020 to March 31 2020 (1)	March 09 2020 to March 18 2022 (2)	March 19 2022 to March 30 2023 (3)
10-year nominal yield	0.38	0.60	-0.22
Real yield	0.50	0.87	-0.37
Expected inflation	-0.13	-0.24	0.11
Default risk	0.06	0.11	-0.05
C. France			
		Break in March 18, 2020	
	March 09 2020 to March 31 2020 (1)	March 09 2020 to March 18 2022 (2)	March 19 2022 to March 30 2023 (3)
10-year nominal yield	0.37	0.71	-0.34
Real yield	0.64	1.00	-0.37
Expected inflation	-0.04	-0.22	0.18
Default risk	0.09	0.20	-0.11

Notes: This table presents cumulative changes in the 10-year nominal yield, real rates, breakeven expected inflation, and credit default swaps for three countries. Panel A displays results for the United Kingdom, Panel B for Germany, and Panel C for France. All values are in percentage points.

why the Fed has to step in and use its balance sheet to intermediate in U.S. Treasury markets, essentially taking over intermediation from primary dealers. This perspective implicitly assumes that debt is risk-free or has zero beta. As explained, the government faces a trade-off between insuring taxpayers and bondholders against adverse macro shocks, such as wars and pandemics (JLVX (2020)). The 'plumbing view' implicitly relies on the assumption that the government and the central bank choose to insure bondholders and force taxpayers to bear most of the macro risk.

Second, we can view the government debt portfolio as risky when investors expect government spending to be partially unfunded, as we showed in Section 2.4. Viewed through this lens, the bond market was reappraising the value of the Treasury portfolio. This view is supported by the empirical evidence from other countries and other episodes. As investors learned about the scale of the government's massive fiscal effort, the fiscal news was priced into Treasury yields, causing yields to rise as investors marked the Treasury portfolio to market. Yield increases could reflect an increase in expected inflation, a rise in the bond risk premium, a higher default risk premium, or an increase in real rates.

This mark-to-market process for Treasurys would have started in March of 2020 when Treasury yields started to climb. Market observers were preparing for large increases in the supply of U.S. Treasurys.

4.4 Price Support

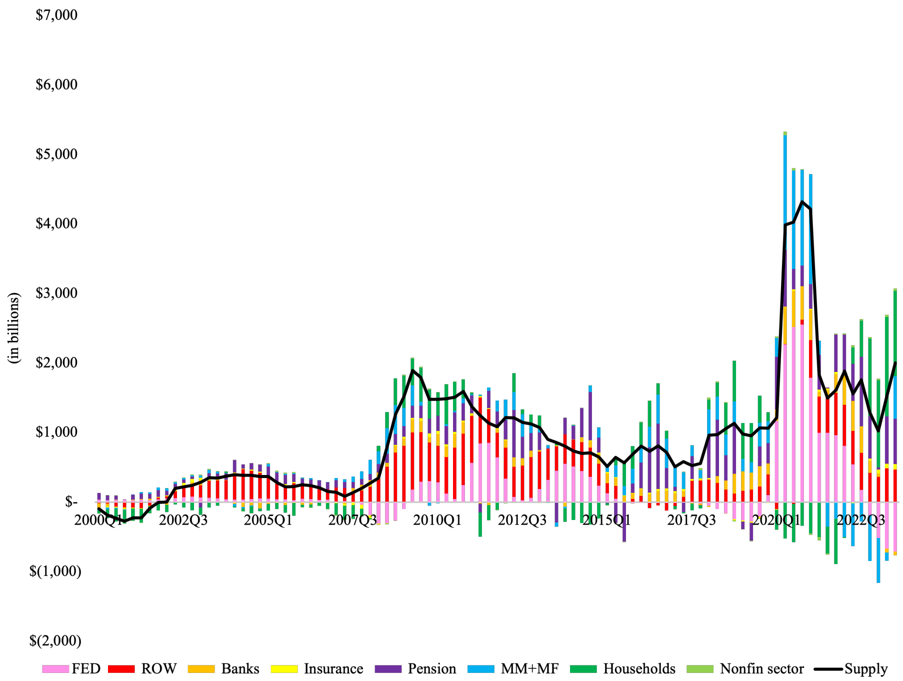
Between March 9 and March 18, 2020, the U.S. 10-year Treasury note yield rose by 68 bps, causing a 2.54% loss in value for the Treasury portfolio (Panel B, Table 2). This mark-to-market process was suspended in mid-March. As pointed out by Hall and Sargent (2022b), the Fed's response to COVID is similar to that in WW-I and WW-II, characterized by a massive expansion of its balance sheet through asset purchases, effectively providing price support to government bonds.

The Fed started an expansion of its balance sheet in mid-March 2020. On March 15, the Fed announced Treasury purchases of at least $500 billion and Mortgage Backed Security purchases of $200 billion 'To support the smooth functioning of markets for Treasury securities and agency mortgage-backed securities that are central to the flow of credit to households and businesses, over the coming months.' On March 23, the FOMC added that its purchases were open-ended. The Federal Reserve ended up buying $2.7 trillion in long-term Treasurys, $1.36 trillion in Mortgage-backed Securities, funding an additional $447 billion in liquidity measures, $110 billion in other loan purchases, and $88 billion in lending facilities.

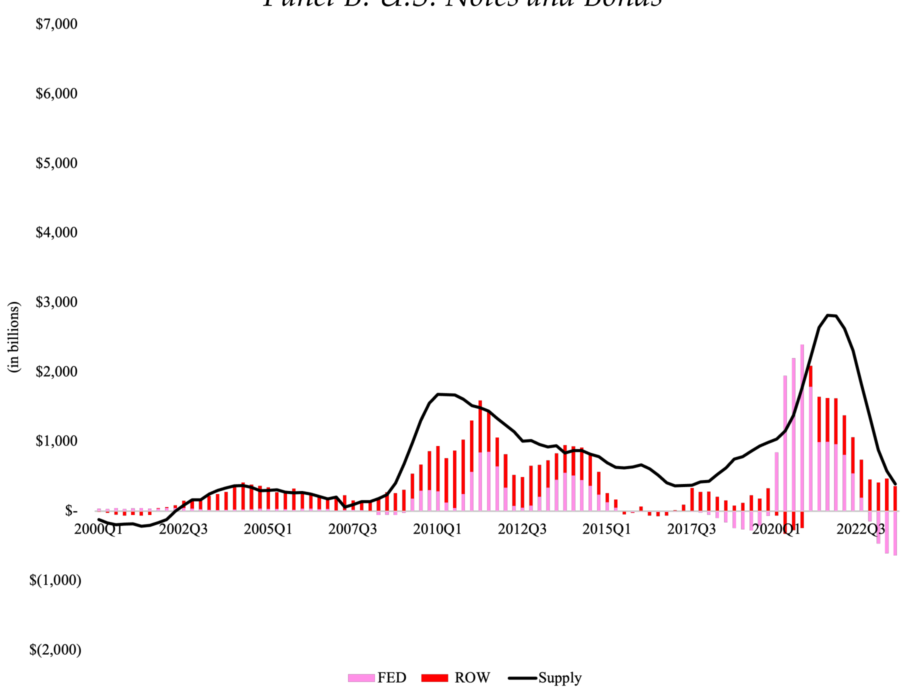
The Fed absorbed a significant fraction of the total issuance of U.S. Treasurys

Fig. 8. **Purchases and Issuance of U.S. Treasurys**

Panel A: U.S. Treasurys



Panel B: U.S. Notes and Bonds



Notes: Plots a 4-quarter moving average of U.S. Treasury purchases by sector. The flows are annualized. The units are in billions. Panel A aggregates all U.S. Treasurys. Panel B excludes T-Bills. Source: U.S. Flow of Funds. Table F210.

(including T-bills, Bonds, and Notes) starting in March 2020. Panel A of Figure 8 plots a 4-quarter moving average of purchases by sector. The flows are annualized. At the peak in 2020 Q4, the Treasury was issuing \$4.3 trillion per year. The Fed was absorbing Treasurys at a rate of \$2.5 trillion per year. The household sector and the ROW were selling Treasurys in 2020Q1. The purchases by money market funds are exclusively T-bills, not Notes and Bonds. Money market and mutual funds were selling Notes and Bonds in Q1. Panel B excludes T-bills. The Fed was buying more than the Treasury's issuance from Q2 to Q4 in 2020. For example, in 2020 Q4, the Fed was purchasing Notes and Bonds at a rate of \$2.4 trillion per year, which exceeded the annual rate at which the Treasury was issuing these securities of \$1.77 trillion per year. Excluding T-bills, the Fed had absorbed 99% of Bond and Note issuance between 2020Q1 and 2021Q1, regularly purchasing much more than what was being issued by the Treasury. At the longer end of the yield curve, the Fed was crowding out all other investors.[20]

The mark-to-market process only really resumed in March of 2022, when the Fed announced an end to its balance sheet expansion program. Consistent with our price support interpretation, there is no evidence the Fed was buying under-priced securities prior to March 2022. The Fed reported mark-to-market losses of \$1.08 trillion in 2022– \$672 billion on the Treasury portfolio; the rest on agency and GSE MBS– and \$948 billion in 2023 – \$585 billion on the Treasury portfolio– on its portfolio of securities.[21] The large-scale asset purchases destroyed value from the perspective of taxpayers.

In buying these long-dated bonds, the Fed reduced the duration of the consolidated government's IOUs by substituting bank reserves held at the Fed for long-dated Treasurys, thus adding a massive fixed-for-floating interest rate swap to the government's balance sheet, where the government pays floating and receives fixed, rather than locking in historically low long rates by extending the duration. The central bank's mark-to-market losses measure the cost to taxpayers of reducing the duration (JLVX (2022)).

There is a normative literature on optimal taxation and public debt management

[20] Haddad, Moreira, and Muir (2024) argue that instituting a QE program can have an impact on yields even when the central bank is not actively purchasing assets.

[21] Source: Federal Reserve Bank Combined Financial Statement. Cumulative unrealized gains on total SOMA.

starting with Barro (1979)'s seminal work on tax smoothing. Risky debt is not undesirable. In their normative analysis, Lucas and Stokey (1983) argued that returns on debt should be negative in the case of large spending shocks, such as wars. From an optimal taxation perspective, risky debt may be optimal because it shifts part of the fiscal burden in the face of large spending shocks onto bondholders while shielding taxpayers (Lucas and Stokey, 1983; Angeletos, 2002; Buera and Nicolini, 2004). Long-term nominal debt may be particularly useful in shielding taxpayers from large spending shocks, as increases in expected future inflation reduce the market value of debt (Lustig et al., 2008). Large-scale asset purchases transfer these bondholder losses back to taxpayers.

4.5 *Stock-Bond Correlation*

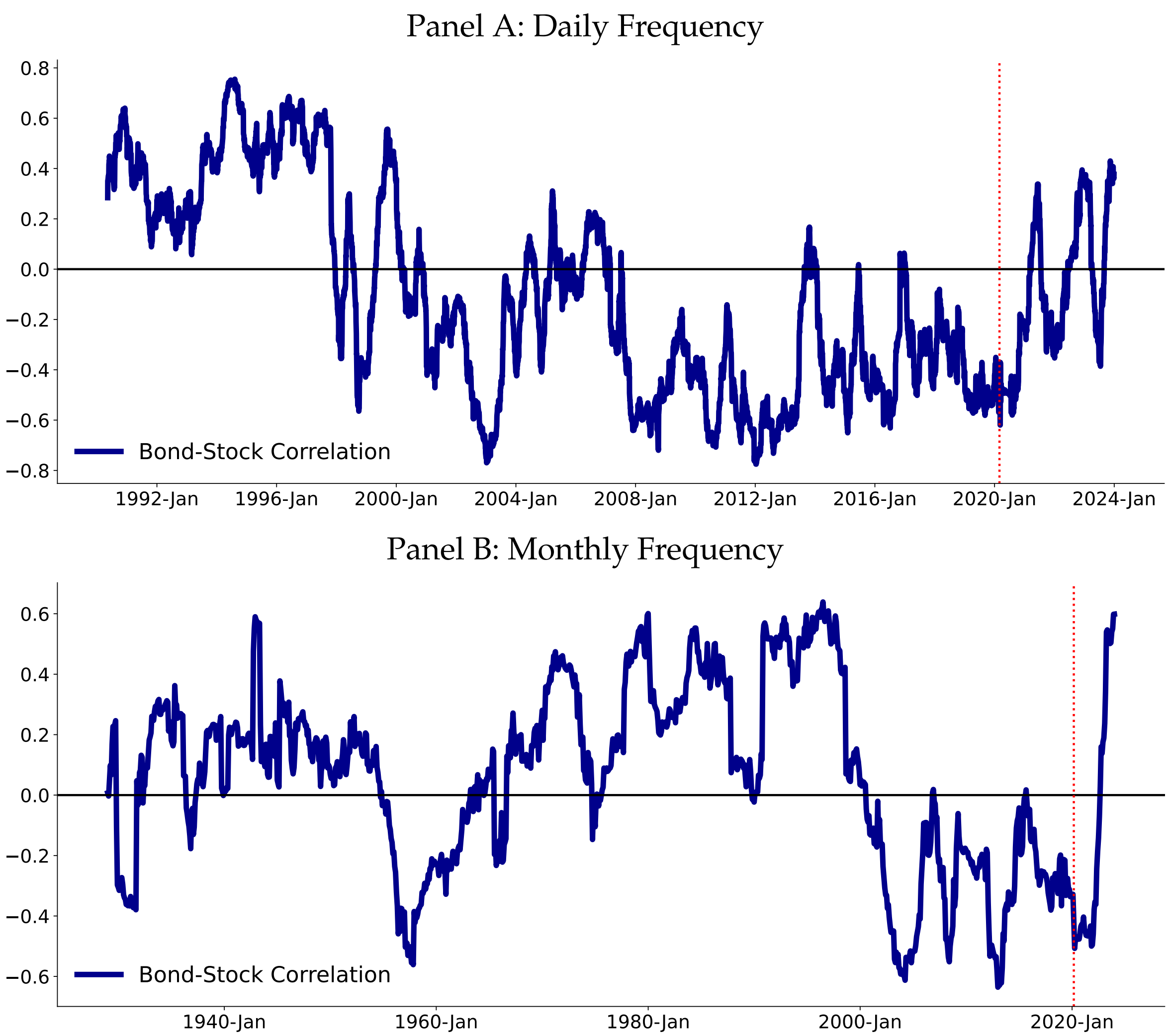
Consistent with the risky debt regime under fiscal dominance, U.S. Treasury investors revised their assessment of Treasury riskiness. The U.S. stock-bond correlation, consistently negative since 1998 (including the 2008 GFC),[22] switched to positive around March 2020. Figure 9 illustrates this shift in correlation using returns from the entire U.S. Treasury bond portfolio and an aggregate stock market index. Panel A, based on daily data, shows the correlation changing from -0.6 to 0.4. Panel B, using monthly data, demonstrates a change from -0.4 to 0.6. Figure A.4 in the Appendix shows similar patterns for the U.K., Germany, and France.

The shift in bond riskiness should have prompted rational U.S. Treasury investors to reassess their Treasury portfolios. As Treasuries transitioned from a hedge to an equity-like instrument, rational long-horizon investors would have recognized that Treasury allocations now increased their overall portfolio risk. Holding expected returns constant, investors would have reduced their exposure to long-dated Treasuries, and the expected returns on long-dated Treasuries would have needed to increase.

The repricing in early March with the Treasury yield spiking is reinforced by the

[22] Campbell et al. (2020) attribute the change in the stock-bond correlation around 1998 to the change in the correlation between the output gap and inflation. Higher inflation goes hand in hand with higher output, implying lower real bond returns but higher stock returns. We show that the joint monetary-fiscal stance also informs the riskiness of government bonds.

Fig. 9. **U.S. Bond-Stock Correlation**



Notes: Panel A shows rolling correlations between bond and stock returns over a three-month window. The bond returns are calculated using daily log returns on the portfolio of U.S. government debt, while the stock returns are based on the daily log returns, including dividends of the S&P 500 value-weighted stock market index. The red dotted line denotes March 2020. The sample ranges from January 1990 to December 2023. Panel B shows rolling nominal correlations between bond and stock returns over a three-year window. The bond returns are calculated using monthly log returns on the portfolio of U.S. government debt, while the stock returns are based on the monthly log returns, including dividends of the S&P 500 value-weighted stock market index. The sample ranges from January 1926 to December 2023.

switch in the stock-bond correlation. However, central banks, including the Fed, paused that adjustment by absorbing more than issuance at the long end of the maturity spectrum, effectively controlling the long end of the yield curve. The term premium eventually did increase by 170 bps. However, 120 bps of that increase came after March of 2022.

4.6 *Flight from Maturity in Treasury Markets*

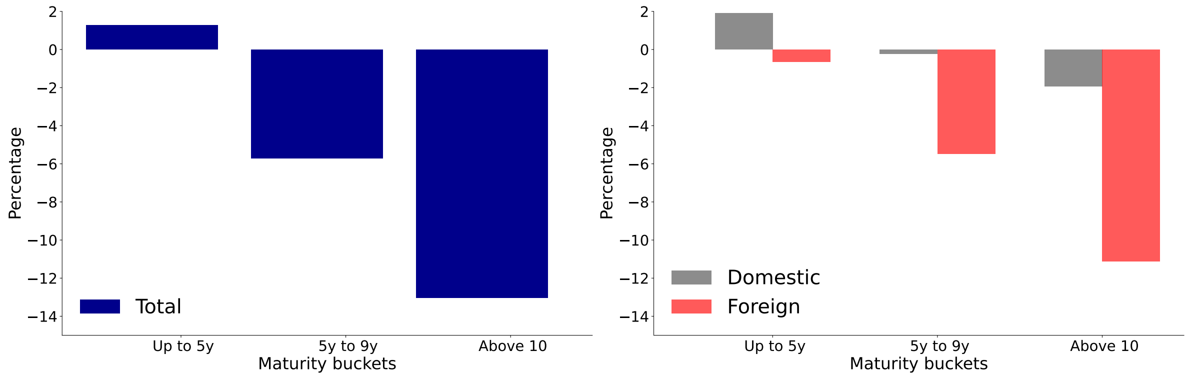
Long-horizon investors want a larger bond risk premium in light of the increased riskiness. However, the Fed paused the repricing. As a result, long-horizon investors sold long-term bonds. We establish three stylized facts. First, in 2020 Q1, selling in U.S. Treasury markets was concentrated exclusively at longer maturities. Second, foreign investors conducted the majority of this selling. Third, there was no corresponding sell-off in U.S. corporate bonds. We characterize this phenomenon as the (foreign) flight from maturity in U.S. Treasury markets.

We start by analyzing the evidence from the Flow of Funds data more closely. Figure A.5 in the Appendix plots purchases of U.S. Treasurys, including T-Bills, during the pandemic. In the first quarter of 2020, the Federal Reserve purchased $1.019 trillion, $863 billion of which was in the form of Notes and Bonds. Other investors were selling Treasurys during the first quarter, including the U.S. household sector ($372 billion) and foreign investors ($284 billion). In Q2, the Fed followed up by purchasing another $1.03 trillion, all of which were Notes and Bonds. In the second quarter, money market and mutual funds started buying T-bills ($1.35 trillion), but they were still selling Notes and Bonds ($71 billion).

As shown in Figure 8, the COVID episode looks quite different from the GFC. Early on in the GFC during 2008, the Treasury benefited from significant purchases of Treasurys by foreign investors (ROW). In the first quarter of the COVID-pandemic, the ROW was selling Notes and Bonds. Next, we analyze the TICS data to take a closer look at the rest of the world's purchases of Treasurys. To add more detail, Figure A.6 in the Appendix plots the monthly net purchases of U.S. bonds by foreign investors computed using the Bertaut and Judson (2014) TICS data. In March 2020, foreign investors sold more than $400 billion of U.S. Treasury Notes and Bonds, a 7-sigma decline in holdings –standard deviations measured over the 2012-2022 sample. In April of 2020, foreign investors sold another $200 billion. Importantly, foreign investors were not selling corporate bonds or agency bonds.

Finally, we use EMAXX data on the holdings of institutional investors to analyze

Fig. 10. **Change in Institutional Investor Holdings of U.S. Bonds and Notes**



Notes: Change in holdings of U.S. Bonds and Notes as a percentage of total holdings in each maturity bucket. The right panel separates the change in Treasury holdings into foreign and domestic investors. The changes shown are for 2020Q1. Based on EMAXX Holdings data.

the maturity composition of bond sales.[23] The selling of Treasurys at the start of COVID by foreign private investors was concentrated at longer maturities above ten years. Figure 10 plots the changes in the par value of Treasury Notes and Bonds (excluding T-bills) by maturity. Private investors sold 14% of their holdings in the longest maturity bucket. This pattern is quite different from what happened during the Great Financial Crisis, as can be seen from Figure A.7 in the Appendix.

We do not observe a similar pattern across maturities in institutional investors buying and selling of corporate bonds. Corporate bond sales by institutional investors were concentrated at the short end of the maturity spectrum. Interestingly, we find that the main sellers of U.S. Treasurys were buying both U.S. and non-U.S. corporate bonds during 2020Q1 and continued afterward. Figure A.9 shows the same results for U.S. corporate bond holdings. We find that institutional investors bought long-term (above six years) U.S. corporate bonds and slightly sold short-term (below six years) U.S. corporate bonds.

[23]EMAXX provides fixed income holdings data for a diverse range of institutional investors, including U.S. and some European insurance companies, U.S. mutual funds, top public pension funds, and European, Canadian, and Asian mutual funds. The database covers $7 trillion in total fixed income par value held across more than 19,000 funds. Each entry in the EMAXX holdings data includes bond identification (CUSIP), holding institution information (e.g., country), type of holding institution (e.g., mutual fund, insurance company), par amount of the position, and reporting date. To select U.S. Treasuries from the EMAXX dataset, we apply the following filters: GEOCODE == 'USA', CREDITSEC == 'SOV', ENTITYCODE == 'GT' (Federal/Sovereign Government (Treasury)), and ALPHANAM starts with 'UNITED ST'. For corporate securities, we use ENTITY == PC (Public/Private Corporation).

If the plumbing view is correct, investors who sold in early March 2020 should have realized lower dollar-weighted returns due to selling at distressed prices. To test this conjecture, we used the EMAXX dataset to compute dollar-weighted returns between 2019:Q4 and 2022:Q4 for investors who sold and did not sell U.S. Treasury Notes and Bonds in 2020:Q1, following Dichev and Yu (2011). The results indicate that investors who sold during 2020:Q1 realized dollar-weighted returns of -1.40% on their notes and bonds investments, compared to -3.70% for those who did not sell. For notes and bonds with a duration above five years, the dollar-weighted returns were -1.60% for sellers versus -5.31% for non-sellers. For context, during the same period, the Federal Reserve's dollar-weighted returns on U.S. Treasuries (excluding T-bills) were -7.73%.

5 Safe or Risky? High-frequency Evidence.

This section examines high-frequency evidence demonstrating that Treasury yields responded significantly to fiscal news releases during the COVID-19 pandemic. These findings are inconsistent with a safe debt regime but align with a risky debt regime.

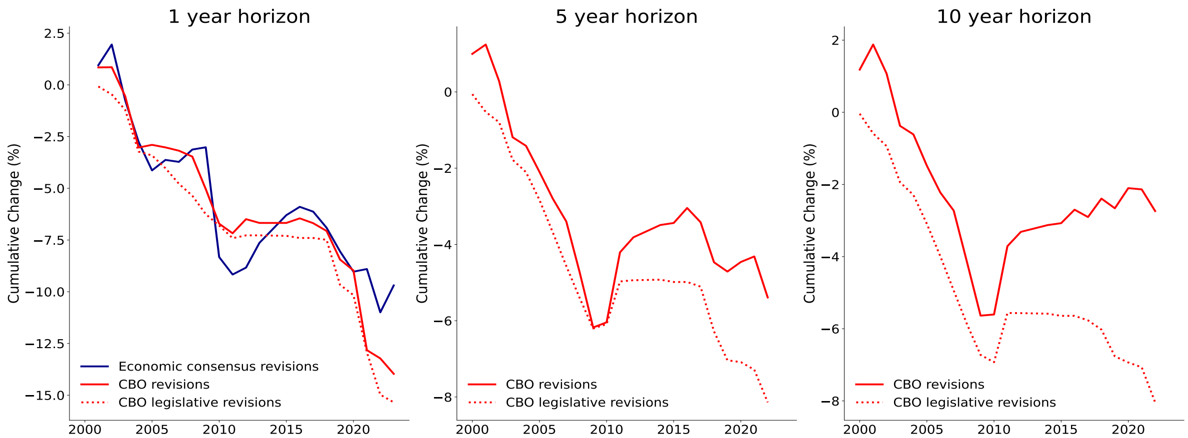
We adopt the high-frequency identification strategy of GCKL(2023) who construct a measure of a proposal's budgetary impact by aggregating the cash flow estimates for each CBO cost release.[24] We extend their sample to include data up to 2023 and augment the CBO cost releases with time-stamped news on fiscal spending sourced from Bloomberg. For a Bloomberg article to be included in our sample, we apply strict classification criteria, requiring that the article's title contains news directly related to spending and specify the total amount. An example of such a title would be "EXTRA: US Senate reaches deal on new stimulus worth 480 billion dollars."[25]

We focus on fiscal news directly linked to legislative actions, as these have been the

[24]This measure cannot be interpreted as news because some of the budgetary impact could have already been priced in when the bill was first introduced. Instead, we use this measure as a way to classify proposals by the sign (positive and negative) and magnitude (large and small) of the budgetary impact. To capture the news component, we compute Treasury value changes around the cost release dates.

[25]In the Appendix, Figure A.11 illustrates the bill-level cash flow contributions, Table A.2 lists all Bloomberg news articles that do not coincide with contemporaneous releases of macroeconomic news, and Table A.1 provides the list of macroeconomic announcements included as controls.

Fig. 11. **Cumulative U.S. Budget Revisions in Consensus Forecast 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 the 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.

primary drivers of deficits over recent decades. The left panel of Figure 11 illustrates this point. The dark blue line plots the Economic Consensus cumulative revisions for the next fiscal year's deficit (similar to Figure 5), while the red line shows cumulative revisions in CBO baseline budget projections from the Budget and Economic Outlook report. CBO categorizes its baseline budget projection revisions into legislative, economic, and technical components. The red dotted line represents cumulative budget revisions resulting from laws enacted since the CBO's previous baseline projections.

Both analysts and the CBO have consistently revised their deficit forecasts and projections downward, with Economic Consensus forecast revisions closely tracking CBO projection revisions. The red dotted line in Figure 11 indicates that legislative actions account for the majority of these revisions. The middle and right panels of the same figure display cumulative CBO projection revisions for 5 to 10-year horizons. While these longer horizons do not exhibit the business cycle patterns seen in shorter horizons, they still show consistent downward revisions over the past two decades. Notably, these long-term revisions are primarily driven by new legislative actions with persistent effects spanning multiple years.

Table 6 presents the average daily change and cumulative effect in Treasury values

Table 6. **Changes in U.S. Treasury Values on Large Deficit Days**

	All days	Other days	Deficit days	Deficit days and controlling for other news		
	(1)	(2)	(3)	(4)	(5)	(6)
Mean bps	-1.58	-0.54	-4.10	-4.03	-6.65	-8.34
t-statistic	[-1.98]	[-0.54]	[-2.81]	[-2.58]	[-2.84]	[-2.09]
p-value	–	–	(0.03)	(0.05)	(0.04)	(0.04)
Cumulative change in %	-14.55	-3.55	-11.00	-9.52	-5.25	-3.67
p-value	–	–	(0.03)	(0.05)	(0.04)	(0.04)
Observations	922	654	268	236	79	44
			Controls			
FOMC days			No	Yes	Yes	Yes
Large Macro News			No	No	Yes	Yes
Small Macro News			No	No	No	Yes

Notes: This table presents the average daily and cumulative changes in Treasury values across three sets of days: all trading days (Column 1), days without large deficit announcements (Column 2), and days with large deficit announcements (Column 3). Columns 4 through 6 control for other news occurring on the same day as the large deficit announcements by excluding those days and re-computing the changes in Treasury values. Column 4 excludes large negative deficit days that overlap with FOMC meeting days. Column 5 further excludes days with large news from macroeconomic announcements, while Column 6 excludes days with both large and small news from macroeconomic announcements. Macroeconomic news is categorized as large (small) when the absolute value of the analysts' forecast error exceeds (falls below) its rolling window median for each of the top 50 macroeconomic indicators. t-statistics are in square brackets. Parentheses report the percentage of simulated Treasury value changes that fall below the actual realizations, based on 10,000 samples generated by randomly selecting, without replacement, the number of observations in the actual sample for large deficit days and calculating the average daily and cumulative changes in Treasury values for each sample. The sample goes from February 28, 2020 to October 30, 2023.

around large negative proposals using CBO and Bloomberg news from February 28, 2020, to October 30, 2023. Following GCKL(2023), large bills are identified as those above the median CBO cost estimate, and this cutoff is also used to select relevant Bloomberg news. Columns (1) to (3) report the average daily change and cumulative effect over the sample period for all trading days, non-deficit announcement days, and deficit announcement days, respectively. On large deficit days, the Treasury portfolio falls by an average of -4.1 bps (t-statistic = -2.81), with a cumulative effect of -11.0% out of the total -14.5% decline shown in Column (1) (see also Column (1) of Table 2). Table A.3 in the Appendix shows that the mean Treasury value change on deficit days is 3.56 bps lower than on other days, with the difference being statistically significant (t-statistic = -2.15).

Our identifying assumption is that on large deficit days, the information contained in the CBO and Bloomberg News is the main driver of changes in Treasury valuations. However, other relevant news coinciding with deficit days could also be driving changes in Treasury values on these days. Columns (4) to (6) progressively add more stringent controls. Column (4) excludes Treasury value changes that occur on large deficit days but fall within a three-day window around FOMC announcements. Column (5) further excludes days with large news from macroeconomic announcements, while Column (6) excludes days with both large and small news from macroeconomic announcements. Macroeconomic news is categorized as large (small) when the absolute value of the analysts' forecast error exceeds (falls below) its median value for each of the top 50 macroeconomic indicators.[26]

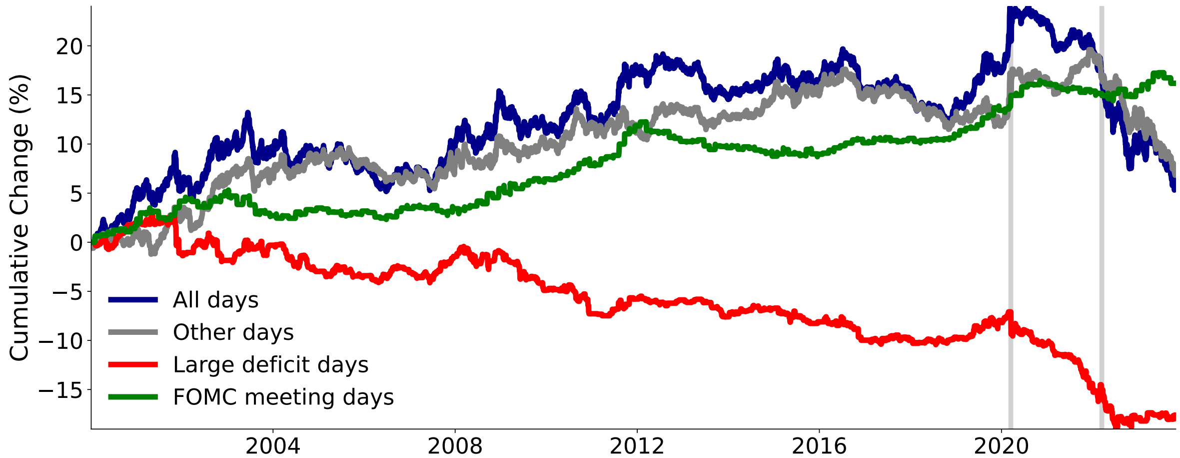
Table 6 demonstrates that as we move from column (4) to column (6), the average daily effect of fiscal news doubles in magnitude from -4.03 bps (t-statistic = -2.58; Column 4) to -8.34 bps (t-statistic = -2.09; Column 6), while the number of relevant days drops from 236 to 44. This evidence suggests that we are indeed measuring the effect of fiscal news on Treasury valuations, as other days with relevant news for Treasuries generate background noise, introducing attenuation bias.[27]

Figure 1 plots the cumulative returns around the large deficit days after controlling for FOMC meeting days and large macro announcements, helping us better understand when the drop in Treasury valuations occurs. As shown in the figure, the effect of adverse fiscal news consistently decreases Treasury valuations throughout the pandemic. Notably, prior to March 2022 (highlighted by the gray shaded area), Treasury

[26] The top 50 macroeconomic indicators are selected based on the Bloomberg relevance score, as in Bianchi, Gómez-Cram, Kind, and Kung (2023b). This score represents the number of alerts set on Bloomberg Terminals for an economic event relative to all alerts set for the 130 macro events in the U.S. We control for macroeconomic announcements given the large influence of these events on Treasury values (e.g., Balduzzi, Elton, and Green, 2001; Gürkaynak, Kısacıkoğlu, and Wright, 2020).

[27] Table A.4 in the Appendix presents robustness checks with respect to the median classification, varying the percentile threshold for classifying a large deficit day from the 50th to the 1st percentile. As we switch to higher cutoffs (smaller percentiles), the measured average effect on Treasury valuations increases monotonically from -6.65 bps at the 50th percentile to -20.67 bps at the 1st percentile. Furthermore, Table A.5 in the Appendix presents results using CBO and Bloomberg news separately, with a mean effect of -7.15 bps (-8.40 bps) on CBO news releases (Bloomberg news) days. Figure A.12 in the Appendix further shows the individual contribution of Bloomberg News and large CBO bills to the overall fiscally driven yield increases. Including fiscal news from Bloomberg is valuable, as these news items primarily capture discussions surrounding the legislative process, while CBO news provides information about the budgetary impact of legislation.

Fig. 12. **Cumulative Changes in the Valuation of U.S. Treasurys**



Notes: This figure shows the cumulative change in Treasury values across four distinct sets of days. The dark blue line represents the cumulative change using all trading days. The green line plots the cumulative change using a three-day window around FOMC meeting days. The red line shows the cumulative change on large deficit days measured by the release of above-median CBO cost projections that do not coincide with the three-day window around FOMC meeting days. The dark gray line depicts the cumulative change on all remaining trading days. The gray-shaded areas denote March 2020 and March 2022. The sample covers 2000 to 2023.

values were increasing on other days. After adding the FOMC and macro controls, around 36 percent of the overall -14.55% drop in Treasury valuations occurred on days with large deficit announcements, despite these days accounting for only about 8.5 percent (=79/922) of the sample's trading days.

Figure 12 expands the sample to include the two decades prior to 2020, as in GCKL(2023). The figure plots the cumulative change in Treasury values on three non-overlapping sets of days: the green line represents the three days centered around FOMC meetings, the red line depicts large deficit days measured by CBO cost projections that do not coincide with FOMC meeting days, and the gray line shows cumulative changes on other days. The dark blue line illustrates the cumulative change on all trading days.

The cumulative change in the Treasury portfolio valuation on large negative proposal days exhibits a smooth downward trend over the extended sample, implying that the effects are attributed to a consistent flow of fiscal news rather than a few large observations. Notably, between March 2020 and March 2022, indicated by the two gray shaded bars, the effect is much larger, as shown by the significant steepening of the red line. During the COVID period, Treasury values increased on other days and remained largely flat during FOMC announcement days. Hence, the overall value changes observed during this time, as shown by the blue line, were primarily driven by fiscal news.

The green line in Figure 12 shows that on FOMC meeting days, Treasury values increased significantly, reflecting the fact that until 2020, Fed policy imputed a secular downward drift to long-term bond yields (Hillenbrand, 2021).[28] 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.[29] However, this is no longer the case after 2020, when the FOMC-day returns (green line) diverge from the total returns (blue line). The cumulative effect of FOMC announcements on Treasury returns is zero after March 2020 because, during COVID, yields decline when the Fed actually purchases long-dated Treasurys, not when they announce the purchases (Vissing-Jorgensen, 2021).

Next, we compute the effect of fiscal news on nominal and real yields, as well as on measures of default risk, expected inflation, convenience yields, and term premia (i.e., the same variables as in Table 2). Table 7 presents daily average changes in Panel A and cumulative changes in Panel B. This decomposition allows us to quantify the proportion of cumulative changes in these variables that occurred during large deficit news announcements. The main takeaway is that these days had a substantial impact on these measures. For instance, 26.8% of the nominal yield increases, 19.7% of the real yield increases, and 31% of the term premium increases took place on large deficit announcement days, despite these days accounting for only about 8.5% of all trading days from February 28, 2020, to October 30, 2023.

Figure 13 shows the cumulative changes in these variables throughout the sample period. We observe that even before March 2022, there are substantial increases in real and nominal yields, as well as in the term premia, on large deficit announcement days. Such increases are not evident on other days before 2022. This is particularly

[28] Alam (2022) show that the secular decline in interest rates observed around FOMC meetings is primarily concentrated on days when these meetings coincide with macroeconomic announcements.

[29] Hall and Sargent (2022b) compare U.S. fiscal and monetary policy during the pandemic and the world wars.

Table 7. **Cumulative U.S. Treasury Returns and Changes in U.S. Treasury Yields around Deficit Days**

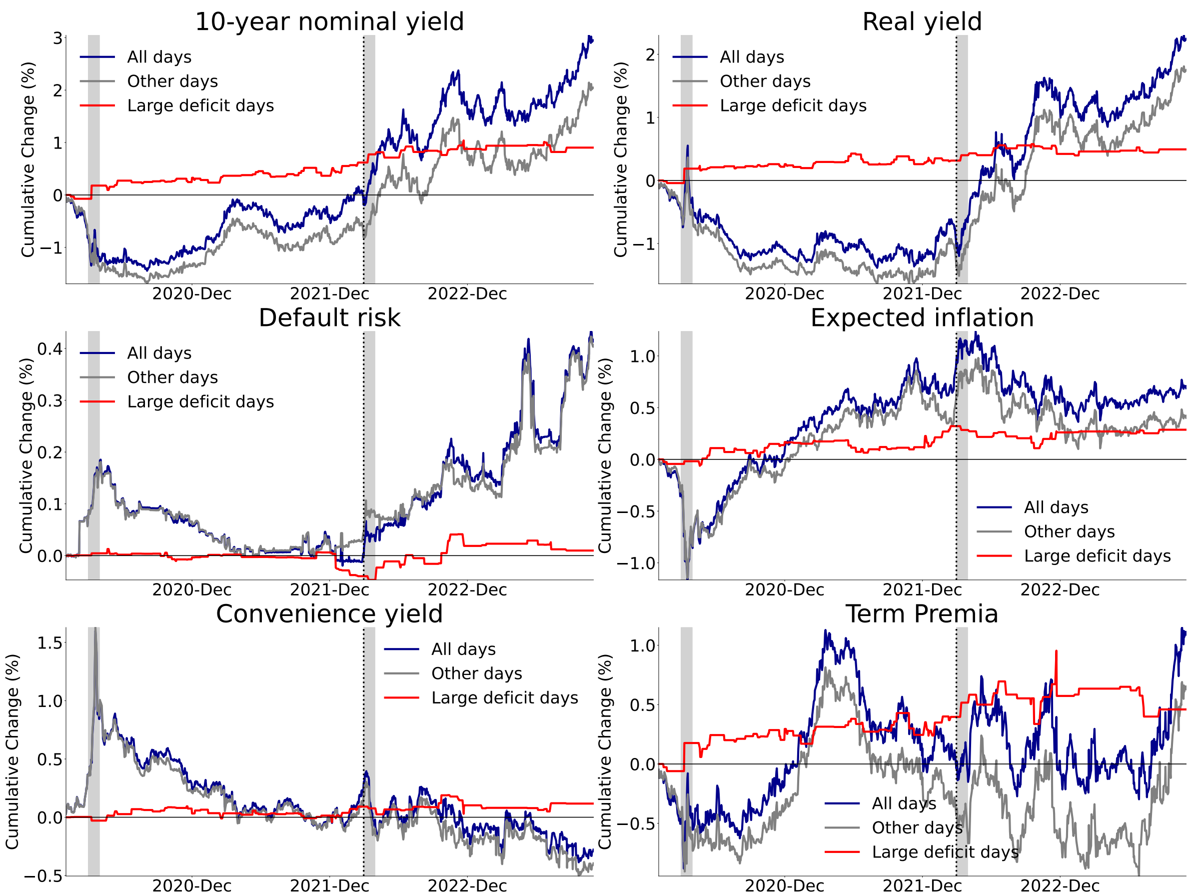
A. Average daily changes from February 28, 2020, to October 30, 2023	All days (1)	Deficit days (2)	Other days (3)
Nominal bond returns	-1.58	-6.65	-1.10
t-statistic	[-1.99]	[-2.84]	[-1.30]
Real bond returns	-2.85	-7.98	-2.37
t-statistic	[-3.50]	[-3.49]	[-2.73]
10-year nominal yield	0.39	1.23	0.31
t-statistic	[1.87]	[2.40]	[1.39]
Real yield	0.29	0.68	0.25
t-statistic	[1.40]	[1.52]	[1.19]
Default risk	0.04	0.01	0.04
t-statistic	[1.22]	[0.14]	[1.22]
Expected inflation	0.11	0.42	0.08
t-statistic	[0.79]	[1.41]	[0.53]
Convenience yield	-0.06	0.15	-0.08
t-statistic	[-0.45]	[0.63]	[-0.55]
Term premium	0.17	0.66	0.12
t-statistic	[0.87]	[1.07]	[0.59]
Observations	923	79	844

B. Cumulative changes from February 28, 2020, to October 30, 2023	All days (1)	Deficit days (2)	Other days (3)
Nominal bond returns	-14.56	-5.25	-9.31
Real bond returns	-26.35	-6.30	-20.04
10-year nominal yield	3.65	0.98	2.67
Real yield	2.68	0.53	2.14
Default risk	0.35	0.01	0.34
Expected inflation	0.98	0.33	0.65
Convenience yield	-0.61	0.11	-0.72
Term premium	1.66	0.52	1.14
Observations	923	79	844

Notes: This table presents daily average changes (Panel A) and cumulative changes (Panel B) in the following variables: nominal government debt portfolio returns, computed using procedures similar to Hall and Sargent (2011); the 10-year nominal yield; convenience yields, proxied by the spread between long-term Aaa-rated corporate bonds and 10-year Treasury yields; real rates, measured via 10-year TIPS; default risk, gauged through 10-year U.S. credit default swaps; expected inflation, captured by 10-year inflation swaps; and term premia, estimated employing the methodology outlined in Adrian et al. (2013). Both panels show changes across three sets of days: all trading days (Column 1), days with large deficit announcements (Column 2), and days without large deficit announcements (Column 3). In Column 2 of both panels, we control for other news coinciding with large deficit announcements by excluding days that overlap with FOMC meetings and days with large macroeconomic news, defined as days when the absolute value of analysts' forecast errors exceeds the rolling window median for each of the top 50 macroeconomic indicators. Square brackets contain t-statistics. The sample period spans from February 28, 2020, to October 30, 2023.

noteworthy given that, as documented in Figure 6, most of the observed increase in nominal and real yields occurred primarily after March 2022.

Fig. 13. **Decomposing Cumulative U.S. Treasury Returns and Changes in Yields on Large Deficit Days**



Notes: This figure presents the cumulative changes in the 10-year nominal yield, real yields, default risk, expected inflation, convenience yield, and term premia across three different sets of days. The dark blue line represents the cumulative change using all trading days, while the red line shows the cumulative change on large deficit announcement days that do not coincide with FOMC meeting days or large macroeconomic announcements. The dark gray line illustrates the cumulative change using all remaining trading days. Convenience yield is measured by the spread between long-term Aaa-rated corporate bonds and 10-year Treasury yields. Real rates are based on 10-year TIPS. Default risk is measured using 10-year U.S. credit default swaps. Expected inflation is derived from 10-year inflation swaps. Term premia are calculated using the Adrian et al. (2013) measure. The black dotted line marks March 2020. The sample spans from January 01, 2020, to October 30, 2023.

6 Conclusion

Central banks and governments need to ensure that bond markets function smoothly. Before the arrival of COVID, the U.S. had not witnessed large responses to fiscal shocks in Treasury markets in the past decades, including during the GFC. Based on extrapolation from recent U.S. experience, one might have expected Treasury yields to be insensitive to fiscal news when bond markets function well.

The U.S. Treasury market's actual response to COVID was markedly different from its response during the GFC and more in line with the predictions of standard valuation models. Throughout COVID, U.S. Treasurys were marked down along with the sovereign bonds issued by the governments of other advanced economies, such as France, Germany, and the U.K. We provide direct high-frequency evidence that these U.S. Treasury yield increases were concentrated on days with significant fiscal news, the footprint of the risky debt regime. In a large class of standard asset pricing models, the valuation of the government's IOUs is marked down when the economy is hit by unfunded spending increases.

In March of 2020, foreign investors did not flee to the safety of U.S. Treasurys. Instead, they sold long-dated U.S. Treasurys in a flight from maturity. The convenience yield on long-dated Treasurys declined throughout the COVID period. During COVID, U.S. Treasurys were not trading as the world's safe asset of choice, but rather, Treasurys were trading much like the sovereign bonds issued by other mature economies. Towards the end of the sample, AAA corporates are priced as close substitutes for long-dated Treasurys.

In response to COVID, U.S. Treasury investors seem to have shifted to the risky debt model when pricing Treasurys. Policymakers, including central banks, should internalize this shift when assessing whether bond markets are functioning properly. In the risky debt regime, valuations will respond to government spending shocks, which may involve large yield changes in bond markets. In this environment, large-scale asset purchases by central banks in response to a large government spending increase have undesirable public finance implications. These purchases, which provide temporary price support, destroy value for taxpayers but subsidize bondholders.

These purchases may also distort the incentives of governments and impair the price discovery in government bond markets. It is not inconceivable that governments in some mature economies have overestimated their true fiscal capacity as a result of these large-scale asset purchases.[30]

[30] More generally, a recognition that the portfolio of all government liabilities in mature economies may be inherently risky will also lead to more realistic assessments of that country's fiscal capacity (JLVX (2020); JLVX (2024b) and Jiang et al. (2022a)).

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Appendix

Government Debt in Mature Economies

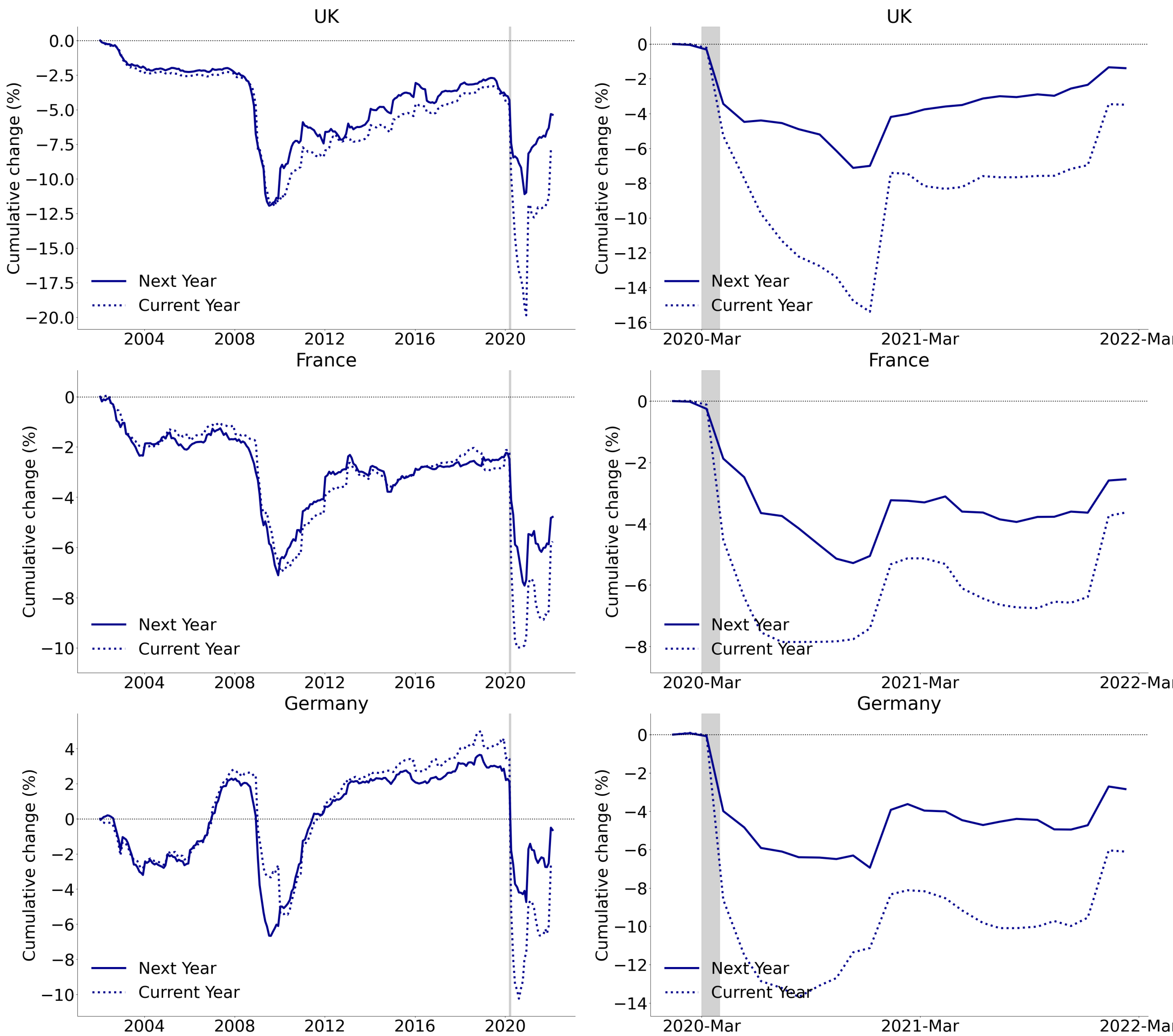
Roberto Gómez-Cram   Howard Kung   Hanno Lustig

List of Figures

List of Tables

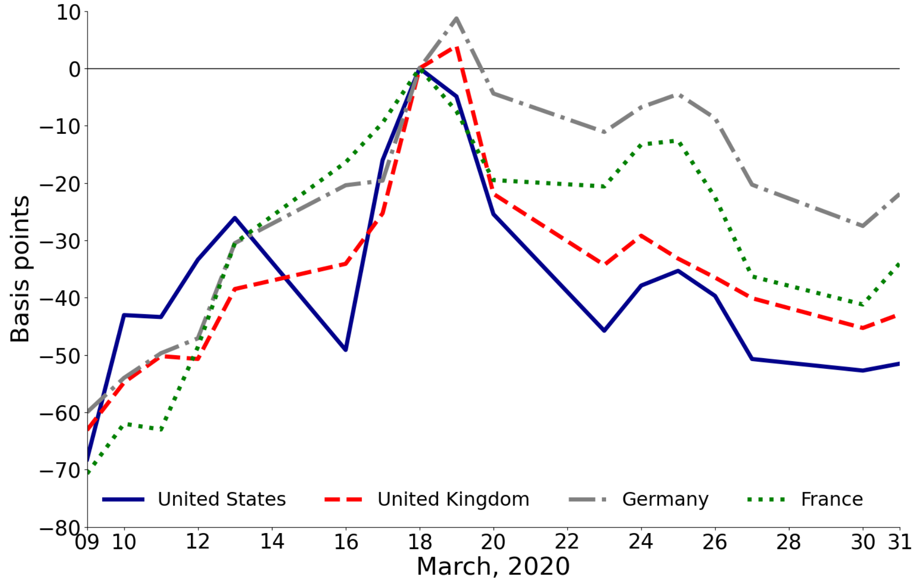
Appendix A

Fig. A.1. **Cumulative Revisions in Consensus Forecasts for Budget Balance in Other Countries**



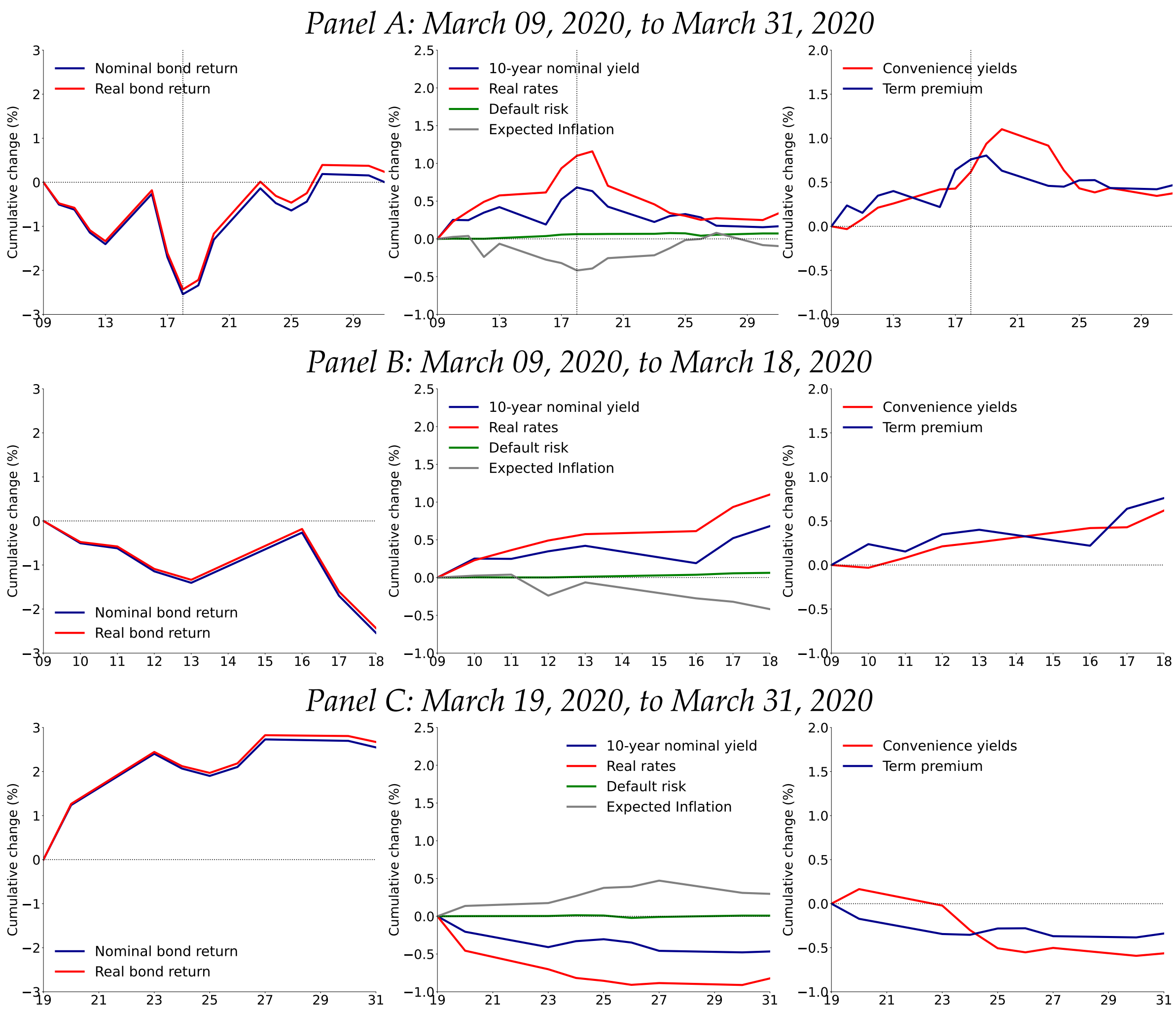
Notes: This figure shows the cumulative revisions in the consensus forecast for the current and next fiscal year's budget balance. For each country, we scaled the consensus forecast by the most recent GDP value available at the time the forecasts were made. The data comes from Consensus Economics. In the left panel, the sample ranges from 2002 to 2022, while in the right panel, the sample ranges from 2020 to 2022.

Fig. A.2. **10-Year Benchmark Yields**



Notes: 10-Year Benchmark Yields for Government Bonds issued by the U.S., the U.K., Germany and France.

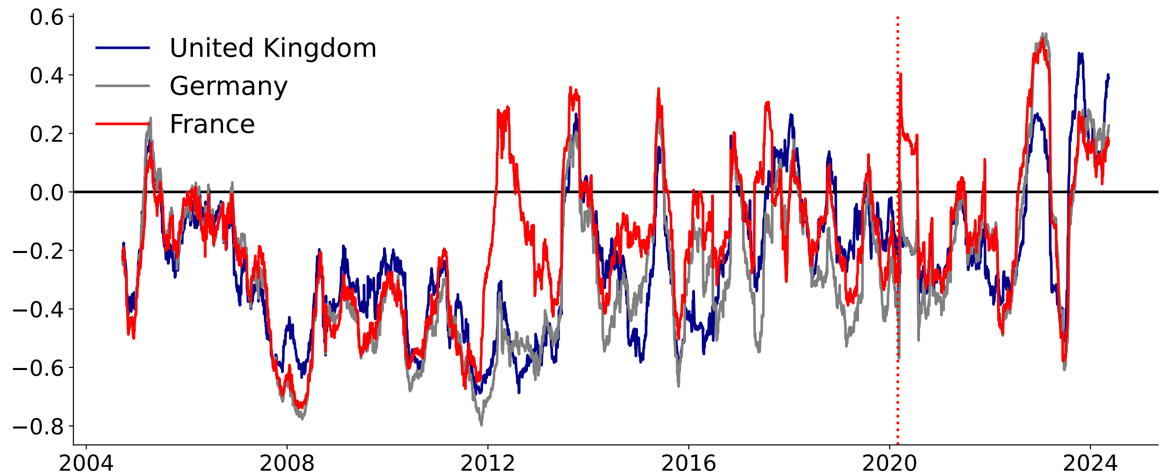
Fig. A.3. **Cumulative U.S. Treasury Returns and Changes in U.S. Treasury Yields during March 2020**



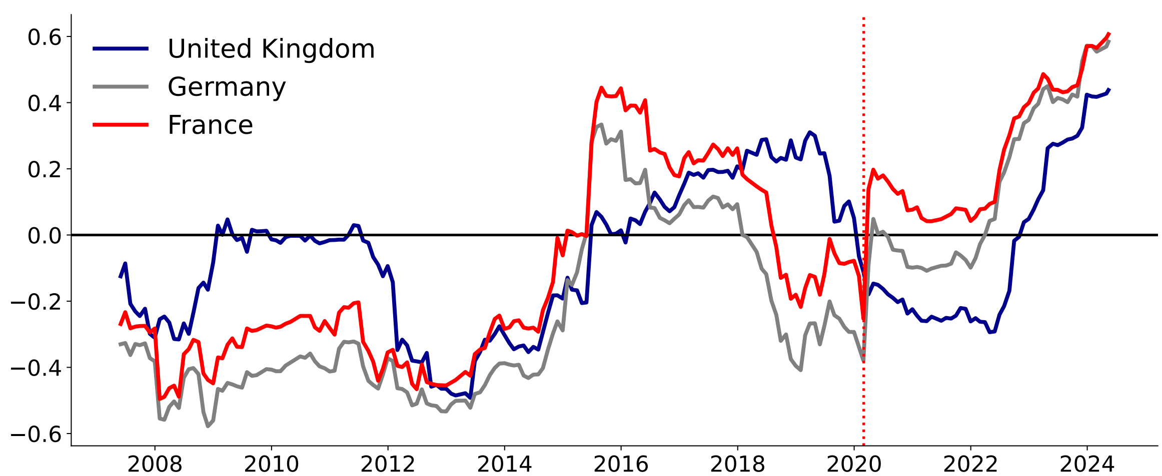
Notes: The left panels present cumulative daily changes in nominal and real government debt portfolio returns, computed using methods similar to Hall and Sargent (2011). Real values are calculated by subtracting realized inflation over the period. The middle panels show cumulative daily changes in the 10-year nominal yield, real rates (10-year TIPS), default risk (10-year U.S. credit default swaps), and expected inflation (10-year inflation swaps). The right panels display cumulative daily changes in convenience yields (spread between long-term Aaa-rated corporate bonds and 10-year Treasury yields) and term premia (estimated using Adrian et al. (2013) methodology). Panel A covers March 09, 2020, to March 31, 2020. The dotted line denotes March 18, 2020. Panel B covers March 09, 2020, to March 18, 2020, 2022. Panel C covers March 19, 2020, to March 31, 2020.

Fig. A.4. **Bond-Stock Correlation for the U.K., Germany, and France**

Panel A: Daily Frequency

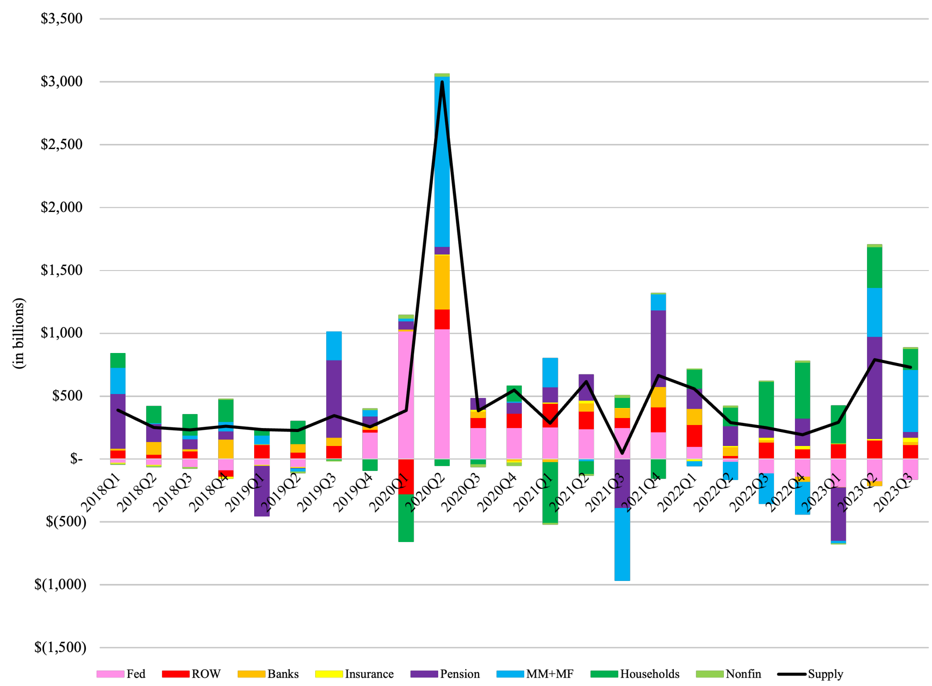


Panel B: Monthly Frequency



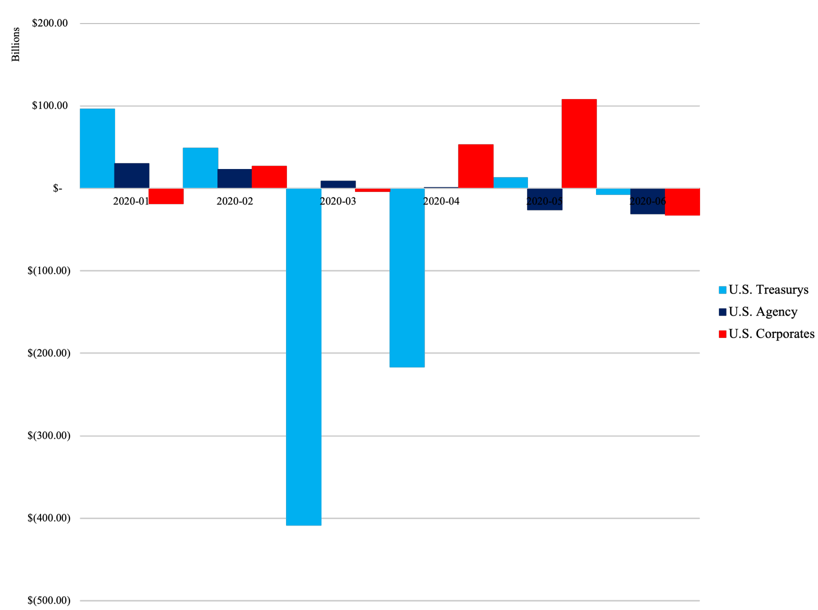
Notes: Panel A shows rolling correlations between bond and stock returns using bond indices and stock indices for the U.K., Germany, and France over a three-month window. The bond and stock returns are calculated using daily log returns. Panel B shows nominal correlations between bond and stock returns over a three-year window using monthly bond and stock returns. The red dotted line denotes March 2020. The sample period is from May 2004 to May 2024.

Fig. A.5. **Purchases and Issuance of U.S. Treasurys by Sector**



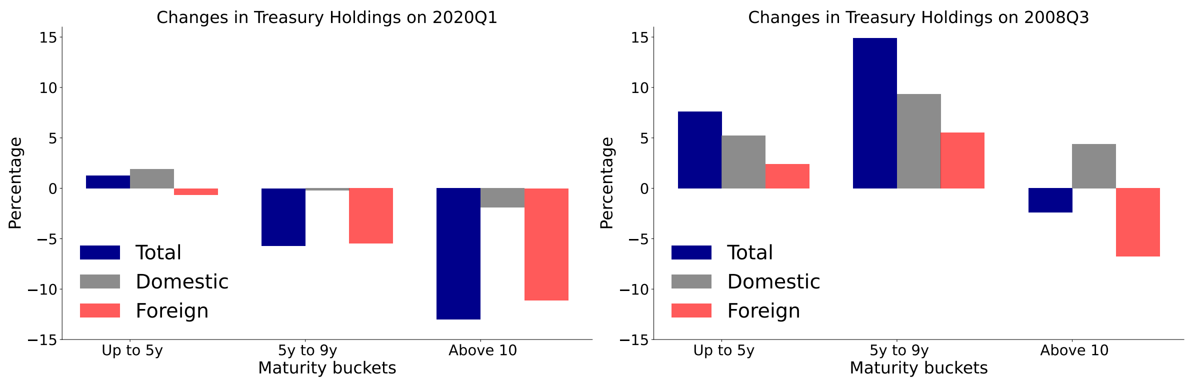
Notes: Quarterly net purchases of U.S. Treasury by sector. The flows are not annualized. Source: Flow of Funds data Table F210.

Fig. A.6. **Net Foreign Purchases of U.S. Bonds**



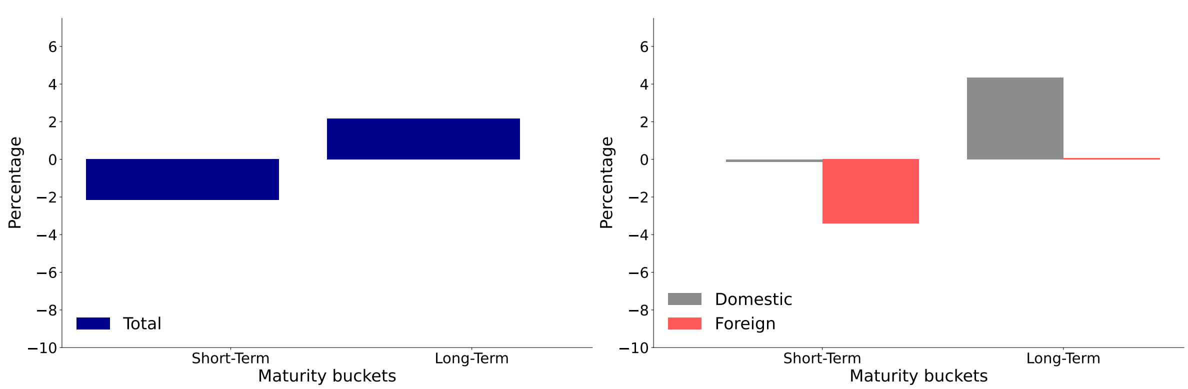
Notes: Net foreign purchases of U.S. Treasury bonds, Agency bonds, and U.S. corporate bonds. Estimates based on Bertaut and Judson (2014) TICS (Treasury International Capital System) data.

Fig. A.7. **Change in Institutional Investor Holdings of U.S. Bonds and Notes: 2020Q1 vs. 2008Q3**



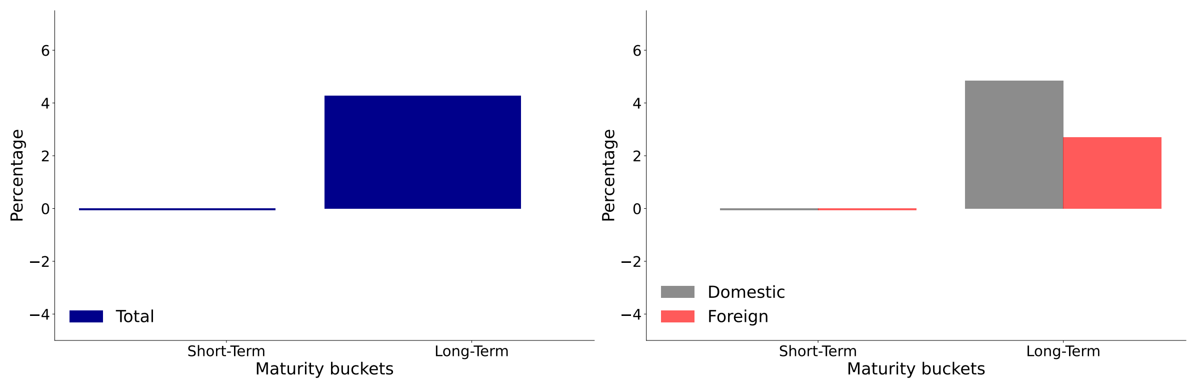
Notes: Change in Treasury holdings of bonds and notes as a percentage of total holdings by maturity bucket. We separate the change in Treasury holdings into foreign and domestic investors. The left panel shows changes for 2020Q1, while the right panel shows changes for 2008Q3. Based on EMAXX Holdings data.

Fig. A.8. **Change in Institutional Investor Holdings of Corporate Bonds**



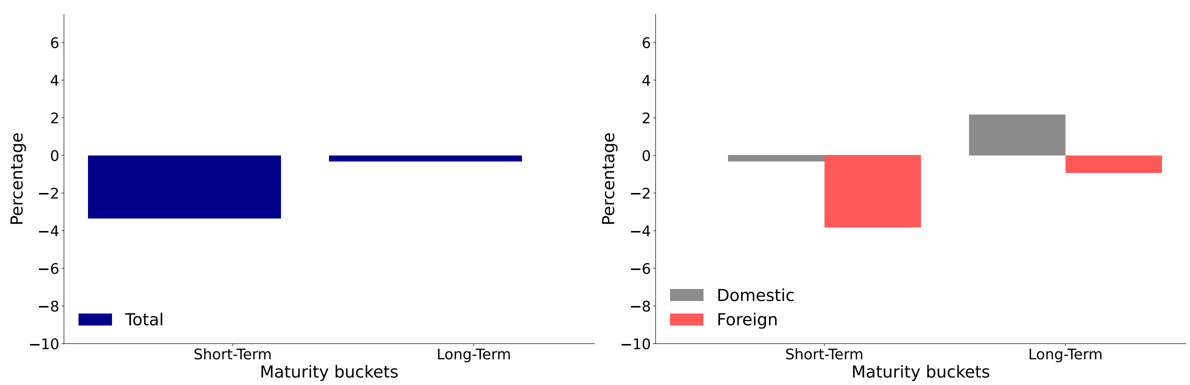
Notes: This figure presents the change in corporate bond holdings as a percentage of total holdings in each maturity bucket for the first quarter of 2020. The short-term bucket includes securities with maturities below six years, while the long-term bucket includes securities with maturities above six years. The right panel separates the change in Treasury holdings into foreign and domestic investors. The data is based on EMAXX Holdings.

Fig. A.9. **Change in Institutional Investor Holdings of U.S. Corporate Bonds**



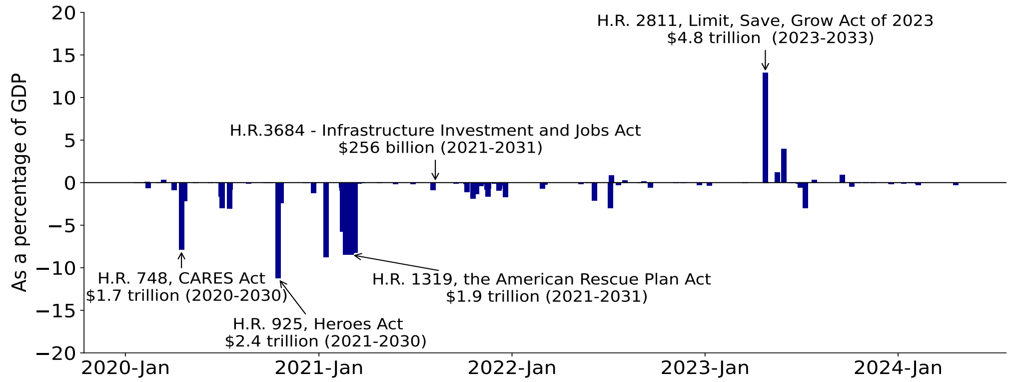
Notes: Change in U.S. corporate bond holdings as a percentage of total holdings in each maturity bucket. The right panel separates the change in Treasury holdings into foreign and domestic investors. The changes shown are for 2020Q1. Based on EMAXX Holdings data.

Fig. A.10. **Change in Institutional Investor Holdings of Non-U.S. Corporate Bonds**



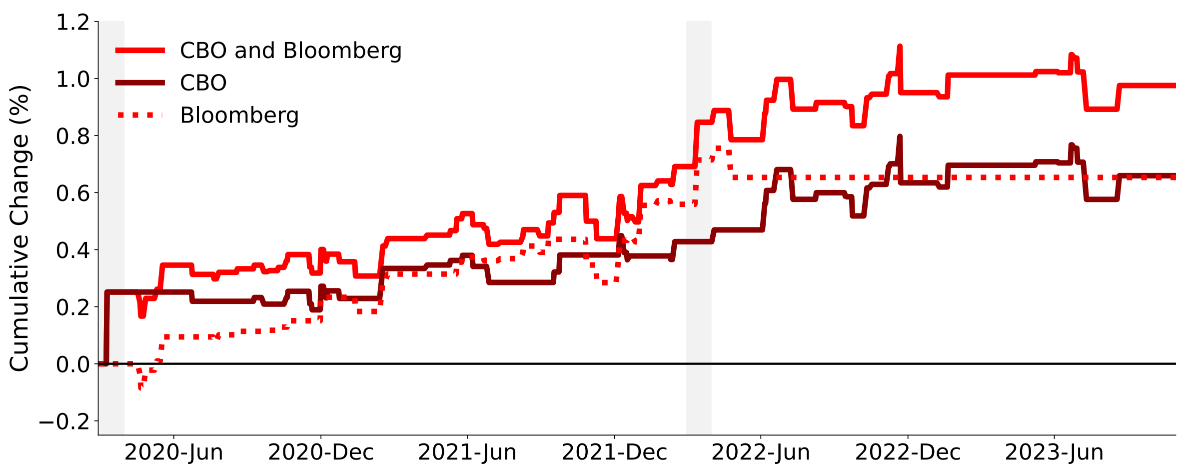
Notes: This figure presents the change in non-U.S. corporate bond holdings as a percentage of total holdings in each maturity bucket for the first quarter of 2020. The short-term bucket includes securities with maturities below six years, while the long-term bucket includes securities with maturities above six years. The right panel separates the change in Treasury holdings into foreign and domestic investors. The data is based on EMAXX Holdings.

Fig. A.11. **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 $\nu = 0.996$, is calculated as the average annual return of the nominal government debt portfolio, adjusted for growth and inflation. The dataset encompasses 998 unique cost estimates, spanning from January 2020 to April 2024.

Fig. A.12. **Cumulative Changes in Long-term Nominal Yields**



Notes: This figure displays the cumulative change in the 10-year nominal yield around large deficit days. The red solid line shows yield changes on days identified by both CBO cost estimates and Bloomberg articles as having large deficits, excluding days coinciding with FOMC meetings and major macroeconomic announcements. The dark red line uses only CBO cost estimates, while the red dotted line uses only Bloomberg news articles to identify large deficit days. The combined effect does not equal the sum of individual CBO and Bloomberg effects because on days with both types of news, the impact is counted twice in the individual measures but only once in the combined effect. The gray shaded areas indicate March 2020 and March 2022. Sample period: March 1, 2020 to October 30, 2023.

Table A.1. **Macroeconomic Announcements**

Event	Ticker	Relevance	Time
Change in Nonfarm Payrolls	NFP TCH Index	99.213	08:30:00
Initial Jobless Claims	INJCJC Index	98.425	08:30:00
FOMC Rate Decision (Upper Bound)	FDTR Index	97.638	14:00:00
GDP Annualized QoQ	GDP CQOQ Index	96.850	08:30:00
CPI MoM	CPI CHNG Index	96.063	08:30:00
ISM Manufacturing	NAPMPMI Index	95.276	10:00:00
U. of Mich. Sentiment	CONSSENT Index	94.488	10:00:00
Conf. Board Consumer Confidence	CONCCONF Index	93.701	10:00:00
Durable Goods Orders	DGNOCHNG Index	92.913	08:30:00
Retail Sales Advance MoM	RSTAMOM Index	92.126	08:30:00
New Home Sales	NHSLTOT Index	91.339	10:00:00
Industrial Production MoM	IP CHNG Index	90.551	09:15:00
Markit US Manufacturing PMI	MPMIUSMA Index	90.000	09:45:00
Unemployment Rate	USURTOT Index	89.291	08:30:00
Housing Starts	NHSPSTOT Index	88.976	08:30:00
Existing Home Sales	ETSLTOTL Index	88.189	10:00:00
ADP Employment Change	ADP CHNG Index	87.402	08:15:00
PPI Final Demand MoM	FDIDFDMO Index	86.614	08:30:00
Personal Spending	PCE CRCH Index	85.827	08:30:00
Personal Income	PITLCHNG Index	85.827	08:30:00
Factory Orders	TMNOCHNG Index	85.039	10:00:00
Trade Balance	USTBTOT Index	84.252	08:30:00
Leading Index	LEI CHNG Index	83.465	10:00:00
Empire Manufacturing	EMPRGBCI Index	82.677	08:30:00
MNI Chicago PMI	CHPMINDX Index	81.890	09:45:00
Wholesale Inventories MoM	MWINCHNG Index	81.102	10:00:00
ISM Services Index	NAPMNMI Index	79.528	10:00:00
Philadelphia Fed Business Outlook	OUTFGAF Index	78.740	08:30:00
GDP Price Index	GDP PIQQ Index	77.480	08:30:00
Import Price Index MoM	IMP1CHNG Index	77.165	08:30:00
CPI Ex Food and Energy MoM	CPUPXCHG Index	76.850	08:30:00
Pending Home Sales MoM	USPHTMOM Index	76.378	10:00:00
Monthly Budget Statement	FDDSSD Index	75.591	14:00:00
ISM Prices Paid	NAPMPRIC Index	74.016	10:00:00
Current Account Balance	USCABAL Index	71.653	08:30:00
Richmond Fed Manufact. Index	RCHSINDX Index	70.866	10:00:00
CPI YoY	CPI YOY Index	70.079	08:30:00
Markit US Services PMI	MPMIUSSA Index	70.000	09:45:00
Change in Manufact. Payrolls	USMMMNCH Index	69.449	08:30:00
Continuing Claims	INJCSP Index	68.898	08:30:00
FHFA House Price Index MoM	HPIMMOM Index	68.504	09:00:00
Personal Consumption	GDPCTOT Index	67.795	08:30:00
PPI Final Demand YoY	FDIUFDYO Index	67.716	08:30:00
PPI Ex Food and Energy MoM	FDIDSGMO Index	66.142	08:30:00
PPI Ex Food and Energy YoY	FDIUSGYO Index	65.354	08:30:00
Retail Sales Ex Auto MoM	RSTAXMOM Index	64.488	08:30:00
Dallas Fed Manf. Activity	DFEDGBA Index	63.779	10:30:00
Capacity Utilization	CPTICHNG Index	63.386	09:15:00
Building Permits	NHSPATOT Index	62.283	08:30:00
NFIB Small Business Optimism	SBOITOTL Index	61.417	06:00:00

The table lists the macroeconomic announcements we use as controls in our analysis. We identified the top 50 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. Time denotes the Eastern Time (ET) at which the announcement was most commonly released during our sample period.

Table A.2. **Bloomberg News Articles**

Date	Link	Title
2020-04-20	NSN Q92BV2T0G1KW	Mnuchin, Democrats Close on Virus Aid Deal Nearing $500 Billion
2020-04-20	NSN Q93KRR0799MO	U.S. senators propose $500 billion rescue for state, local govts
2020-04-20	NSN RT1GDK0799MQ	Oil Tanks as Congress and Mnuchin Near a $500 Billion Aid Deal – Barrons.com
2020-04-20	NSN Q93OHFT0AFB9	Farm Backers See $19 Billion Rescue as Down Payment on More Aid
2020-04-20	NSN Q93S463V7U9S	White House, Congress Get Closer on $450B Virus Aid Talks
2020-04-20	NSN Q93ORS3V2800	McConnell Adds Senate Session Amid $450B Virus Aid Talks
2020-04-20	NSN Q92SAX3H0JKR	Deal Nears for $450 Billion to Replenish Aid to Taxpayers and Small Businesses
2020-04-21	NSN Q939SBDWLU6F	Senate Passes $484 Billion for Small-Business, Hospitals, Tests
2020-04-21	NSN Q95LKRBUJSAU	Democrats reportedly reach a $450 billion deal with the White House to expand funding for small-business loans, and Trump says
2020-04-21	NSN Q95H2TBUJSAP	Democrats reach a $450 billion-dollar deal with the White House in order to expand funding for small business loans, and Trump
2020-04-21	NSN Q95P2Q3PR6RM	1ST LEAD US lawmakers reach deal on 480 billion dollars in new stimulus By Sophie Wingate and Shabtai Gold, DPA
2020-04-21	NSN Q95L5E3PR6RK	EXTRA US Senate reaches deal on new stimulus worth 480 billion dollars
2020-04-21	NSN Q95PCMAA7G8Z	Senate passes $484 billion interim coronavirus funding bill
2020-04-21	NSN Q95RCB3HBS3K	Senate Passes $484 Billion Bill That Would Expand Small Business Aid, Boost Money for Hospitals And Testing
2020-04-21	NSN Q93ZESDWRGG4	Manu Raju: As part of the $25 billion for testing in emerging deal, Democrats want a national testing strategy just as Trump
2020-04-21	NSN Q95PYRALADJ5	Senate Passes $484 Billion Interim Relief Package. Here's What's In It—And What's Missing
2020-04-21	NSN Q95PLU3PR6RK	EXTRA Senate passes 484-billion-dollar additional coronavirus stimulus
2020-04-21	NSN Q95P6ADWLU6U	Senate Passes $484 Billion Interim Economic Stimulus Package
2020-04-21	NSN Q95PJM3V2800	Senate Approves $500B Virus Aid Deal; Sends to House
2020-04-21	NSN Q95JCW073NCW	U.S. Congress, White House agree on nearly $500 billion more coronavirus bailout
2020-04-21	NSN Q95O823V2800	Congress, Trump Reach $500B Virus Aid Deal; Senate Debates
2020-04-21	NSN Q95I6J3V7U9S	Congress, Trump in Tentative Deal on $500B Virus Relief Bill
2020-04-21	NSN Q95RH53V7U9S	Senate Approves $500B Virus Aid Deal, Sends It to House
2020-04-21	NSN Q95PAIT0G1LH	*SENATE PASSES $484 BILLION FOR SMALL BUSINESS, HOSPITALS, TESTS
2020-04-21	NSN Q95JDD073NCW	U.S. coronavirus bill provides $321 bln for small business: aide
2020-04-27	NSN Q9GP3TDWX2PX	Coalition Seeks $150B for Clean Cars, Tax Credit Extension
2020-04-27	NSN Q9GBIMT0G1L1	Top Court Backs Insurers on $12 Billion Obamacare Payments (1)
2020-05-11	NSN QA4YTGDWX2PT	F-35's Image as $428 Billion Bundle of Flaws Improved by Fixes
2020-05-11	NSN QA6HX2T0G1KZ	Republicans Willing to Back $500 Billion Stimulus Bill: Menendez
2020-05-11	NSN QA6MFGDWRGG2	Some Republicans Open to $500B Aid; White House Requires Masks
2020-05-18	NSN QAJOQPDWX2PS	Treasury Has Spent Small Part of $500 Billion in Coronavirus Aid
2020-08-19	NSN QFAIJ3T0G1KW	Trump Team Sees Path to Pared-Down $500 Billion Stimulus Deal
2020-08-19	NSN QFBOO6T0G1L5	White House Open to $25 Billion for Postal Service, McEnany Says
2020-08-19	NSN QFBWM7DWX2PU	White House Open to $25 Billion for USPS; Harris Readies Speech
2020-09-28	NSN QHDZ86T0AFB4	Colleges Battling Covid Upsurge Seek $120 Billion as Costs Mount
2020-10-09	NSN RUQFWC0799MP	White House Preparing New $1.8 Trillion Stimulus Proposal–2nd Update
2020-10-21	NSN QIKD7TBUJSAO	Democrats block a $500 billion 'skinny' coronavirus aid bill identical to another that Republicans unveiled a month ago
2020-10-21	NSN QIK355DWLU6K	U.S. Sees Spending $10 Billion on Missile Defense Through 2025
2020-12-01	NSN QKNWM13HBS3K	Bipartisan Group of Senators Prepares $908 Billion Stimulus Plan, Aiming to Break Partisan Logjam
2020-12-01	NSN QKOJ7BBP8R2C	Mitch McConnell rejects bipartisan proposal by Senate moderates for $900 billion COVID relief package - day after accusing Nancy
2020-12-01	NSN QKO5Z40799MP	U.S. bipartisan lawmakers propose $908 billion COVID-19 relief bill
2020-12-01	NSN QKO8O8T0AFB7	Bipartisan Senate Group Pitching $908 Billion Stimulus Plan (3)

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Table A.2 – continued from previous page

Date	Link	Title
2020-12-01	NSN QKOJREDWX2Q2	Mnuchin Says Congress Must Redirect $455 Billion, Not Biden
2020-12-01	NSN QKOG8NT0G1KX	Senate GOP Relief Package Includes $332.7 Billion for PPP Plan
2021-01-13	NSN QMVYUST1UM16	Schumer Asks Biden to Seek More Than $1.3 Trillion in Relief (1)
2021-01-13	NSN QMVXHSDWLU6Q	Stocks Gain, Schumer Wants Stimulus North of $1.3T: Macro Squawk
2021-02-16	NSN QON00R3HBS3K	Focus on Capitol Hill Turns to Passing Biden's $1.9 Trillion Coronavirus Relief Bill
2021-02-16	NSN QOMZ213HBS3K	Focus on Capitol Hill Turns to Passing Biden's $1.9 Trillion Covid Relief Bill
2021-02-16	NSN QON3VJBUJSAV	Biden's $1.9 trillion stimulus plan is popular with voters, but it's crashing into strong Republican resistance in Congress
2021-02-22	NSN QOXYJVBP8R29	Midday Report: Most US Stocks Fall While Copper Hits Decade High; $1.9 Trillion Stimulus to Reach House of Representatives
2021-02-22	NSN QOXZPQBP8R2B	Most US Stocks Fall While Copper Hits Decade High; $1.9 Trillion Stimulus to Reach House of Representatives Shortly
2021-02-22	NSN QOXG5PDWX2PU	Biden Stimulus Dash; M&T's $7.6b Deal: N.A. Financials Premarket
2021-02-22	NSN QOXRJO0799MQ	$1.9T plan a 'bailout for lockdowns' Top GOPer rips COV bill
2021-02-22	NSN QOS5DFT1UM0W	Biden's $1.9 Trillion Stimulus Plan Enters 3-Week Congress Dash
2021-05-19	NSN QTD99FHTXJ40	The Senate is weighing a bill that would invest $120 billion in technology research to counter China.
2021-05-19	NSN QTBW5BHTXJ40	Senate Weighs Investing $120 Billion in Science to Counter China
2021-05-19	NSN QTBNW5T1UM0W	Senate China Bill to Add $52 Billion for U.S. Chip Making (1)
2021-05-19	NSN QTBS18073NCW	Senate Democrat proposes $52 billion for U.S. chips production, R
2021-05-19	NSN QTD0D4DWX2PX	GOP's $400 Billion Highway Bill Focuses on 'Core Infrastructure'
2021-05-26	NSN QTOG9HT0G1KZ	Bipartisan $304b Highway Bill Advanced by Senate Panel
2021-05-26	NSN QTPNWLDWRGGD	Biden's American Jobs Plan Will Include $318 Billion for Housing
2021-06-22	NSN QV4EA6DWLU7L	Biden's $6.5 Billion Biomedical Agency Backed in Bipartisan Bill (1)
2021-06-22	NSN QV469DDWRGG6	Biden's $6.5 Billion Biomedical Agency Backed in Bipartisan Bill
2021-06-22	NSN QV4DBSDWLU6L	Warren Leads Letter Seeking $700B for Child-Care Infrastructure
2021-07-12	NSN QW4MHEDWLU76	Biden's $579 Billion Plan Is a Tiny Step in the Right Direction
2021-08-09	NSN QXL7OXDWLU6T	Democrats Unveil $3.5 Trillion Budget Plan; Crypto Deal Reached
2021-08-09	NSN QXKRBHT0AFB9	Democrats Release Budget Enabling Biden's $3.5 Trillion Plan (2)
2021-08-10	NSN QXMS1WT0G1KW	*SWEEPING $550 BILLION INFRASTRUCTURE BILL PASSES U.S. SENATE
2021-08-10	NSN QXMAC7DWLU6P	Senate Poised to Pass $550 Billion Infrastructure Bill (Video)
2021-08-10	NSN QXMT7NT1UM0W	Senate Passes $550 Billion Infrastructure Plan in Win for Biden
2021-08-10	NSN QXMVVH073NCW	U.S. senate passes $550 billion infrastructure bill that could unleash biggest burst of spending in decades
2021-08-10	NSN QXMYY56QRTHC	Senate Approves Bipartisan, $1 Trillion Infrastructure Bill, Bringing Major Biden Goal One Step Closer
2021-08-10	NSN QXN38Q0799MO	Treasury yields end higher as Senate passes $1 trillion bipartisan infrastructure bill
2021-08-10	NSN QXMWQ1T0G1KW	Senate Passes $550 Billion Infrastructure Bill (Video)
2021-08-30	NSN QYNZR1T0G1L3	Top Defense Republican to Propose $25 Billion Pentagon Boost
2021-08-30	NSN QYO6SUT0G1KZ	Democrats Pressured to Add $10 Billion to Transit in Budget Bill
2021-08-30	NSN QYO2QJ073NCW	Groups, mayors urge U.S. Congress to back $10 billion in new public transit funding
2021-08-30	NSN QYNR2TDWLU70	Modeling Impact of $4 Trillion Fiscal Stimulus on U.S. Outlook
2021-09-10	NSN QZ8MLUT0G1KW	Senators Push for $6 Billion Bailout for Private Bus Industry
2021-09-10	NSN QZ7QPCDWRGG5	ENERGY BRIEFING: House Panel Readies $150B Clean Energy Plan
2021-09-10	NSN QZ8FS5T0G1KY	Extra $28 Billion to Appease Farms Promised in Full Budget Bill
2021-10-27	NSN R1LUGWT0AFBD	Democrats Near Deal on $500 Billion to Fight Climate Change (1)
2021-11-09	NSN R2B2NCDWLU6V	BI's Companies to Watch in Biden's $1.2T Infrastructure Bill
2021-12-06	NSN R3PTNL33O5C0	Senate Revs Up Work on $2 Trillion Spending Proposal, Aiming to Complete Vote on Biden-backed Bill Before Christmas
2021-12-07	NSN R3QZCKT1UM0Y	U.S. to Spend $11b in 3yrs to Fight Global Malnutrition: Blinken
2021-12-07	NSN R3RLTWA30ZR4	House Prepares to Pass $768 Billion Defense Policy Bill

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Table A.2 – continued from previous page

Date	Link	Title
2021-12-08	NSN R3RORKT0G1KW	House Passes Defense Policy Bill With $25 Billion Funding Boost
2021-12-08	NSN R3S0EU073NCW	House Approves $778 Billion Defense Bill – Update
2021-12-08	NSN R3TA7Y073NCX	U.S. Likely Ran A $193 Billion Deficit In November Versus $145 Billion A Year Earlier, CBO Says – MarketWatch
2021-12-08	NSN R3RT50A30ZR4	House Prepares to Pass $768 Billion Defense Policy Bill
2021-12-08	NSN R3RPQ26QRTHC	Congress Strikes Compromise on $768 Billion Defense Bill, But Key Omissions Prompt Fury Among Some Democrats
2021-12-08	NSN R3RRTODTVIF8	House Set to Pass $768 Billion Bill Providing Big Boost to
2021-12-08	NSN R3S08JA30ZR4	House Passes $768 Billion Defense Policy Bill
2021-12-08	NSN R3SNHQ6QRTHC	House Approves $768 Billion Defense Bill With Strong Support, Despite Some Discord Among Democrats
2021-12-20	NSN R4EA3EB2RNYA	Elon Musk says he will pay over $11 billion in taxes this year
2021-12-20	NSN R4EW0MDWLU6P	Infrastructure Funds Contract Spending Can't Exceed $125 Billion
2021-12-20	NSN R4F1F1BJXPU7	Elon Musk said he'll pay more than $11 billion in taxes this
2021-12-27	NSN R4S82QDWRGG0	Biden Signs $768.2 Billion Annual Defense Policy Bill
2021-12-27	NSN R4SOQVA30ZR4	Biden Signs $770 Billion Defense Bill
2022-01-03	NSN R55GL0DWRGG0	USTs Hold Losses After Early Slide; IG Slate Kicks Off With $11b
2022-02-09	NSN R70NFC6QRTHC	House Republicans And Democrats Agree on $57 Billion USPS Overhaul
2022-03-14	NSN R8QBM0DWX2PT	BGOV OnPoint: Congress Clears $1.5 Trillion Fiscal 2022 Omnibus
2022-03-14	NSN R8QHCKT0AFBE	Where Did $6 Trillion in Covid Funding Actually Go?: Editorial
2022-04-04	NSN R9TV5VBP8R2E	Democrat and Republican lawmakers reach a DEAL for an extra $10billion extra in funding for the US COVID response - without the
2022-04-04	NSN R9SX0U073NCW	U.S. News: Lawmakers Aim to Get $10 Billion Covid Deal
2022-04-04	NSN R9TS6C073NCW	Congressional Negotiators Settle on $10 Billion for Covid Tests, Treatments – WSJ
2022-04-04	NSN R9U40X073NCX	Congressional Negotiators Settle on $10 Billion for Covid-19 Tests, Treatments – 2nd Update
2022-04-04	NSN R9TTNV073NCX	Congressional Negotiators Settle on $10 Billion for Covid Tests, Treatments – Update
2022-04-04	NSN R9SY8W073NCX	Lawmakers Aim to Get $10 Billion Covid Deal – WSJ
2022-04-04	NSN R9U3ICALADJ8	Senate Reaches A Deal On $10 Billion Pandemic Response Package. Here's What's In It.
2022-04-04	NSN R9U13FDWLU70	Senate Reaches Deal on $10 Billion Covid Bill Without Global Aid
2022-04-04	NSN R9TPZJT1UM0X	Feds' Annual Climate Tab May Near $128 Billion, White House Says
2022-04-04	NSN R9U3RWAA7G8Y	Senators reach deal on bipartisan $10 billion COVID package
2022-04-04	NSN R9U7GMDTVIF6	Senators Reach Deal on $10 Billion Covid Aid Package
2022-04-25	NSN RAWI16073NCW	The $67 Billion Tariff Dodge That's Undermining U.S. Trade Policy – WSJ

Table A.3. **U.S. Treasury Returns and Fiscal News**

Coefficient	Variable	(1)	Controlling for other news (2)	(3)	(4)
a	1	-0.54	-0.53	-1.10	-1.24
t-statistic		[-0.51]	[-0.45]	[-1.21]	[-1.35]
b	I_t	-3.56	-4.18	-5.54	-7.11
t-statistic		[-2.15]	[-1.84]	[-1.91]	[-1.55]
Observations		922	922	922	922
				Controls	
FOMC days		No	Yes	Yes	Yes
Large Macro News		No	No	Yes	Yes
Small Macro News		No	No	No	Yes
Number of Deficit Days in I_t		268	236	79	44

Notes: This table presents coefficient estimates from the regression: $\Delta b_t = a + b \cdot \mathrm{I}_t + \epsilon_t$, where Δb_t is the daily Treasury value change on day t, and I_t is an indicator variable equal to 1 for large deficit announcement days, 0 otherwise. Column 1 shows results without controls. Columns 2 to 4 progressively control for other news by setting $\mathrm{I}_t = 0$ on specific days: Column 2 excludes FOMC meeting days, Column 3 further excludes days with large macroeconomic news, and Column 4 excludes days with both large and small macroeconomic news. Macroeconomic news is categorized as large (small) when the absolute value of analysts' forecast errors exceeds (falls below) the rolling window median for each of the top 50 indicators. t-statistics in brackets use Newey-West standard errors with lag length $L = \left\lceil 1.3 \times T^{1/2} \right\rceil$. Sample period: February 28, 2020 to October 30, 2023.

Table A.4. **U.S. Treasury Returns: Robustness Results**

	Percentile threshold for classifying a large deficit day: 50%	40%	25%	10%	5%	1%
Deficit over GDP in %	-0.00	-0.01	-0.04	-0.27	-0.81	-5.77
Mean bps	-6.65	-5.39	-6.19	-7.81	-7.87	-20.67
t-statistic	[-2.84]	[-3.20]	[-3.02]	[-2.56]	[-2.15]	[-3.88]
p-value	(0.04)	(0.10)	(0.09)	(0.08)	(0.09)	(0.03)
Cumulative change in %	-5.25	-3.72	-3.28	-2.66	-2.20	-1.45
p-value	(0.04)	(0.10)	(0.09)	(0.08)	(0.09)	(0.03)
Observations	79	69	53	34	28	7

Notes: This table presents the average daily and cumulative changes in Treasury values on large deficit announcement days, with each column varying the percentile threshold for classifying a large deficit day from the 50th to the 1st percentile. To control for other news occurring on the same day as the large deficit announcements, we exclude large deficit days that overlap with FOMC meeting days and days with large news from macroeconomic announcements, defined as days when the absolute value of the analysts' forecast error exceeds its rolling window median for each of the top 50 macroeconomic indicators. t-statistics are in square brackets, and parentheses indicate the percentage of simulated Treasury value changes that fall below the actual realizations, based on 10,000 samples randomly selected without replacement of the number of observations in the actual sample for large deficit days. The sample period is from February 28, 2020, to October 30, 2023.

Table A.5. **U.S. Treasury Returns on CBO and Bloomberg News Days**

A. Large deficit days using CBO cost projections	Large deficit days (1)	Other days (2)	All days (3)
Mean bps	-7.15	-1.25	-1.58
t-statistic	-2.65	[-1.50]	[-1.98]
p-value	(0.06)	–	–
Cumulative change in %	-3.72	-10.83	-14.55
p-value	(0.06)	–	–
Observations	52	870	922

B. Large deficit days using Bloomberg news	Large deficit days (1)	Other days (2)	All days (3)
Mean bps	-8.40	-1.30	-1.58
t-statistic	[-3.12]	[-1.60]	[-1.98]
p-value	(0.06)	–	–
Cumulative change in %	-3.02	-11.53	-14.55
p-value	(0.06)	–	–
Observations	36	886	922

Notes: This table presents the average daily and cumulative changes in Treasury values across three sets of days: days with large deficit announcements (Column 1), days without large deficit announcements (Column 2), and all trading days (Column 3). Panel A uses CBO cost projections to select large deficit announcement days, while Panel B uses Bloomberg News to select large deficit announcement days. In Column 1 of both panels, we control for other news coinciding with large deficit announcements by excluding days that overlap with FOMC meetings and days with large macroeconomic news, defined as days when the absolute value of analysts' forecast errors exceeds the rolling window median for each of the top 50 macroeconomic indicators. *t*-statistics are in square brackets, and parentheses indicate the percentage of simulated Treasury value changes that fall below the actual realizations, based on 10,000 samples randomly selected without replacement of the number of observations in the actual sample for large deficit days. The sample period is from February 28, 2020, to October 30, 2023.