The Treasury Maturity Rule[*]

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Abstract

This paper studies how the U.S. Treasury manages debt maturity and how these decisions affect aggregate economic activity. We estimate a Treasury maturity rule and find that the Treasury systematically shortens debt maturity when economic activity weakens or borrowing needs increase. We then identify a debt maturity shock as the residual from this rule. An unexpected shift toward longer-term debt issuance contracts economic activity by raising long-term borrowing costs, which spill over to broader financial markets and tighten financial conditions. Debt maturity also shapes the transmission of fiscal policy: counterfactual analysis shows that financing government spending at longer maturities dampens its expansionary effects.

JEL classification: E44, E61, E62, E63, H63

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1. Introduction

The U.S. Treasury is responsible for financing roughly $40 trillion of outstanding federal debt. In doing so, it decides how government borrowing is allocated across maturities. This decision influences the government's borrowing costs and, ultimately, the tax burden required to finance public expenditures. Yet, despite its importance, relatively little is known about how the Treasury systematically chooses the maturity structure of public debt. Do Treasury officials adjust debt maturity in response to macroeconomic and financial conditions? If so, what policy rule governs these decisions? And beyond its effect on government borrowing costs, does the maturity structure of public debt affect aggregate economic activity?

To answer these questions, we begin by studying the Treasury's policymaking process. Treasury debt managers consult quarterly with the Treasury Borrowing Advisory Committee (TBAC), a group of private-sector market participants that advises the Treasury on debt management. We collect and analyze policy documents produced throughout the quarterly refunding process to identify the considerations underlying maturity decisions. Our analysis of these documents shows that macroeconomic and financial conditions feature prominently in Treasury debt-management deliberations.

Guided by this evidence, we specify a Treasury maturity rule relating debt maturity decisions to the yield curve slope, economic activity, and borrowing needs. We measure debt maturity using the weighted average maturity (WAM) of outstanding marketable Treasury securities, defined as the average remaining maturity weighted by their face value. We find that the Treasury systematically shortens debt maturity when economic activity weakens or borrowing needs increase, while the yield curve slope carries little explanatory power. We corroborate this result using identified financial and monetary policy shocks that weaken activity and raise public debt. Across specifications, WAM declines following these shocks, consistent with the estimated maturity rule.

We then rationalize the estimated maturity rule as the outcome of optimal debt management. In the model, the Treasury minimizes borrowing costs while recognizing that short- and long-term debt differ in their price impact. The model predicts the estimated maturity rule: the Treasury shortens debt maturity when economic activity weakens or borrowing needs increase. Intuitively, bills are the least disruptive instrument for meeting additional financing needs, and their advantage grows during downturns as long-term bond prices become more sensitive to new issuance. Narrative evidence from Treasury policy documents supports this mechanism. Treasury officials repeatedly describe Treasury bills as the government's "issuance shock absorber" because their issuance has the smallest impact on prices.

We next turn to the macroeconomic consequences of Treasury maturity decisions. Doing so requires isolating unexpected changes in debt maturity from the Treasury's systematic response to macroeconomic conditions. Following the monetary policy literature, we identify these unexpected changes using the residual from the estimated Treasury maturity rule. This approach, however, is only valid if the rule adequately captures the information set available to Treasury officials. Otherwise, the residual may still reflect endogenous responses to omitted information rather than genuine policy shocks.

To address this concern, we follow Aruoba and Drechsel (2026) and augment the rule with the Treasury's information set. In addition to our baseline variables, we include public surveys closely monitored by Treasury officials, sentiment indices constructed from Treasury policy documents, and indicator variables capturing the seasonal pattern of borrowing needs and debt ceiling episodes. Because this richer information set contains many predictors, we estimate the rule using ridge regression, a penalized least-squares estimator. The resulting specification increases the share of explained variation in WAM from 74% to 89%. Importantly, the estimated responses to output and debt growth remain virtually unchanged. Thus, although the Treasury's true decision rule is likely more complex than our parsimonious specification, its central relationship with macroeconomic conditions proves remarkably robust.

We interpret the residual from this augmented policy rule as a debt maturity shock and estimate its dynamic effects using local projections. A one standard deviation shock persistently raises WAM by about one month and produces a sustained contraction in economic activity. Real GDP gradually declines, remaining roughly 0.5% below trend five years after the shock, while prices follow a similar path. As economic activity weakens, the Federal Reserve responds by lowering the policy rate, although only with a delay once the contraction has materialized.

The contraction operates through a tightening of financial conditions. A larger-than-expected shift toward longer-term issuance raises long-term Treasury yields, and, as a result, the yield curve slope. These increases pass through almost one-for-one to corporate borrowing costs and mortgage rates, leading investment and consumption to contract. At their trough, real investment and consumption lie about 2% and 0.5% below trend, respectively.

Importantly, our shock changes the maturity composition of public debt while leaving the total amount of debt outstanding unchanged. The rise in WAM is implemented primarily by replacing Treasury bills with long-term securities, while total debt and government consumption remain unchanged in the short run. This pattern helps distinguish an unexpected change in debt maturity from news about a broader fiscal expansion.

We conclude by studying how the maturity structure shapes the transmission of fiscal policy. We first estimate the macroeconomic effects of identified government spending shocks. We then construct counterfactual paths for output, debt, and WAM under an alternative Treasury maturity rule. Our analysis reveals that maturity policy materially alters the effects of government spending shocks. A counterfactual in which the Treasury borrows at longer maturities than in the baseline substantially dampens the expansionary effects of higher government spending. The effects of higher government spending therefore depend in part on the maturity of the debt issued to finance it.

Literature review. The paper contributes to the long-standing literature on optimal debt management (Lucas and Stokey, 1983; Angeletos, 2002; Greenwood, Hanson, and Stein, 2015; Belton et al., 2018; Faraglia et al., 2019; Bigio, Nuño, and Passadore, 2023). While much of the prior work is theoretical, our contribution is empirical in nature: we document how Treasury issuance adjusts systematically over the business cycle. We show that the Treasury tilts debt maturity in response to output and borrowing needs, while the term premium plays little role. We further develop a model of optimal debt management in which short- and long-term debt differ in their price impact, following Bigio, Nuño, and Passadore (2023). The model delivers the estimated policy rule and highlights a novel mechanism: shocks to economic activity affect debt maturity not only through borrowing needs but also by changing the relative price impact of short- and long-term issuance.

We also connect to the literature on estimating policy rules. This literature has primarily focused on the Federal Reserve's reaction function—commonly referred to as the Taylor rule (Taylor, 1993). It has employed a range of estimation methods, from ordinary least squares (Carvalho, Nechio, and Tristao, 2021; Nakamura, Steinsson, and Riblier, 2025) to instrumental variables (Clarida, Gali, and Gertler, 2000), while generally reaching similar conclusions (Ferrara and Zanotti, 2025). We apply many of the insights from this literature to a new setting, providing a parsimonious characterization of the Treasury maturity rule.

Building on the literature that estimates the Taylor rule, a related strand of research identifies monetary policy shocks as the residual from the estimated policy rule, beginning with the seminal contribution of Christiano, Eichenbaum, and Evans (1999). A central challenge in this literature is accurately capturing the policymaker's information set. To address this issue, researchers have augmented the Federal Reserve's information set using both the central bank's own forecasts (Romer and Romer, 2004; Romer and Romer,

2023) and sentiment indicators extracted from FOMC policy documents (Aruoba and Drechsel, 2026). We adapt these insights to the Treasury setting by constructing a novel dataset of Treasury policy documents and extracting sentiment indicators that summarize Treasury officials' assessment of economic conditions.

Finally, we contribute to the growing literature on the macroeconomic and financial effects of Treasury policy. Recent work has shown that changes in the quantity of public debt issued affect financial markets and the macroeconomy (Phillot, 2025; Houtz, 2025; Endo et al., 2026). Relatedly, a number of recent papers study shocks to the maturity composition of public debt while holding its overall level fixed. In particular, Mustafi (2025) and Bi, Phillot, and Zubairy (2025) identify maturity shocks using high-frequency movements in Treasury futures prices around issuance announcements.

As discussed in these papers, announcement-based shocks may partly capture a signaling channel, whereby longer-term issuance conveys favorable information about future fiscal conditions, which stimulates economic activity. Our identification strategy instead isolates unexpected changes in debt maturity that abstract from this channel. Consistent with this distinction, we find that a shift toward longer-term debt leaves government spending essentially unchanged and contracts economic activity. Our results are also consistent with Hubert de Fraisse (2024), who shows that plausibly exogenous legislative changes toward longer debt maturity crowd out long-term investment.

Outline. The remainder of the paper is organized as follows. Section 2 describes the Treasury's policymaking process. Section 3 estimates the Treasury maturity rule. Section 4 identifies the debt maturity shock as the residual from the estimated rule and studies its macroeconomic effects. Section 5 examines how debt maturity shapes the transmission of fiscal policy through policy counterfactuals. Section 6 concludes.

2. Treasury Policy: Institutional Background

In this section, we first describe the institutional background related to Treasury policy. We next examine Treasury policy documents to understand the information debt managers consider when making issuance decisions. Text data reveals that Treasury officials closely monitor both macroeconomic and financial conditions.

2.1. Debt Management Policy

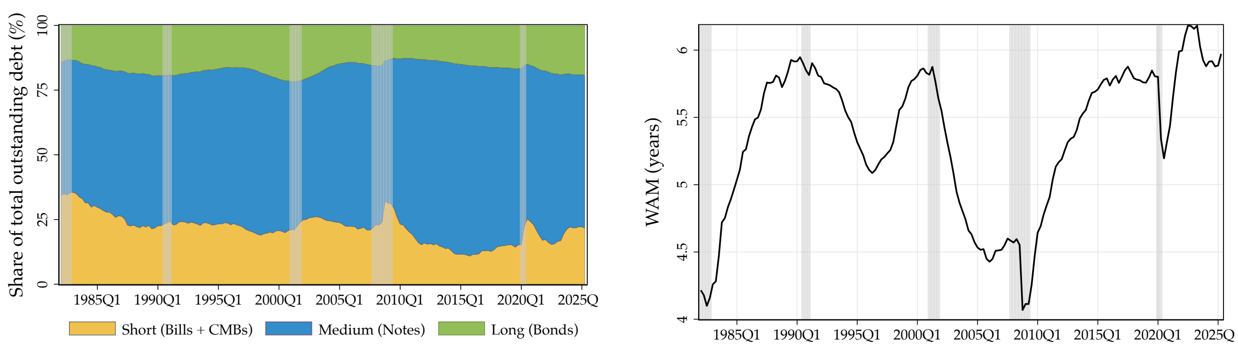
Debt management concerns how the Treasury meets the government's financing needs. Spending and taxation decisions made by Congress largely determine the primary deficit, while maturing obligations generate refinancing needs. Taking these requirements as given, the Treasury decides: (i) how much debt to offer at each auction, and (ii) how to allocate issuance across bills, notes, and bonds of different maturities. We focus on the latter decision: the maturity composition of issuance.

The Treasury's stated objective is to finance the government at the lowest cost over time. Maturity choice involves a cost-risk trade-off. Short-term securities are generally cheaper but expose the government to more risk. Longer-term securities reduce these risks but typically require higher yields. The Treasury manages this trade-off within a "regular and predictable" issuance framework rather than attempting to time short-run movements in yields. Regular auction schedules reduce uncertainty for investors and thereby help lower borrowing costs over time (Gensler, 1998; Fisher, 2002). Regularity does not, however, imply a fixed maturity composition.

Figure 1a shows the maturity composition of outstanding marketable Treasury debt. Notes account for the largest share throughout the sample, but the relative importance of bills and bonds varies substantially over time. In particular, the share of bills rises sharply during the Global Financial Crisis and the Covid-19 pandemic before gradually receding.

Figure 1: Maturity Composition of U.S. Treasury Debt

(a) Composition of Outstanding Debt (b) Weighted Average Maturity



Notes: Panel (a) reports the shares of marketable Treasury debt accounted for by short-term securities (bills and cash-management bills), medium-term securities (notes, floating-rate notes, and corresponding inflation-protected securities), and long-term securities (bonds and corresponding inflation-protected securities). Panel (b) reports the quarterly average of the weighted average maturity (WAM) of outstanding marketable Treasury debt. Shaded areas denote NBER recessions. The sample spans 1982:Q1 to 2025:Q2.

We summarize these shifts using the weighted average maturity (WAM) of outstanding debt. On date t,

$$\text{WAM}_t = \frac{\sum_i FV_{i,t} M_{i,t}}{\sum_i FV_{i,t}}, \tag{1}$$

where $FV_{i,t}$ is the face value of security i outstanding on date t and $M_{i,t}$ is its remaining time to maturity. Figure 1b plots the average WAM over each quarter. WAM falls sharply during the Global Financial Crisis and the Covid-19 pandemic, consistent with the temporary shifts toward bills shown in Figure 1a. It subsequently recovers as the share of bills declines. To understand the policy decisions driving these movements, we next describe the quarterly refunding process.

2.2. Institutional Process

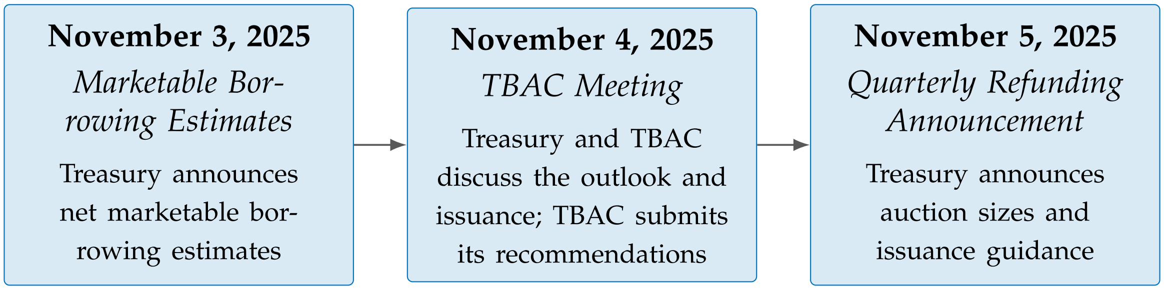
The Treasury develops its issuance strategy through the quarterly refunding process and implements it through Treasury auctions. As part of each refunding, the Treasury first estimates its privately held net marketable borrowing needs for the current and subsequent quarters. It also consults primary dealers and other market participants on the outlook for borrowing and issuance. These inputs inform how the Treasury distributes issuance across maturities.

A central part of this process is the consultation with the *Treasury Borrowing Advisory Committee* (TBAC), a federal advisory committee comprising senior representatives from buy- and sell-side financial institutions. At each quarterly meeting, Treasury officials present the government's borrowing outlook and pose specific questions related to debt management. Committee members assess the macroeconomic outlook and financial-market conditions and recommend how issuance should be allocated across maturities. The committee summarizes its recommendations in a formal report to the Secretary of the Treasury. Although formally advisory, these recommendations are typically reflected in the issuance strategy subsequently announced by the Treasury.

Following these consultations, the Treasury communicates its issuance strategy through the *Quarterly Refunding Announcement* (QRA). The announcement specifies the sizes and dates of the 3-, 10-, and 30-year auctions that comprise the quarterly refunding and describes expected changes in the issuance of other securities over the coming quarter. Nominal coupons, Treasury Inflation-Protected Securities, and floating-rate notes generally follow regular auction schedules, whereas bill issuance is typically more flexible, allowing the Treasury to accommodate changes in near-term borrowing needs. Figure 2 illustrates the timing of this process for the November 2025 refunding.

The main decisions about the maturity composition of issuance are made at the quarterly refunding and implemented through individual auctions over the quarter. We there-

Figure 2: Timeline of the Quarterly Refunding Process, November 2025



fore measure WAM at the quarterly frequency, averaging its daily value within each quarter. This measure helps us capture the implementation of the Treasury's overall maturity strategy rather than changes associated with any individual auction.

2.3. Treasury Deliberations: Evidence from Text Data

To understand the considerations underlying the Treasury's quarterly issuance decisions, we collect and digitize three sets of documents from the Treasury's Quarterly Refunding Archives. These documents contain the economic assessments, policy discussions, and recommendations produced as part of each refunding. We use them to identify the factors that recur in these deliberations and to motivate the specification of the maturity rule in Section 3.1.

Documents. Our corpus combines three complementary sources. The *Economic Policy Statements*, prepared by the Treasury's Office of Economic Policy, assess current and projected macroeconomic and fiscal conditions. The *TBAC Meeting Minutes* record the discussion between Treasury officials and committee members, while the *Reports to the Secretary* set out TBAC's formal recommendations on auction sizes and the maturity composition of issuance. The corpus contains 399 documents: 174 reports covering 1982:Q1–2025:Q4, 137 minutes covering 1991:Q4–2025:Q4, and 88 economic statements covering 2004:Q1–2025:Q4.[1] We provide more information regarding the text data in Appendix A.2

Dictionaries. Following Aruoba and Drechsel (2026), we process the documents to identify economic concepts that appear most frequently in the quarterly refunding discus-

[1]Reports are unavailable on the official website for 1985:Q4 and 1987:Q3. TBAC minutes provide the most direct record of quarterly discussions, but they are relatively brief and available only from 1991:Q4. Pooling the three sources extends the sample back to 1982:Q1 and, when all three are available, increases the median amount of text per quarter from about 1,400 to 5,000 words. Our results are unchanged when we construct the text measures using only TBAC minutes.

sions. After removing stop words, we extract all unigrams, bigrams, and trigrams and rank them by their frequency across the corpus. Moving down this ranking, we retain expressions that have a clear economic interpretation. Figure 3 displays the most frequently mentioned concepts identified by this procedure.

Figure 3: Topics Discussed in Quarterly Refunding Documents

Notes: This figure displays the 300 most frequent economic terms in the quarterly refunding documents. Word size is proportional to the frequency of each term across the full corpus.

The documents devote substantial attention to the government's financing needs, economic activity, and financial-market conditions. In the next section, we represent these considerations parsimoniously using debt growth, real GDP growth, and the yield-curve slope, respectively, in a Treasury maturity rule. The documents also contain extensive discussion of inflation, monetary policy, labor-market conditions, housing, and market liquidity. We use this broader textual information when constructing the expanded Treasury information set in Section 4.

3. Empirical Evidence on the Treasury Maturity Rule

Guided by the evidence presented in the previous section, we estimate the Treasury's reaction function. We find that the Treasury systematically shortens the maturity structure of public debt when economic activity weakens or borrowing needs increase. We then present a simple model of optimal debt management that rationalizes these findings. Finally, we corroborate the empirical and theoretical analysis with evidence from Treasury policy documents. These documents consistently describe Treasury bills as a shock absorber, providing a narrative foundation for the Treasury's observed tendency to shift issuance toward shorter maturities in response to adverse macroeconomic conditions.

3.1. Estimation of the Treasury Maturity Rule

The evidence presented in Section 2.3 shows that, before each quarterly refunding decision, the Treasury assesses its borrowing needs together with prevailing macroeconomic and financial conditions before determining the maturity composition of its issuance. Our objective in this section is to estimate the Treasury's reaction function.

Formally, we estimate the following Treasury maturity rule at the quarterly frequency:

$$\Delta\mathrm{WAM}_t = \alpha + \gamma_r r_t^{slope} + \gamma_d D_t + \gamma_y y_t + \mathbf{\Gamma}'\mathbf{X}_{t-p} + \varepsilon_t^{wam}, \tag{2}$$

where $\Delta\mathrm{WAM}_t$ denotes the change in the weighted average maturity of Treasury debt from quarter $t-1$ to quarter t, r_t^{slope} is the yield curve slope measured as the spread between the 10-year and 2-year Treasury yields, D_t is the growth rate of outstanding real public debt, and y_t is the growth rate of real GDP. $\mathbf{X}_{t-p}$ includes two lags of the dependent variable and all regressors. The estimation sample spans 1982:Q1 to 2024:Q4. We report heteroskedasticity-robust standard errors following the lag-augmentation approach of Montiel Olea and Plagborg-Møller (2021).[2] Detailed information on the data, including sources, is provided in Appendix A.1.

Table 1 reports the maturity rule. First, the coefficient on the yield curve slope is statistically indistinguishable from zero across all specifications. This finding is consistent with Treasury's stated policy. As Assistant Secretary Brian Roseboro explained, "Treasury does not time the market. We never have [...] We don't even take the yield curve into account when we allocate how much to raise by different maturities" (Roseboro, 2002). More recently, TBAC advised that "Treasury should prioritize being *regular and predictable* rather than timing shorter-term moves in term premia" (TBAC, 2024a). This commitment to regular and predictable issuance helps explain why the yield curve slope plays little role in the estimated maturity rule.

Second, stronger economic growth is associated with maturity lengthening: a one percentage-point increase in real GDP growth is associated with an increase of 0.147 months, or 4.4 days, in the quarterly change in WAM. Third, higher borrowing needs are associated with maturity shortening: an equivalent increase in real public debt growth is associated with a decrease of 0.336 months, or 10.1 days, in the quarterly change in WAM. Interpreting changes in WAM as driven primarily by new issuance, these estimates imply that the Treasury shifts issuance toward longer maturities when output growth is stronger and toward shorter maturities when debt growth rises.

[2] In Table B.1, we conduct inference directly accounting for serial correlation in the residuals. Newey-West standard errors leave the results unchanged.

Table 1: Treasury Maturity Rule

ΔWAM_t	(1)	(2)	(3)	(4)
r_t^{slope}	-0.373	-0.109	0.072	
	(0.407)	(0.370)	(0.154)	
y_t		0.363^{***}	0.162^{***}	0.147^{**}
		(0.116)	(0.058)	(0.058)
D_t			-0.338^{***}	-0.336^{***}
			(0.032)	(0.034)
ρ	0.491^{***}	0.494^{***}	0.682^{***}	0.683^{***}
	(0.114)	(0.109)	(0.066)	(0.065)
N	172	172	172	172

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are the yield curve slope (r_t^{slope}), real GDP growth (y_t), and real public debt growth (D_t). Columns (1)–(3) add these regressors sequentially, while column (4) excludes the yield curve slope. All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Treating the estimated coefficients as causal requires an identifying assumption. Because we estimate Equation (2) using ordinary least squares, the error term must be orthogonal to the contemporaneous regressors. In economic terms, this requires that Treasury maturity decisions do not affect the growth rates of real public debt or output within the same quarter. Otherwise, the estimated coefficients would be subject to simultaneity bias. Under this assumption, the coefficients identify how the Treasury adjusts debt maturity in response to contemporaneous macroeconomic conditions.

This identifying restriction is analogous to the recursive (Cholesky) identification assumption, commonly employed in the monetary policy literature. Under this assumption, policy decisions are allowed to respond contemporaneously to macroeconomic conditions, while macroeconomic variables respond to policy only with a lag (Christiano, Eichenbaum, and Evans, 1999). Moreover, the literature estimating Taylor rules has shown that any simultaneity bias arising from ordinary least squares estimation is quantitatively small, yielding estimates that are nearly identical to those obtained using instrumental variables (Carvalho, Nechio, and Tristao, 2021; Ferrara and Zanotti, 2025). The intuition is that monetary policy shocks—that is, the residual component of the policy rule—account for only a small fraction of business cycle fluctuations. As a result, the correlation between the regression residual and the included regressors is negligible, implying little bias in OLS estimates. We apply the same reasoning to Treasury maturity policy.

Robustness. Table 1 shows that output and debt growth are important predictors of the maturity structure of public debt, whereas the slope of the yield curve has little explanatory power for the change in WAM. Accordingly, in the remainder of the paper, we take the specification without the yield curve slope as our baseline Treasury maturity rule:

$$\Delta \text{WAM}_t = \alpha + \gamma_d D_t + \gamma_y y_t + \mathbf{\Gamma}' \mathbf{X}_{t-p} + \varepsilon_t^{wam}. \tag{3}$$

As the dependent variable, our baseline Treasury maturity rule uses the change in WAM. Because WAM is a stock variable, the Treasury's influence over the maturity structure of public debt is more naturally captured by the composition of newly issued debt flows. We therefore use the first difference in WAM as a simple approximation for the maturity of new issuance. By contrast, the Taylor rule literature typically estimates the Federal Reserve's reaction function using the level of the federal funds rate as the dependent variable (see for example, Clarida, Gali, and Gertler, 2000; Nakamura, Steinsson, and Riblier, 2025, among others). To facilitate comparison with this literature, we re-estimate our maturity rule using the level of WAM. Table B.2 shows that our main results are robust to this alternative specification.

Given the strong persistence of macroeconomic time series, we further examine the sensitivity of our results to alternative lag structures. Table B.3 shows that both the statistical significance and the economic magnitudes of the estimated coefficients remain remarkably stable across specifications.

We also assess the robustness of our findings to alternative definitions of the key regressors. Table B.4 reports eight specifications that vary the measures of either economic activity or borrowing needs. Although the estimated coefficients differ in magnitude because the regressors are measured on different scales, the qualitative results remain unchanged: the estimated relationships are statistically robust, and the signs of the coefficients are consistent across specifications.

Our baseline sample spans 1982–2024, a period that includes episodes of exceptional financial market volatility, such as the early 1980s, as well as two severe but fundamentally different recessions: the Great Financial Crisis and the COVID-19 pandemic. It is therefore important to assess whether our results are driven by these extraordinary episodes or instead reflect a more general pattern of Treasury behavior. Table B.5 shows the latter. The Treasury systematically shortens the maturity structure of public debt in response to weaker economic activity and higher borrowing needs, and these relationships remain robust after excluding each of these episodes from the sample.

Informational sufficiency. The baseline Treasury maturity rule relates changes in WAM to economic activity and borrowing needs. While this relationship is robust across a variety of specifications, the Treasury may also condition its decisions on additional macroeconomic or financial variables. To the extent that these variables contain information beyond that embedded in output and debt growth, omitting them could bias our interpretation of the estimated rule.

To assess the informational sufficiency of our baseline specification, we sequentially augment the policy rule with one additional control. Specifically, we estimate:

$$\Delta \mathrm{WAM}_t = \alpha + \gamma_d D_t + \gamma_y y_t + \gamma_x x_t + \mathbf{\Gamma}' \mathbf{X}_{t-p} + \varepsilon_t^{wam}, \tag{4}$$

where x_t denotes the additional variable of interest and $\mathbf{X}_{t-p}$ includes two lags of all regressors, including x_t.

Table B.6 first considers measures of inflation and the monetary policy rate. While all specifications suggest a negative relationship between inflation and WAM, the estimated coefficients are neither statistically significant nor stable in magnitude across alternative measures. Likewise, the level of the short-term policy rate has little explanatory power for Treasury maturity decisions.

Tables B.7 and B.8 extend the analysis to broader financial variables. In Table B.7, we consider several measures of Treasury and corporate long-term yields, which proxy for borrowing costs in the economy. In Table B.8, we further consider reserve balances—which may offer a substitute for short-term Treasury securities—as well as stock prices, financial market volatility, and corporate credit spreads. None of these variables exhibit a statistically significant relationship with WAM. Moreover, the estimated coefficients on borrowing needs and economic activity remain remarkably stable across specifications.

Overall, these exercises indicate that the baseline Treasury maturity rule captures the main macroeconomic determinants of maturity management. Although they do not imply that the Treasury conditions its decisions exclusively on output and borrowing needs, they show that the estimated relationship is both qualitatively and quantitatively robust to the inclusion of a broad set of macroeconomic and financial controls.

Exogeneity. Our baseline Treasury maturity rule is estimated by OLS. Interpreting the estimated coefficients as causal therefore requires the identifying assumption that output and debt growth do not respond contemporaneously to changes in WAM. To provide additional support for this interpretation, we complement the baseline analysis with an empirical exercise that is largely free from endogeneity concerns. The idea is to examine the Treasury's response to identified macroeconomic shocks. To the extent that these shocks are exogenous innovations to macroeconomic and financial conditions, they allow us to trace the Treasury's reaction without endogeneity concerns.

Specifically, we study the response of WAM to identified shocks using local projections (Jordà, 2005). We estimate:

$$y_{t+h} = \alpha_h + \beta_h \hat{\varepsilon}_t + \mathbf{\Gamma}_h' \mathbf{X}_{t-p} + u_{t+h}, \tag{5}$$

where $\hat{\varepsilon}_t$ denotes an identified structural shock. The control vector includes four lags of the dependent variable, four lags of the shock, a linear trend, and NBER recession dummies. To account for serial correlation in several of the identified shock series, we also include four lags of $\hat{\varepsilon}_t$. We focus on shocks for which the joint responses of output and total debt imply a clear direction of adjustment in WAM under the estimated maturity rule.

Figure 4 reports the responses to an excess bond premium shock identified by Gilchrist and Zakrajšek (2012). In response to an exogenous tightening of financial conditions, real GDP gradually declines, remaining about 1% below trend for roughly five years before returning to its baseline. At the same time, total public debt rises substantially, reaching a peak of around 7%. Consistent with the evidence in Table 1, the Treasury responds by shortening the maturity structure of public debt.

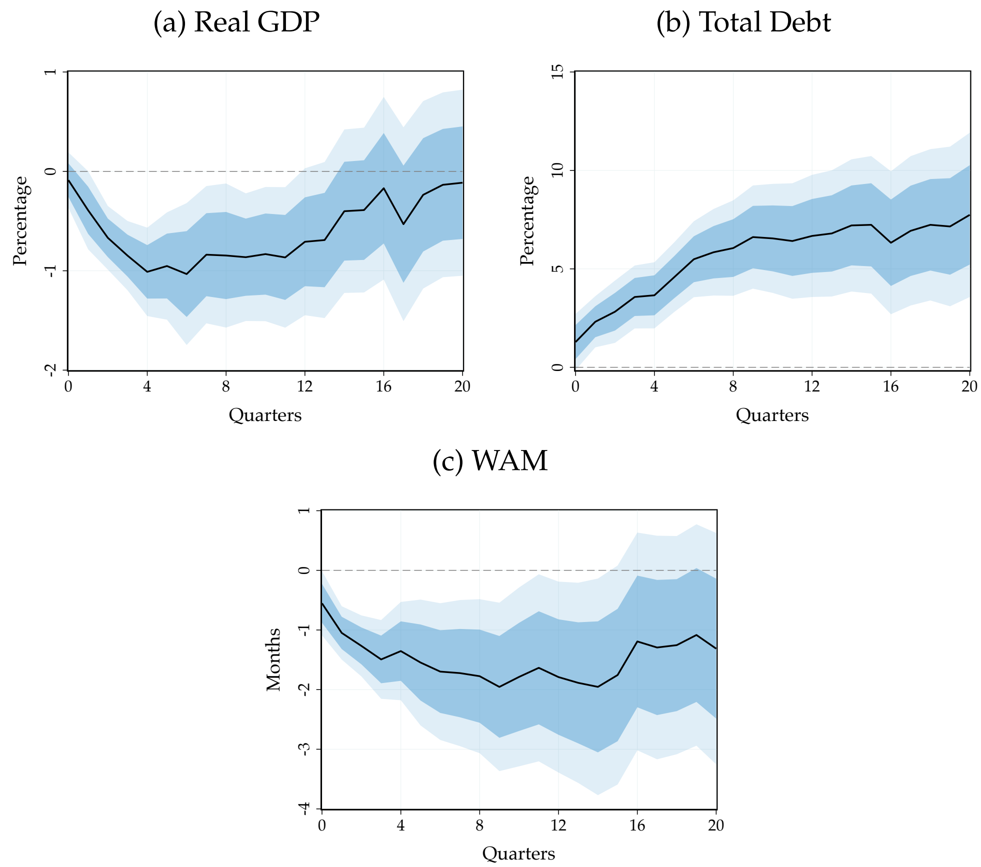
Figure B.1 confirms the same qualitative pattern when considering contractionary monetary policy shocks. Although the estimated responses are smaller in magnitude and less precisely estimated, the Treasury again responds by shortening the maturity structure of public debt. This behavior is consistent with the implications of the estimated policy rule: weaker economic activity and higher borrowing needs are associated with shorter debt maturities.

3.2. A Model to Rationalize the Rule

We now develop a model of optimal debt management that explains why the Treasury shortens debt maturity when borrowing needs rise or economic activity weakens. The model builds on Bigio, Nuño, and Passadore (2023), in which the government chooses issuance across maturities while internalizing its effect on auction prices. As in their framework, price impact of issuance varies by maturity and is larger at longer tenors.[3] We extend this framework by allowing price impact to vary with economic conditions,

[3] Faraglia et al. (2019) also incorporate liquidity costs into the government's debt-management problem.

Figure 4: Impulse Responses to a Positive Excess Bond Premium Shock



Notes: Impulse responses of real GDP, total debt, and WAM to a positive one standard deviation excess bond premium shock (Gilchrist and Zakrajšek, 2012). Responses are estimated using Equation (5). The sample spans 1982:Q1–2023:Q2, based on the availability of the shock series. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

with downturns producing a larger deterioration at longer maturities.[4]

The model delivers the empirical maturity rule through two mechanisms. First, when financing needs rise, the Treasury increases issuance across maturities but tilts toward the short end, where additional supply has the smallest price impact. Second, when economic activity weakens, the relative price impact of long-term issuance rises, inducing the Treasury to shift issuance toward shorter maturities. Both forces therefore lead the Treasury to shorten debt maturity. Appendix C provides the proofs and detailed derivations.

[4] Fleming (2003) shows that the price-impact differential between long- and short-term Treasury securities widened as economic activity weakened around the dot-com bust. Evidence presented in Treasury official Antonio Weiss's Senate testimony suggests a similar pattern around the global financial crisis: the differential was low before the recession, widened as the crisis unfolded, and remained elevated during the crisis (Weiss, 2016, p. 9).

3.2.1. Environment

Bond market. Maturities form a continuum from $\tau = 0$ to $\bar{\tau}$. Let $b(t,\tau)$ denote the face value of zero-coupon debt outstanding at time t with remaining maturity τ, and let $\iota(t,\tau)$ denote the rate of new issuance. Outstanding bonds age deterministically toward redemption, so the stock evolves as:

$$\frac{\partial b(t,\tau)}{\partial t} = \iota(t,\tau) + \frac{\partial b(t,\tau)}{\partial \tau}. \tag{6}$$

The second term is the aging of existing debt: absent new issuance, the profile shifts toward shorter maturities at unit speed. Total debt outstanding is $\mathcal{B}_t := \int_0^{\bar{\tau}} b(t,\tau)\, d\tau$.

The weighted average maturity is each bond's maturity weighted by its face value:

$$\mathrm{WAM}_t = \frac{\int_0^{\bar{\tau}} \tau\, b(t,\tau)\, d\tau}{\int_0^{\bar{\tau}} b(t,\tau)\, d\tau}, \tag{7}$$

the continuum analogue of Equation (1).

The outstanding stock of debt is predetermined, so a shock to issuance initially changes the rate at which WAM evolves rather than its level. Let $d\iota(t,\tau)$ denote the change in issuance induced by the shock and $d\,\dot{\mathrm{WAM}}$ the resulting change in the rate at which WAM evolves. Differentiating Equation (7) with respect to time and using the law of motion in Equation (6) gives the relationship between changes in issuance and the subsequent path of WAM:

$$d\,\dot{\mathrm{WAM}} = \underbrace{\left(\frac{\int_0^{\bar{\tau}} d\iota(t,\tau)\, d\tau}{\mathcal{B}}\right)}_{\substack{\text{issuance response relative} \\ \text{to the outstanding debt}}} \left(\underbrace{\frac{\int_0^{\bar{\tau}} \tau\, d\iota(t,\tau)\, d\tau}{\int_0^{\bar{\tau}} d\iota(t,\tau)\, d\tau}}_{\substack{\text{avg. maturity of} \\ \text{issuance response}}} - \underbrace{\mathrm{WAM}}_{\substack{\text{avg. maturity of} \\ \text{outstanding debt}}}\right). \tag{8}$$

Equation (8) decomposes the response of WAM into the size and maturity composition of the issuance response. The first term measures the change in issuance relative to the outstanding debt stock, while the second compares the average maturity of the additional issuance with the average maturity of outstanding debt. When the average maturity of additional issuance is shorter than the outstanding debt, WAM falls faster than it otherwise would. The effect is larger when the change in issuance is large relative to the outstanding stock.

Bonds of maturity τ have a price $q(\tau) = \exp(-\rho\tau)$ absent issuance impact, where $\rho > 0$ is a constant discount rate. The Treasury faces a downward-sloping demand for new issuance at each maturity: issuing $\iota(t,\tau)$ lowers the price received per unit to $q(\tau) - \frac{1}{2}\lambda(\tau)\iota(t,\tau)$. Issuance revenue is therefore $\big(q(\tau) - \frac{1}{2}\lambda(\tau)\iota(t,\tau)\big)\iota(t,\tau)$. Under this quadratic specification (Faraglia et al., 2019), marginal revenue is $q(\tau) - \lambda(\tau)\iota(t,\tau)$, so a larger $\lambda(\tau) > 0$ means that additional issuance reduces marginal revenue more sharply. We assume that $\lambda(\tau)$ increases with maturity, capturing the greater price impact of long-term issuance.[5]

The Treasury. Each period, the Treasury finances exogenous government spending, G_t, and maturing principal, $b(t,0)$, using taxes, T_t, and new issuance, $\iota(t,\tau)$. The cost of taxation, $u(T_t)$, is increasing and convex, and future tax costs are discounted at rate $\tilde{\rho}$. We assume that $\tilde{\rho} > \rho$, so the Treasury discounts future tax costs more heavily than investors discount future bond payments. As a result, the Treasury has an incentive to defer taxation through debt issuance. The Treasury chooses taxes and issuance across maturities to solve:

$$\min_{\{\iota(t,\tau),\, T_t\}_{t\geq 0}} \quad \int_0^\infty e^{-\tilde{\rho}t}\, u(T_t)\, dt \tag{9}$$

$$\text{s.t.} \quad T_t + \int_0^{\bar{\tau}} \left(q(\tau) - \frac{\lambda(\tau)}{2}\iota(t,\tau) \right) \iota(t,\tau) d\tau = G_t + b(t,0), \tag{10}$$

together with the law of motion in Equation (6).

3.2.2. Optimal Issuance Responses

We study two transitory shocks around the steady state. The first is an exogenous increase in G_t, which raises the Treasury's financing needs. This shock provides the model counterpart to an increase in debt growth, D_t, and rationalizes the estimated $\gamma_d < 0$ in Equation (3). The second is a deterioration in the price-impact schedule, $\lambda(\cdot)$, concentrated at the long end. This shock captures the tightening of financial conditions during downturns and provides the model counterpart to a decline in output growth, y_t, rationalizing the estimated $\gamma_y > 0$. We assume that both shocks are transitory, with G and $\lambda(\cdot)$ reverting to steady state more quickly than the maturity structure adjusts.

Funding shocks. Consider first a transitory increase in G_t. Because tax costs are convex, the Treasury meets the additional financing need through a combination of higher taxes

[5] Jiang, Richmond, and Zhang (2025) show that long-term Treasury convenience yields are more sensitive to changes in supply than short-term convenience yields. Similarly, Endo et al. (2026) find that their identified Treasury policy shock—corresponding to an unexpected increase in debt supply across the maturity spectrum—has minimal effects on short-term rates but raises rates at longer maturities.

and new issuance. Taxes rise by less than the increase in spending, with the remainder financed through additional issuance at every maturity:

$$\frac{d\iota(\tau)}{dG} \;\geq\; 0. \tag{11}$$

Because price impact increases with maturity, the Treasury tilts the additional issuance toward the short end, where debt can be placed without a large price concession. As Equation (8) shows, this response shortens WAM only if the average maturity of the additional issuance lies below that of the outstanding stock. However, the same price-impact schedule has also tilted past issuance toward the short end, leaving the outstanding stock shorter. An increasing $\lambda(\tau)$ therefore does not, by itself, ensure that the additional issuance is shorter than the outstanding stock. The following proposition provides sufficient conditions under which a rise in funding needs reduces WAM.

Proposition 1. *If $\bar{\tau} \to \infty$ and the function $\tau \mapsto 1/\lambda(\tau)$ is completely monotone, then:*

$$\frac{d\,\dot{\mathrm{WAM}}}{dG} < 0.$$

The condition that $\tau \mapsto 1/\lambda(\tau)$ be completely monotone is satisfied by a broad class of price-impact schedules. These include a constant schedule, the exponential schedule $\lambda_0 e^{g\tau}$ for any $g > 0$, and the power schedule $\lambda_0(1 + k\tau)^{\beta}$ for any $k > 0$ and $\beta > 0$. Under these schedules, the average maturity of the additional issuance lies below the WAM of the outstanding stock, so an increase in funding needs shortens the maturity structure.[6]

Price-impact shocks. We next consider a deterioration in the price-impact schedule, which provides the model counterpart to a decline in output. The idea is that downturns tighten financial conditions and make Treasury debt more costly to place, particularly at longer maturities. To formalize this channel, let $d\lambda(\tau)$ denote the increase in price impact at maturity τ. The resulting response of WAM can be decomposed into substitution and income effects:

$$d\,\dot{\mathrm{WAM}} = \underbrace{-\frac{1}{\mathcal{B}}\int_0^{\bar{\tau}} (\tau - \mathrm{WAM})\frac{\iota(\tau)}{\lambda(\tau)}\,d\lambda(\tau)\,d\tau}_{\text{substitution}} + \underbrace{\left(\int_0^{\bar{\tau}} \mathcal{T}(\tau)\,d\lambda(\tau)\,d\tau\right)\frac{d\,\dot{\mathrm{WAM}}}{dG}}_{\text{income}}, \tag{12}$$

where $\mathcal{T}(\tau) > 0$ is the the increase in financing needs generated by a unit deterioration in price impact at maturity τ, evaluated at the pre-shock issuance rate.

[6] This proposition is closely related to Proposition 4 of Bigio, Nuño, and Passadore (2023).

The first term captures substitution away from maturities at which the price impact has increased. An increase in price impact at the long end prompts the Treasury to issue shorter-term debt, whereas an increase at the short end shifts issuance toward longer maturities. We focus on the first case because, during downturns, price impact rises at longer maturities but remains comparatively stable at the short end. The second term captures the loss of issuance revenue generated by the deterioration in price impact. This loss increases the Treasury's financing needs by $\int \mathcal{T}\, d\lambda\, d\tau$ and therefore operates like a funding shock of the same size. When the deterioration is concentrated above the current WAM, the two channels reinforce each other. The following proposition formalizes this result.

Proposition 2. *Suppose the conditions of Proposition 1 hold. Let $d\lambda(\tau) \geq 0$ be supported on maturities above the current WAM. Then, both terms of Equation (12) are negative, and:*

$$d\,\dot{\mathrm{WAM}} < 0.$$

Together, the two propositions explain why the Treasury shortens the maturity structure when funding needs rise or economic activity weakens. Higher funding needs are met disproportionately through short-term issuance, where price impact is smaller. During downturns, a deterioration in price impact at long maturities reinforces this response through two channels: the Treasury substitutes away from long-term issuance, and the resulting loss of issuance revenue creates an additional funding need that is absorbed at the short end. In both cases, short-term debt serves as the primary margin of adjustment.

3.3. Narrative Evidence: Bills as Shock Absorbers

We documented that the Treasury systematically shortens the maturity structure of public debt when funding needs increase or economic activity weakens. The model presented in Section 3.2 rationalizes this behavior as the optimal response to shocks to funding needs or price impact at longer maturities. Because short-term issuance has a smaller price impact, the Treasury relies primarily on bills to absorb these shocks while keeping coupon issuance relatively stable. We now turn to narrative evidence from Treasury policy documents to assess whether this mechanism is consistent with the Treasury's own account of its debt-management strategy.

Both TBAC and Treasury officials describe bills as the primary margin of adjustment when financing needs change unexpectedly. In material prepared for its July 2024 meeting, TBAC characterizes T-bills as "critical shock absorbers" because adjusting their issuance allows the Treasury to respond to short-term funding surprises without making rapid and costly changes to coupon auction sizes (TBAC, 2024a). Assistant Secretary Joshua Frost similarly describes bills as the Treasury's "issuance shock absorber," explaining that adjusting their issuance has smaller effects on broader financial markets than changing coupon issuance (Frost, 2022).

The historical evidence illustrates how this principle operates in practice. TBAC reports that unexpected increases in borrowing needs during the Global Financial Crisis and the Covid-19 pandemic were met primarily through bill issuance, allowing coupon issuance to adjust more gradually (TBAC, 2024a). Likewise, in January 2024, primary dealers anticipated that lower SOMA redemptions would reduce the Treasury's privately held borrowing needs and be reflected primarily in lower bill issuance (TBAC, 2024b).

Together, these narrative accounts support our interpretation of Treasury maturity management. Bills provide a flexible margin through which the Treasury accommodates fluctuations in funding needs and issuance costs, while limiting market disruptions and preserving stable coupon issuance. This mechanism, formalized in our model, provides a natural explanation for the empirical evidence documented in Section 3.1.

4. Macroeconomic Effects of Maturity Shocks

We showed that the Treasury systematically adjusts the maturity structure of public debt in response to macroeconomic conditions. But does debt maturity, in turn, affect macroeconomic outcomes? Answering this question requires confronting a central empirical challenge: as the preceding analysis shows, maturity decisions are endogenous. We address this issue by isolating plausibly exogenous shocks to the maturity structure of debt from an estimated Treasury reaction function that conditions on the information available to policymakers. We then use these maturity shocks to trace the dynamic effects of an unanticipated change in debt maturity on financial conditions and output.

4.1. Identifying Maturity Shocks

Our objective is to distinguish shocks to debt maturity from the Treasury's systematic response to its information set. To do so, we apply the approach used to identify monetary policy shocks by Romer and Romer (2023) and Aruoba and Drechsel (2026) to the Treasury maturity rule estimated in Section 3.1. Let $\mathbf{X}_t$ collect the variables included in the baseline rule. We can write the rule as:

$$\Delta \text{WAM}_t = f\left(\mathbf{X}_t, \Delta \text{WAM}_{t-p}\right) + \varepsilon_t^{wam}, \tag{13}$$

where p denotes the number of lags and ε_t^{wam} is the component of the change in WAM not explained by the baseline rule.

The key identification concern is that the variables in the baseline maturity rule may fail capture the full set of information used by the Treasury. If the Treasury responds to omitted information that also predicts subsequent macroeconomic outcomes, the residual may combine maturity shocks with systematic maturity adjustments in response to that information. To address this concern, we augment the rule with forecasts $\mathbf{F}_t$, sentiment indicators $\mathbf{S}_t$ extracted from Treasury policy documents, seasonal indicators $\mathbf{s}_t$, and an indicator for debt-limit episodes d_t:

$$\Delta\text{WAM}_t = f\left(\mathbf{X}_t, \mathbf{F}_t, \mathbf{S}_t, \mathbf{s}_t, d_t, \Delta\text{WAM}_{t-p}\right) + \varepsilon_t^{wam}. \tag{14}$$

The forecasts consist of revisions from the Survey of Professional Forecasters at several horizons, while the text-based indicators summarize the quarterly change in the Treasury's assessment of macroeconomic and financial conditions. We align both sets of measures with the timing of Treasury decisions.[7] Detailed information on the data, including sources, is provided in Appendix A.1.

Because the augmented information set contains many, potentially correlated predictors, we estimate the rule using ridge regression, following Aruoba and Drechsel (2026). Table 2 compares the fit of the baseline rule with increasingly rich specifications. Adding extended forecasts, sentiment indicators, and seasonal controls raises the goodness-of-fit from 0.7427 to 0.8930, while adding the debt-limit indicator yields no further improvement. We therefore define the baseline maturity shock as the residual from the 150-regressor specification that includes macroeconomic variables, extended forecasts, sentiment indicators, and seasonal controls.[8] Figure D.1 shows the resulting shock series.

Properties of the maturity shock. Following Ramey (2016), we evaluate the shock series along three dimensions: serial correlation, forecastability, and correlation with other identified shocks. The maturity shock displays no serial correlation and is not forecastable using lagged macroeconomic or financial variables. It is also uncorrelated with commonly used measures of monetary, fiscal, and uncertainty shocks. Overall, this evidence supports the validity of the maturity shock series. The corresponding figures and tables can

[7] To align the information set with the timing of Treasury decisions and avoid look-ahead bias, we measure WAM_t as the quarterly average and use forecast revisions and sentiment data from the Treasury meeting in the preceding quarter.

[8] Relative to the OLS sample, six observations are unavailable because the underlying documents are missing in those quarters. To preserve the same sample, we set the shock to zero in these six quarters. This choice is immaterial for our results.

Table 2: Goodness of Fit across Maturity-Rule Specifications

Specification	# of regressors	Goodness-of-fit
(1) OLS: Macro	8	0.7427
(2) Ridge: Macro + F_t	38	0.7644
(3) Ridge: Macro + F_t + S_t	75	0.8559
(4) Ridge: Macro + ext. F_t	110	0.8531
(5) Ridge: Macro + ext. F_t + S_t	147	0.8915
(6) Ridge: Macro + ext. F_t + S_t + s_t	150	0.8930
(7) Ridge: Macro + ext. F_t + S_t + s_t + d_t	151	0.8921

Notes: This table reports the number of regressors and the goodness-of-fit for each specification. Goodness of fit is measured by the R^2 for (1) and by the deviance ratio for all subsequent rows. (1) includes the regressors in Equation (3). (2) adds a restricted set of forecast revisions from the Survey of Professional Forecasters (SPF), while (3) adds a restricted set of changes in sentiment. (4) expands the set of forecast revisions, and (5) includes the full set of changes in sentiment. (6) further adds seasonal dummies, while (7) includes an indicator equal to one if the debt ceiling is mentioned in the corresponding QRA.

be found in Appendix D.1-D.2.

In unreported results, we also examine the sensitivity of the shock to alternative measures of the Treasury's information set. In particular, we vary whether forecasts and sentiment indicators enter in levels or revisions, use mean rather than median forecasts, and sequentially exclude individual forecast variables, forecast horizons, and text-based indicators. The resulting shock series is stable across these choices, suggesting that it is not driven by any particular forecast measure or text-based indicator.

Augmented maturity rule. Before studying the macroeconomic effects of debt maturity shocks, we verify that the coefficients on output and debt growth is robust to the inclusion of a richer set of controls. Specifically, we estimate a Bayesian ridge regression that allows us to incorporate a large number of additional regressors, while preserving the coefficients of interest on output and debt growth. In practice, we estimate the coefficients on output and debt growth in Equation (3) by OLS, while applying ridge shrinkage to the remaining controls. Details of the procedure are provided in Appendix D.3.

Table 3 reports the results. Across the last three ridge specifications, the coefficient on output and debt growth is remarkably stable in both magnitude and statistical significance. Relative to the baseline specification in column (1), the coefficient on debt growth

Table 3: Augmented Treasury Maturity Rule

	OLS	Ridge Spec. (5)	Ridge Spec. (6)	Ridge Spec. (7)
y_t	0.147**	0.154***	0.155***	0.141***
	(0.058)	(0.025)	(0.024)	(0.024)
D_t	-0.336***	-0.410***	-0.415***	-0.422***
	(0.034)	(0.014)	(0.014)	(0.014)
ρ	0.683***	0.759***	0.788***	0.769***
	(0.065)	(0.036)	(0.036)	(0.039)
N	172	166	166	164
Penalized regressors	0	139	142	143
Unpenalized regressors	8	8	8	8

Notes: This table reports estimates of the augmented Treasury maturity rule using quarterly data. The dependent variable is $\Delta \mathrm{WAM}_t$. The regressors are real GDP growth (y_t) and real public debt growth (D_t). All specifications include two lags of $\Delta \mathrm{WAM}_t$ and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of $\Delta \mathrm{WAM}_t$. ridge specifications from Table 2 add penalized controls: forecast revisions and changes in sentiment in specification 5, seasonal dummies in specification 6, and debt-limit indicator in specification 7. For the OLS, heteroskedasticity-robust standard errors are reported. For the ridge, confidence bands are based on approximate posterior-normal standard errors conditional on the marginal-likelihood estimate of the ridge hyperparameter.

becomes somewhat more negative. The economic conclusion, however, is unchanged: even conditional on a substantially richer information set, weaker economic activity and greater borrowing needs are associated with a shorter maturity structure.

Taken together, these results suggest that, although the *true* Treasury maturity rule is likely more complex than the specification in Equation (3), the key economic relationship of WAM with output and debt growth are robust. Thus, while accounting for the broader information set is important for isolating the maturity shock, as we will show below, doing so does not overturn the findings presented in Section 3.

4.2. Empirical Specification and Main Results

We estimate the dynamic effects of maturity shocks using local projections (Jordà, 2005). For each outcome y_t and horizon h, we estimate:

$$y_{t+h} = \alpha_h + \beta_h \varepsilon_t^{wam} + \gamma_h' \mathbf{Z}_{t-p} + u_{t+h}, \tag{15}$$

where $\mathbf{Z}_{t-p}$ contains lags of the outcome, real GDP, and the price level. The baseline specification includes two lags and a linear trend and is estimated over 1982:Q1–2024:Q4. The coefficients β_h therefore trace the response of each outcome to an exogenous increase in the weighted average maturity. We report impulse responses normalized to a one standard deviation maturity shock and conduct inference following the lag-augmentation approach of Montiel Olea and Plagborg-Møller (2021).[9]

Macroeconomic effects. Figure 5 reports the baseline responses. A one standard deviation maturity shock raises WAM by about half a month on impact. The response builds over the following two years, peaks at roughly 1.2 months, and remains positive throughout the five-year horizon. The increase in maturity is contractionary. Real GDP begins to fall after about six quarters and is roughly 0.5 percent below its pre-shock level by three years. The price level declines gradually and by a similar magnitude. The joint decline in output and prices suggests that the maturity shock affects the economy primarily by contracting aggregate demand.

The one-year Treasury rate moves little during the first two years following the shock. As economic activity weakens and the price level declines, the Federal Reserve lowers the policy rate, which remains about 50 basis points below trend five years after the shock.

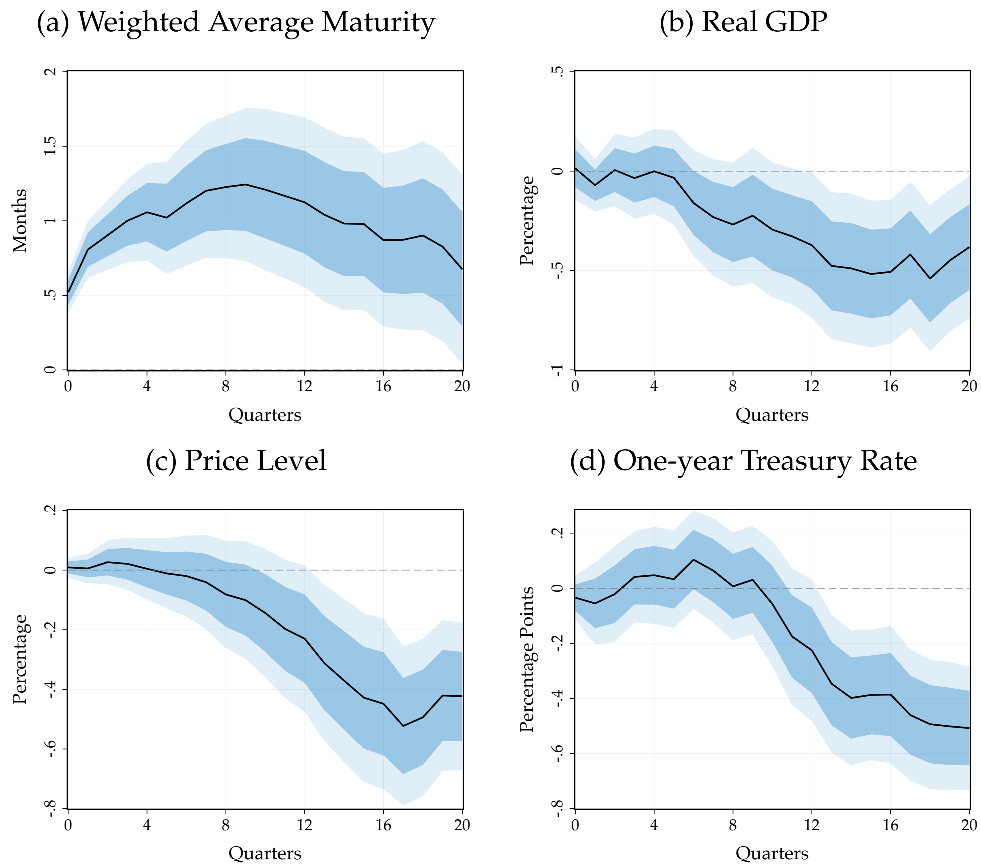
Public debt composition. The responses of short, medium, and long-term debt confirm that the shock represents a shift along the maturity spectrum. Figure 6 shows that the amount of short-term debt falls sharply on impact, while long-term debt rises persistently. Medium-term debt initially changes little and increases at longer horizons, although the response is insignificant across all horizons. Thus, the increase in WAM is implemented primarily by replacing bills with longer-dated securities.

Private expenditure. The contraction is concentrated in private demand. Figure 7 shows that investment falls gradually and reaches a trough of nearly 2 percent after about three years. Personal consumption declines similarly, reaching roughly 0.5 percent below its pre-shock level. These responses indicate that a shift toward longer-term Treasury issuance reduces activity through interest-sensitive components of private expenditure.

Financial effects. Panel (a) of Figure 8 shows the response of Treasury yields. The 30-year Treasury yield rises for about two years before gradually returning toward trend. Because the policy rate remains broadly unchanged over this period, the yield curve steepens in the short run. It steepens further as the one-year rate subsequently declines.

[9] The baseline confidence bands treat the shock as observed, and therefore do not take into account its estimation uncertainty. Appendix Figure D.6 shows that results are unchanged when we account for this uncertainty with a paired bootstrap that resamples both the extracted shock and the local-projection innovations.

Figure 5: Macroeconomic Effects of a Maturity Shock

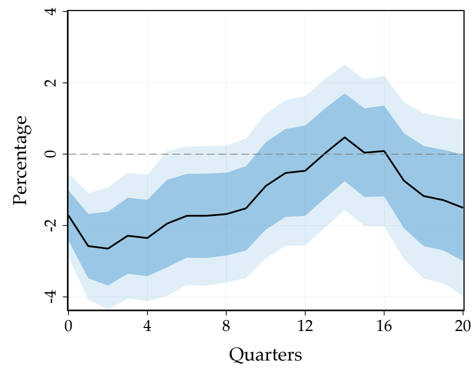


Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

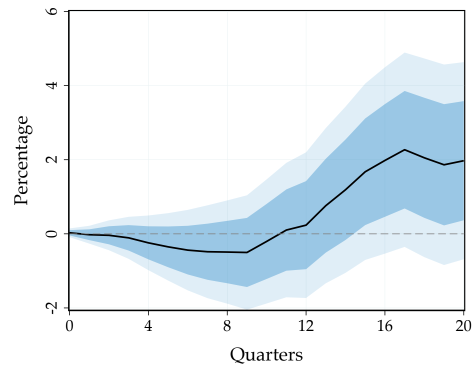
Panel (b) shows the response of broader financial conditions. The effects on the yield curve pass through to broader financial conditions with a lag. The National Financial Conditions Index (NFCI) rises gradually, reaching a peak of about 10 index points two years after the shock. Moody's Aaa and Baa corporate bond yields display a similar pattern, reaching roughly 20 and 25 basis points above trend, respectively, around two years after the shock. The tightening in financial conditions also spreads to the housing market: the thirty-year mortgage rate rises and reaches a peak of nearly 20 basis points above trend two years after the shock. Taken together, these responses suggest that a shift in Treasury supply toward longer maturities raises longer-term borrowing costs and spills over into private credit markets.

Figure 6: Effects on the Maturity Composition of Public Debt

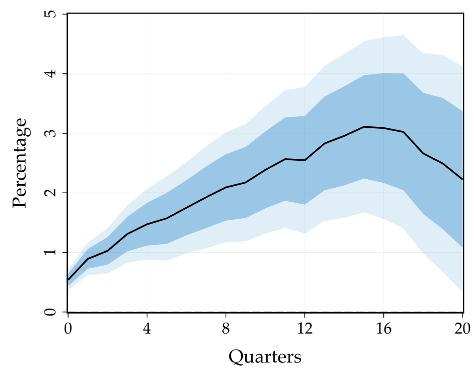
(a) Short-term Debt



(b) Medium-term Debt



(c) Long-term Debt

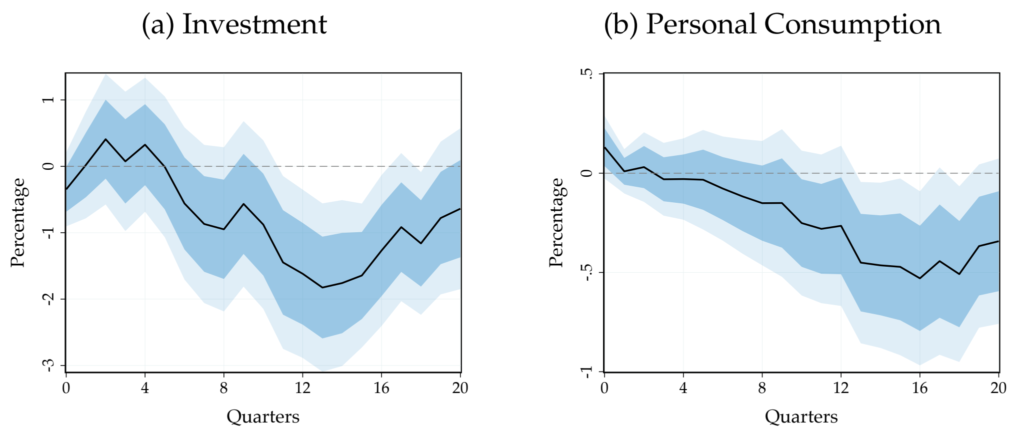


Notes: Impulse responses of short-, medium-, and long-term debt to a positive one standard deviation debt maturity shock. Short-term debt is defined as the real face value of outstanding Treasury securities with a remaining maturity of one year or less; medium-term debt includes securities with maturities between two and nine years; and long-term debt includes securities with maturities between ten and thirty years. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Level vs. compositional effect. To interpret the shock as an exogenous change in the maturity composition of public debt, it is important that it does not affect the total quantity of debt in the short run. Figure 9a confirms that this is the case. The real value of total debt outstanding is essentially unchanged for the first two years following the shock and rises only gradually thereafter, as the contraction in economic activity deepens. This pattern is not surprising, since the shock is obtained by residualizing changes in WAM with respect to an information set that includes changes in public debt. Importantly, however, this restriction is imposed only contemporaneously,[10] not at subsequent horizons. If

[10]Since the set of controls used in the local projections differs slightly from that in the Treasury maturity rule, the contemporaneous response of public debt need not be exactly zero. Reassuringly, however, the response is never statistically different from zero at any horizon during the first three years following the

Figure 7: Effects on Private Expenditure



Notes: Impulse responses of real private investment and consumption to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Treasury maturity policy were instead signaling future fiscal expansions determined by Congress, one would expect the total quantity of debt to respond soon after the shock.

As an additional check that the shock is not confounded by information about future fiscal expansions, we examine the response of real government consumption in Figure 9b. Reassuringly, government consumption remains essentially unchanged throughout the five-year horizon following the shock.

4.3. Robustness

We assess the robustness of our baseline results along three dimensions: the identification of the shock, the presence of trends and influential observations in the sample, and the dynamic specification.

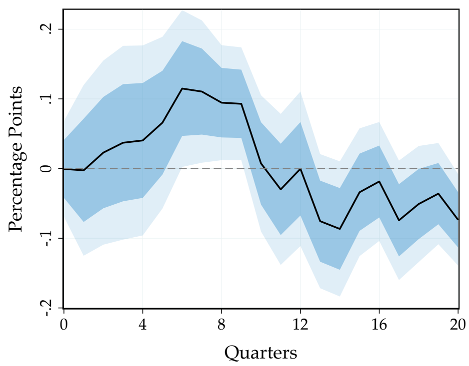
Shock identification. In Equation (15), we treat the shock extracted from the ridge regression as the true structural maturity shock. However, as emphasized by Stock and Watson (2018), our shock measure may fail to capture all exogenous variation in debt maturity. To address this concern, we estimate a local-projection instrumental-variable (LP-IV) specification, in which WAM is instrumented with the residual from our Treasury maturity rule. Figure D.3 reports the results. The robust first-stage F-statistic is around 38, well above conventional thresholds. The resulting impulse responses are nearly identical

shock.

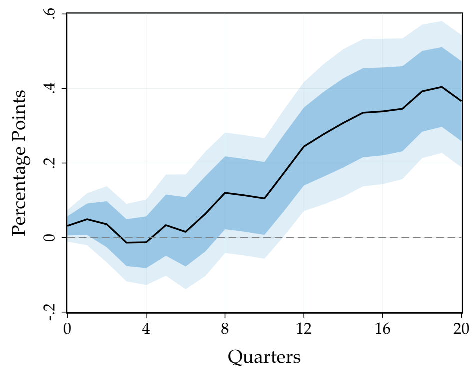
Figure 8: Effects on Financial Conditions

Panel (a): Treasury Market

(a) 30-year Treasury Yield

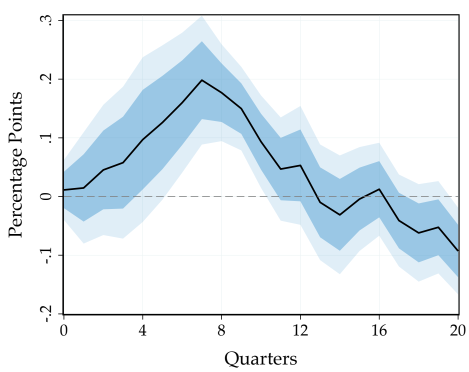


(b) 30-year minus 1-year Slope

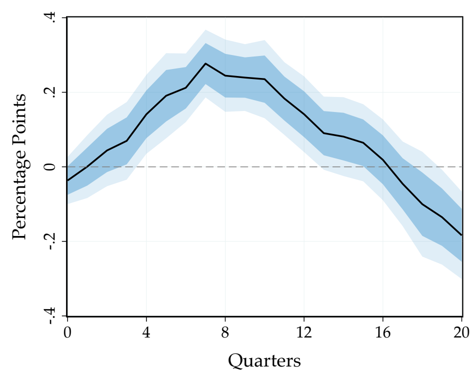


Panel (b): Broader Financial Conditions

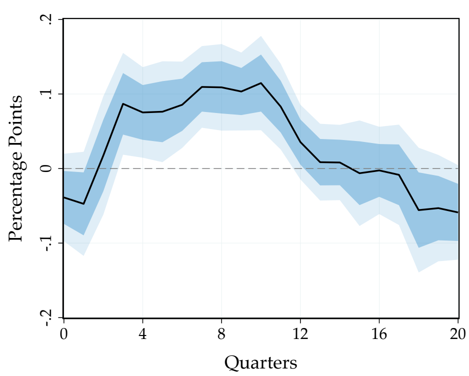
(c) Aaa Corporate Yield



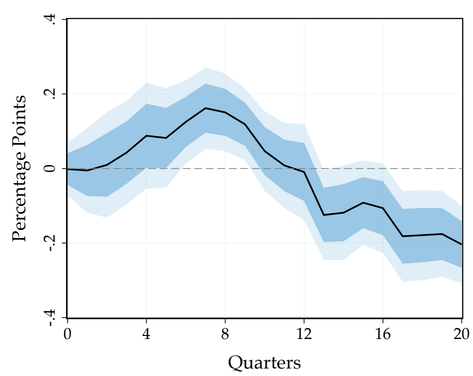
(d) Baa Corporate Yield



(e) Financial Conditions



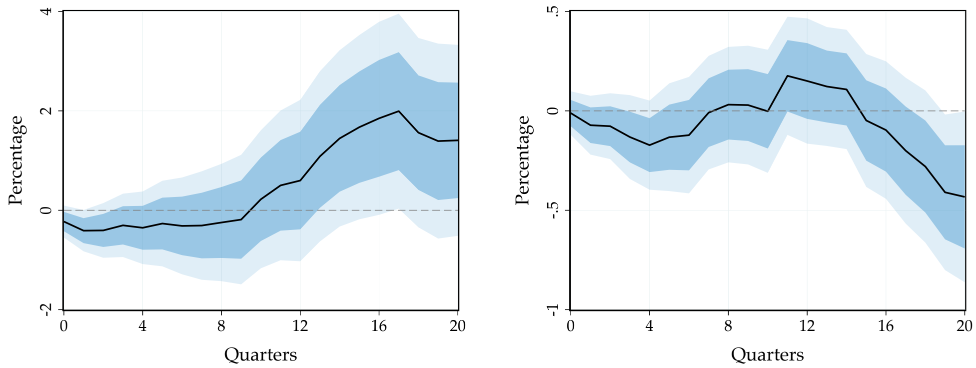
(f) Mortgage Rate



Notes: Impulse responses of the thirty-year Treasury yield, the thirty-minus-one-year yield curve spread, the NFCI index of financial conditions, the Aaa and Baa corporate bond yields, and the thirty-year fixed rate mortgage to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Figure 9: Effects on Fiscal Quantities

(a) Total Debt (b) Government Consumption



Notes: Impulse responses of total real public debt outstanding and real government consumption to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

to those in Figure 5. This suggests that our residual series captures most of the relevant variation in the underlying structural maturity shock.

Our shock is extracted from the specification that delivers the highest goodness-of-fit for changes in WAM. It is therefore natural to ask whether augmenting the information set materially affects the results. Figure D.4 addresses this question by using as the shock measure the residual from the simpler rule that includes only output and public debt growth. The qualitative shape of the responses remains similar to the baseline, but the confidence bands become substantially wider. This suggests that augmenting the information set helps filter out noise and yields a cleaner measure of the underlying Treasury maturity shock.

Finally, we assess whether the advantages of our approach persist relative to a standard Cholesky identification in a VAR. More specifically, we assume that real GDP and public debt do not react contemporaneously to a debt maturity shock.[11] We estimate a six-variable VAR including WAM, real GDP, price level, one-year Treasury rate, NFCI, and total public debt.[12] The VAR includes two lags and is estimated over the sample

[11]Our Treasury maturity rule in Equation (3) is specified in terms of first differences in real GDP and public debt. The corresponding identifying assumption is therefore that output and debt growth do not respond contemporaneously to changes in WAM. To facilitate comparison with the local-projection evidence, we estimate the VAR in levels and impose the recursive restriction on the levels of output and debt. We have verified, however, that the results are similar when the VAR is estimated in first differences.

[12]We depart slightly from the four-variable specification used in the local projections for two reasons. First, VARs may be more vulnerable to informational insufficiency, and including NFCI and public debt helps mitigate this concern. Second, the identification scheme requires the inclusion of total public debt.

1982:Q1–2024:Q4.

Figure D.5 suggests that the Cholesky identification is likely confounding the debt maturity shock—a supply shock—with demand disturbances. Financial conditions ease, while total public debt rises persistently. Both responses are consistent with a positive shock to the demand for public debt: an exogenous increase in demand lowers borrowing costs and is accommodated by the Treasury through greater debt issuance. This exercise therefore highlights the importance of our identification procedure in isolating a debt maturity shock that is free from a demand component.

Pre-trends and outliers. Our sample spans 1982 to 2024. Several variables, including WAM and the one-year Treasury rate, display persistent low-frequency movements over this period. It is therefore important to verify that the estimated responses are not driven by pre-existing trends. Figure D.7 shows no evidence of systematic pre-trends prior to the shock.

The sample also includes episodes of extreme financial-market volatility, most notably the Global Financial Crisis and the Covid-19 pandemic recession. To assess whether the results are driven by influential observations in the shock series, we perform a jackknife exercise in which each shock observation is censored to zero in turn and the corresponding quarter is controlled for with an indicator variable. Figure D.8 shows that no individual observation has a material influence on the estimated responses.

Dynamic specification. The baseline specification includes two lags of the dependent variable and of the controls. Figure D.9 shows that the results are robust to alternative lag structures. Increasing the number of lags from two to four or six leaves the impulse responses essentially unchanged. Including eight lags leads to a somewhat larger increase in WAM and a more pronounced contraction in economic activity.

The shock series exhibits only mild autocorrelation at the seventh lag. We therefore also assess whether the results are sensitive to including lags of the shock directly in the local projections. Figure D.10 confirms that the economic conclusions are essentially unaffected.

We further verify that the results are not sensitive to the particular set of controls included in the local projections. Figure D.11 shows that excluding all controls, adding NBER recession indicators, including the one-year Treasury rate, or removing deterministic controls altogether leaves the results broadly unchanged.

5. Maturity Rule as Fiscal Support

We have shown that Treasury maturity decisions affect economic activity. We next examine whether maturity policy also shapes the transmission of fiscal shocks. We first show that the Treasury responds to an expansionary government spending shock by tilting issuance toward short-term debt, thereby lowering WAM. Under a counterfactual rule that prevents this decline, real GDP rises by less, while the response of total debt remains broadly unchanged. Therefore, by directly affecting financial conditions and aggregate economic activity, Treasury maturity policy shapes the macroeconomic effects of fiscal expansions.

5.1. Econometric Framework

Policy experiment. We begin by studying the response of the economy to the identified government spending shock of Ramey and Zubairy (2018). Under the prevailing Treasury maturity rule, the shock leads the Treasury to shorten debt maturity, causing WAM to decline. Our counterfactual rule instead holds WAM at its no-shock path at every horizon. The exercise therefore asks how real GDP and total debt would respond if the Treasury did not shorten debt maturity following a fiscal expansion. Appendix E describes the government spending shock and the estimation of the responses under the prevailing rule.

To construct the counterfactual paths, we use two complementary approaches. Our baseline follows McKay and Wolf (2023) and chooses the realization of the identified debt maturity shock that brings WAM as close as possible to its counterfactual path. Because the adjustment uses only a date-0 shock, it provides a Lucas-critique-robust approximation to the counterfactual rule. However, with only one identified shock, it may approximate the counterfactual rule imperfectly. We therefore complement it with the approach of Sims and Zha (2006), which uses a sequence of unanticipated maturity shocks to enforce the rule more closely, at the cost of treating a predictable policy adjustment as a series of surprises.

Counterfactuals robust to the Lucas critique. Following McKay and Wolf (2023), we construct the counterfactual by adding a debt maturity shock at date 0 to the estimated responses under the prevailing rule. Let $\mathbf{x}_g$ denote the $H \times n_x$ matrix collecting the responses of the n_x endogenous variables to the fiscal shock g, and let $\mathbf{WAM}_g$ denote the corresponding $H \times 1$ vector of WAM responses. Let $\mathbf{\Theta}_x$ and $\mathbf{\Theta}_{WAM}$ denote the responses of these variables to a one-unit debt maturity shock. For a debt maturity shock realization $\tilde{\nu}$, the counterfactual paths are:

$$\mathbf{x}_g^{cf} = \mathbf{x}_g + \boldsymbol{\Theta}_x \tilde{\nu},$$
$$\mathbf{WAM}_g^{cf} = \mathbf{WAM}_g + \boldsymbol{\Theta}_{WAM} \tilde{\nu}.$$

Our counterfactual rule holds WAM at its no-shock path at every horizon. Because impulse responses are measured relative to the no-shock path, this restriction requires:

$$\mathbf{WAM}_g^{cf} = \mathbf{0}_H.$$

Combining this restriction with the counterfactual path above gives:

$$\mathbf{WAM}_g + \boldsymbol{\Theta}_{WAM} \tilde{\nu} = \mathbf{0}_H. \tag{16}$$

With only one identified debt maturity shock, $\tilde{\nu}$ is a scalar. A single maturity adjustment generally cannot satisfy the H restrictions in Equation (16) exactly. Following McKay and Wolf (2023), we therefore choose the adjustment that brings the WAM response as close as possible to the zero path implied by the counterfactual rule:

$$\tilde{\nu}^* = \arg\min_{\tilde{\nu}} \left\| \mathbf{WAM}_g + \boldsymbol{\Theta}_{WAM} \tilde{\nu} \right\|_2^2.$$

The resulting counterfactual responses are:

$$\mathbf{x}_g^{cf} = \mathbf{x}_g + \boldsymbol{\Theta}_x \tilde{\nu}^*,$$
$$\mathbf{WAM}_g^{cf} = \mathbf{WAM}_g + \boldsymbol{\Theta}_{WAM} \tilde{\nu}^*.$$

Counterfactuals with sequential maturity shocks. To approximate more closely the zero WAM response implied by the counterfactual rule, we follow Sims and Zha (2006) and allow unanticipated debt maturity shocks to arrive at multiple horizons. Let S denote the total number of shock realizations used in the construction. These shocks arrive in quarters $0, \ldots, S-1$, so $S = 1$ corresponds to the single date-0 shock used in the baseline counterfactual. Let $\boldsymbol{\Theta}_{WAM}^{sz}(S) \in \mathbb{R}^{H \times S}$ denote the lower-triangular Toeplitz matrix constructed from the estimated WAM response to a debt maturity shock. Column $j+1$ gives the response to an unanticipated shock arriving in quarter j, for $j = 0, \ldots, S-1$. Let $\boldsymbol{\nu}_S \in \mathbb{R}^S$ collect the corresponding shock realizations. We choose these realizations to solve:

$$\boldsymbol{\nu}_S^* = \arg\min_{\boldsymbol{\nu}_S} \left\| \mathbf{WAM}_g + \boldsymbol{\Theta}_{WAM}^{sz}(S)\boldsymbol{\nu}_S \right\|_2^2.$$

Once the shock realizations are chosen, we apply the same sequence to the maturity-shock responses of each outcome. For each outcome x, let $\boldsymbol{\Theta}_x^{sz}(S) \in \mathbb{R}^{H \times S}$ denote the corresponding Toeplitz matrix constructed from its estimated response to a debt maturity shock. The counterfactual response is:

$$\mathbf{x}_g^{cf} = \mathbf{x}_g + \boldsymbol{\Theta}_x^{sz}(S)\boldsymbol{\nu}_S^*.$$

Each increase in S adds another later-dated shock with which to approximate the zero WAM response. This flexibility comes at a cost: shocks arriving after date 0 are treated as unanticipated even though the change in the Treasury maturity rule is known in advance. These counterfactuals are therefore not robust to the Lucas critique. We report results for several values of S to assess whether the economic conclusions are sensitive to how closely the counterfactual rule is approximated.

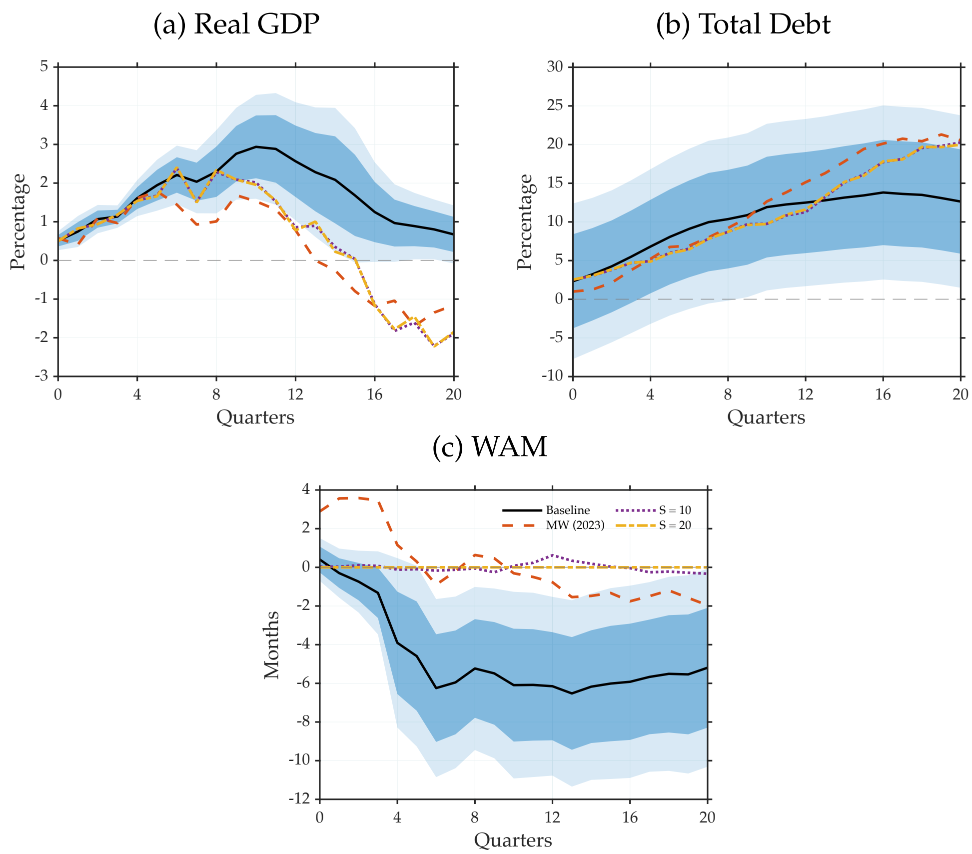
5.2. Results under the Counterfactual WAM Rule

We now apply this framework to a counterfactual in which the Treasury keeps WAM on its no-shock path following a government spending shock. Figure 10 compares the responses of real GDP, total debt, and WAM to the government spending shock of Ramey and Zubairy (2018) under the prevailing and counterfactual maturity rules. Under the prevailing rule, the shock raises real GDP and the additional government spending is financed through debt issuance. The Treasury tilts issuance toward short-term debt, lowering WAM.

The counterfactual constructed following McKay and Wolf (2023) delivers a smaller increase in real GDP than under the prevailing rule. Keeping WAM on its no-shock path requires a positive debt maturity shock. Because such a shock contracts economic activity (see Figure 5), it offsets part of the expansionary response to the government spending shock. We obtain the same qualitative result using the sequential-shock approach of Sims and Zha (2006). As S increases, the WAM peg is approximated more closely, but the qualitative response of real GDP remains unchanged. The attenuation of the output response therefore persists when the counterfactual rule is imposed more accurately.

The counterfactual maturity rule has comparatively modest effects on total debt. Relative to the prevailing rule, debt rises by less over the first eight quarters and by more

Figure 10: Counterfactuals to a Positive Government Spending Shock



Notes: Impulse responses of real GDP, total debt, and WAM to a positive military news shock (Ramey and Zubairy, 2018), under the prevailing (black) and a counterfactual Treasury rule. Responses are reported per unit of the shock, which is expressed relative to nominal potential output. The yellow line is the counterfactual under a WAM peg, constructed following McKay and Wolf (2023). The red and purple lines are the counterfactuals constructed following the expanded shock set of Sims and Zha (2006), indexed by S, the number of additional shocks used to enforce the rule.

at longer horizons.[13] However, the counterfactual debt paths remain well within the baseline confidence bands. Thus, the decline in the output response is accompanied by relatively little change in the quantity of debt outstanding.

Taken together, this exercise shows that the Treasury's maturity policy can meaningfully amplify or dampen the effects of fiscal expansions. From a policy perspective, this implies that the transmission of fiscal policy depends not only on the actions of Congress and their interaction with monetary policy, but also on how the Treasury finances the resulting deficits. The Treasury therefore emerges as an important policy institution in its own right, because the maturity composition of government borrowing shapes the

[13] The roughly 10% increase in real public debt should be interpreted in light of the substantial variation in the debt stock over the sample: 10% of the historical average debt stock is much smaller in absolute terms than 10% of the current stock. We report total debt rather than its ratio to GDP to maintain consistency with the Treasury maturity rule in Equation (3).

macroeconomic effects of fiscal policy.

6. Conclusion

The U.S. Treasury systematically responds to macroeconomic conditions when setting the maturity structure of public debt. Estimates of a Treasury maturity rule reveal that the Treasury shortens debt maturity when economic activity weakens or borrowing needs increase. Both a model of optimal debt management and narrative evidence from Treasury policy documents rationalize this behavior: when macroeconomic and financial conditions deteriorate, the Treasury tilts issuance toward short-term debt because its price impact is smaller than that of long-term debt.

Maturity decisions have consequential macroeconomic effects. We estimate an augmented Treasury maturity rule that incorporates the Treasury's broader information set and use its residual to identify a debt maturity shock. A shock that lengthens debt maturity leads to a persistent slowdown in real economic activity and prices. The transmission mechanism is predominantly financial: greater issuance of long-term debt raises long-term borrowing costs, depressing investment and consumption. Importantly, the shock is purely compositional: it changes the maturity mix of public debt without affecting the total amount of debt outstanding in the short run or real government spending.

Finally, the maturity structure of public debt shapes the transmission of fiscal shocks. Following an exogenous increase in government spending, the expansionary effects depend on the Treasury's maturity decisions. In a counterfactual in which the Treasury does not shorten debt maturity in response to the shock, the expansion in economic activity is substantially dampened, while effects on the total amount of public debt outstanding is only moderate.

Taken together, this paper shows that the U.S. Treasury is an important policy institution whose core function—choosing the maturity structure of public debt—has significant financial and macroeconomic consequences. Rather than being viewed as a purely technical function, maturity policy emerges as an important dimension of U.S. macroeconomic policy.

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Online Appendix

The Treasury Maturity Rule

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A. Data

A.1. Macroeconomic Data Sources

Table A.1 provides details on the data used in the paper, including the data source and the transformation applied.

Table A.1: Data Description and Sources

Variable	Description	Source	Trans.
Treasury Debt and Maturity			
WAM	Face-value-weighted remaining maturity, $\sum_i FV_{i,t} M_{i,t} / \sum_i FV_{i,t}$	U.S. Treasury	Quarterly avg.; $\times 12$; Level or Δ
Short debt	Bills and cash-management bills outstanding, deflated by CPIAUCSL	U.S. Treasury; FRED	$100 \times \log$
Medium debt	Notes, floating-rate notes, and TIPS notes outstanding, deflated by CPIAUCSL	U.S. Treasury; FRED	$100 \times \log$
Long debt	Bonds and TIPS bonds outstanding, deflated by CPIAUCSL	U.S. Treasury; FRED	$100 \times \log$
Total debt	Marketable Treasury debt outstanding, deflated by CPIAUCSL	U.S. Treasury; FRED	$100 \times \log$; Δ in rule
Debt-limit indicator	Indicator for debt-limit discussions in quarterly refunding documents	U.S. Treasury; authors' calculations	Indicator
WAM shock	Residual from the augmented Treasury maturity rule	Authors' calculations	Std. dev.
Macroeconomic Activity and Prices			
GDP	Gross domestic product, deflated by CPIAUCSL	FRED/BEA, BLS	$100 \times \log$; Δ in rule
GDPC1, GDPPOT	Output gap, $100[\log(\text{GDPC1}_t) - \log(\text{GDPPOT}_t)]$	FRED/BEA	Level or Δ
GDPDEF	GDP implicit price deflator	FRED/BEA	$100 \times \log$
CPIAUCSL	Consumer price index for all urban consumers	FRED/BLS	Level; $100\Delta_4 \log$
GPDIC1	Real gross private domestic investment	FRED/BEA	$100 \times \log$
PCECC96	Real personal consumption expenditures	FRED/BEA	$100 \times \log$
GCEC1	Real government consumption and gross investment	FRED/BEA	$100 \times \log$

Continued on next page

Table A.1: Data Description and Sources

Variable	Description	Source	Trans.
Recession indicator	NBER recession quarters	NBER	Indicator
Fiscal Variables			
NIPA deficit	Federal net borrowing, $-\text{net lending}_t/\text{GDP}_t \times 100$	BEA	Level
FGEXPND, A091RC1Q027SBEA, FGRECPT	Primary deficit, $\text{FGEXPND}_t - \text{A091RC1Q027SBEA}_t - \text{FGRECPT}_t$	FRED/BEA	Level
Interest Rates and Financial Conditions			
DFF	Effective federal funds rate	FRED	Quarterly avg.; level
DGS3MO	Three-month constant-maturity Treasury yield	FRED	Quarterly avg.; level
DGS1	One-year constant-maturity Treasury yield	FRED	Quarterly avg.; level
DGS2	Two-year constant-maturity Treasury yield	FRED	Quarterly avg.; level
DGS10	Ten-year constant-maturity Treasury yield	FRED	Quarterly avg.; level
DGS30	Thirty-year constant-maturity Treasury yield	FRED	Quarterly avg.; level
DAAA	Moody's seasoned Aaa corporate bond yield	FRED	Quarterly avg.; level
DBAA	Moody's seasoned Baa corporate bond yield	FRED	Quarterly avg.; level
DGS10, DGS2	Treasury yield-curve slope, $\text{DGS10}_t - \text{DGS2}_t$	FRED	Level
DGS30, DGS1	Treasury yield-curve slope, $\text{DGS30}_t - \text{DGS1}_t$	FRED	Level
DGS3MO, DFF	Three-month Treasury yield minus the effective federal funds rate, $\text{DGS3MO}_t - \text{DFF}_t$	FRED	Level
DBAA, DAAA	Corporate spread, $\text{DBAA}_t - \text{DAAA}_t$	FRED	Level
NFCI	Chicago Fed National Financial Conditions Index	FRED/Chicago Fed	Quarterly avg.; level
MORTGAGE30US	30-year fixed-rate mortgage average in the United States	FRED	Quarterly avg.; level
SPCOMP	S&P 500 Composite index	Datastream	Quarterly avg.; $100 \times \log$

Continued on next page

Table A.1: Data Description and Sources

Variable	Description	Source	Trans.
VXOCLS	CBOE S&P 100 volatility index, extended following Bloom (2009)	FRED	$100 \times \log$
Forecasts			
RGDP2–RGDP6, RGDPA, RGDPB	SPF forecasts of real GDP; quarterly revisions are $F_{j,t} - F_{j+1,t-1}$ and annual revisions are $\Delta F_{j,t}$	Philadelphia Fed SPF	Level
RFEDGOV2–RFEDGOV6, RFEDGOVA, RFEDGOVB	SPF forecasts of real federal government consumption and gross investment; quarterly revisions are $F_{j,t} - F_{j+1,t-1}$ and annual revisions are $\Delta F_{j,t}$	Philadelphia Fed SPF	Level
TBILL2–TBILL6, TBILLA, TBILLB	SPF forecasts of the three-month Treasury bill rate; quarterly revisions are $F_{j,t} - F_{j+1,t-1}$ and annual revisions are $\Delta F_{j,t}$	Philadelphia Fed SPF	Level
BOND2–BOND6, BONDA, BONDB	SPF forecasts of Moody's Aaa corporate bond yield; quarterly revisions are $F_{j,t} - F_{j+1,t-1}$ and annual revisions are $\Delta F_{j,t}$	Philadelphia Fed SPF	Level
Treasury sentiment	Topic-specific sentiment in Treasury policy documents	U.S. Treasury; authors' calculations	Δ; standardized
External Structural Shocks			
EBP shock	Excess bond premium shock	Gilchrist and Zakrajšek (2012)	Std. dev.
MP shock (BS)	Monetary policy shock	Bauer and Swanson (2023)	Std. dev.
MP shock (GK)	Monetary policy shock	Gertler and Karadi (2015)	Std. dev.
MP shock (MAR)	Monetary policy shock	Miranda-Agrippino and Ricco (2021)	Std. dev.
Military news	Military spending news relative to lagged nominal potential GDP	Ramey and Zubairy (2018)	Level
Historical Variables for Counterfactual Exercise			
Historical output	Real GDP relative to potential GDP, $100 \times rgdp_t / rgdp_t^*$	Ramey and Zubairy (2018)	Level
Historical real debt	Federal debt held by the public deflated by the GDP deflator, D_t^N / P_t	Ramey and Zubairy (2018)	$100 \times \log$
Historical debt/GDP	Federal debt held by the public relative to lagged nominal GDP	Ramey and Zubairy (2018)	Level

A.2. Text Data and Construction of Sentiment Indicators

Text sources. We use text data from the Quarterly Refunding Archives of the U.S. Department of the Treasury to measure the information set and decision-making process of the Treasury. The corpus combines three sources: the minutes of TBAC meetings, the committee's Reports to the Secretary, and the Economic Policy Statements prepared by the Treasury's Office of Economic Policy. Together, these documents capture the Treasury's assessment of economic and fiscal conditions, its discussions with private-sector market participants, and the committee's formal recommendations.

Text extraction and processing. We first extract the text from each document. When a usable native text layer is available, we parse it directly from the PDF. For scanned documents and files with insufficient or poorly spaced native text, we instead apply optical character recognition. We retain the substantive body of each document, removing introductory material, signatures, and tables or figures that follow the main text. We exclude stopwords, punctuation, short tokens (less than two characters), and numbers when constructing the dictionaries and calculating document length.

Concept dictionaries. We construct the concept dictionaries using the vocabulary of the Treasury documents themselves. We pool the processed corpus and tabulate the frequency of all unigrams, bigrams, trigrams, and quadgrams. Beginning with the most frequent expressions, we manually review candidate terms and retain those that identify a specific economic concept without generating substantial false positives when encountered in isolation. We supplement these corpus-derived terms with expressions from the dictionaries used by Aruoba and Drechsel (2026) and Cieslak et al. (2024). We also use wildcard endings where appropriate to capture different grammatical forms of the same word. The resulting dictionary contains 37 narrow concepts organized into eight broad categories: economic growth, inflation, monetary policy, fiscal policy, financial-market conditions, financial-market costs, financial-market prices, and financial-market yields.

Sentiment indicators. We construct sentiment indicators by combining the concept dictionaries with a dictionary of directional language from Aruoba and Drechsel (2026), drawing in part on Loughran and Mcdonald (2011). The directional dictionary identifies expressions associated with increases or improvements and decreases or deteriorations. We assign each concept term an orientation $p_j \in \{-1, 1\}$ that maps these expressions into the sign convention for that concept. For example, language indicating an increase in consumer spending contributes positively, while language indicating an increase in inflation contributes negatively.

For each occurrence o of a concept term, let I_o^+ and I_o^- indicate whether its sentence contains at least one positive or negative directional expression, respectively. We define sentiment for concept k in document d in quarter t as:

$$\text{SENT}_{k,d,t} = \frac{\sum_{o \in \mathcal{O}_{k,d,t}} p(o)\left(I_o^+ - I_o^-\right)}{\text{N}_{d,t}}, \tag{17}$$

where $\mathcal{O}_{k,d,t}$ contains all occurrences of concept-k terms, $p(o)$ is the orientation of the matched term, and $N_{d,t}$ is the number of admissible words in the document. Occurrences in sentences containing neither type of directional expression, or both types, contribute zero.

Quarterly aggregation. We first calculate the indicators for each of the 37 narrow concepts and then sum them within the corresponding broad categories. To combine the available document types, we sum the signed concept counts across all documents in a quarter and divide by their combined word count. Longer documents therefore receive weight in proportion to the amount of usable text they contain, while differences in overall document length do not mechanically raise the index. In quarters for which only a subset of the three sources is available, the measure is constructed from the available documents. We standardize the resulting quarterly series where they enter the empirical analysis.

B. Maturity Rule: Robustness and Additional Results

B.1. Robustness Checks

Standard errors. In Table 1, we report heteroskedasticity-robust standard errors following the lag augmentation approach of Montiel Olea and Plagborg-Møller (2021). Table B.1 shows that our inference is unchanged when we instead account for serial correlation in the residuals using Newey–West standard errors.

Table B.1: Inference Accounting for Serial Correlation

ΔWAM_t	(1)	(2)	(3)	(4)
r_t^{slope}	-0.373	-0.109	0.072	
	(0.437)	(0.392)	(0.140)	
y_t		0.363***	0.162***	0.147***
		(0.111)	(0.047)	(0.045)
D_t			-0.338***	-0.336***
			(0.040)	(0.044)
ρ	0.491***	0.494***	0.682***	0.683***
	(0.105)	(0.121)	(0.070)	(0.066)
N	172	172	172	172

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are the yield curve slope (r_t^{slope}), real GDP growth (y_t), and real public debt growth (D_t). Columns (1)–(3) add these regressors sequentially, while column (4) excludes the yield curve slope. All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Rule in levels. Our preferred specification is estimated with WAM in first differences. This choice reflects the fact that the quarterly change in WAM closely approximates the maturity of new issuance, which is the policy instrument the Treasury actively controls on a quarterly basis. While parts of the Taylor rule literature also estimate the Federal Reserve's reaction function in first differences (Orphanides, 2003), the predominant approach is to specify the rule in levels (for example, Clarida, Gali, and Gertler, 2000; Nakamura, Steinsson, and Riblier, 2025, among many others). We therefore verify in Table B.2 that our findings are robust to estimating the Treasury policy rule with WAM in levels instead.

Table B.2: Treasury Maturity Rule with WAM_t in Levels

WAM_t	(1)	(2)	(3)	(4)
r_t^{slope}	-0.440	-0.195	0.060	
	(0.404)	(0.364)	(0.154)	
y_t		0.360^{***}	0.161^{***}	0.148^{***}
		(0.114)	(0.052)	(0.052)
D_t			-0.343^{***}	-0.342^{***}
			(0.030)	(0.031)
ρ	0.976^{***}	0.980^{***}	0.986^{***}	0.985^{***}
	(0.013)	(0.012)	(0.008)	(0.009)
N	172	172	172	172

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are the yield curve slope (r_t^{slope}), real GDP growth (y_t), and real public debt growth (D_t). Columns (1)–(3) add these regressors sequentially, while column (4) excludes the yield curve slope. All specifications include two lags of WAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of WAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Specification. We also examine the sensitivity of our results to three modeling choices in the estimation of Equation (2): lag structure, variable definition, and sample period. First, Table B.3 shows that both the magnitude and statistical significance of the coefficients on output and debt growth remain remarkably stable across alternative lag specifications. This robustness is important because the Treasury may smooth changes in the maturity structure more gradually than the Federal Reserve adjusts its policy rate, potentially requiring a richer lag structure.

Second, we verify that our findings are not driven by a particular measure of borrowing needs or economic activity. As reported in Table B.4, the sign and statistical significance of the coefficients are preserved in seven of the eight alternative specifications. The only exception is the specification using the output gap as the measure of economic activity, for which the coefficient is no longer statistically significant, although its sign and magnitude remain broadly unchanged.

Finally, we assess the stability of the estimated rule across subsamples. Table B.5 shows that excluding either the 1980s, the Great Financial Crisis, or the Covid-19 recession leaves the qualitative conclusions unchanged. While the coefficient on output is smaller when the 1980s are omitted, its sign remains positive and statistically significant. This pattern suggests that the Treasury's assessment of the trade-off underlying maturity management may have evolved over time, while the overall structure of the policy rule remained stable.

Table B.3: Sensitivity to Lag Structure

ΔWAM_t	(1)	(2)	(3)	(4)
y_t	0.147^{**}	0.137^{***}	0.131^{***}	0.112^{**}
	(0.058)	(0.051)	(0.047)	(0.048)
D_t	-0.336^{***}	-0.371^{***}	-0.384^{***}	-0.390^{***}
	(0.034)	(0.027)	(0.029)	(0.037)
ρ	0.683^{***}	0.676^{***}	0.738^{***}	0.776^{***}
	(0.065)	(0.054)	(0.065)	(0.074)
N	172	170	168	166
Lags	2	4	6	8

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are real GDP growth (y_t) and real public debt growth (D_t). Columns (1)–(4) increase the lag structure progressively from 2 to 8. We report persistence as $\rho = \sum_{l=1}^{p} \rho_l$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Table B.4: Sensitivity to Variable Definition

ΔWAM_t	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
y_t	0.147^{**}	0.144^{**}	0.107	0.149^{***}	0.231^{***}	0.193^{**}	0.200^{**}	0.189^{**}
	(0.058)	(0.057)	(0.065)	(0.057)	(0.085)	(0.088)	(0.079)	(0.081)
D_t	-0.336^{***}	-0.336^{***}	-0.330^{***}	-0.330^{***}	-0.478^{*}	-0.101^{*}	-0.556^{**}	-0.114^{**}
	(0.034)	(0.032)	(0.027)	(0.034)	(0.257)	(0.056)	(0.270)	(0.055)
N	172	172	172	172	172	172	172	172

Notes: This table reports estimates of Equation (2) using quarterly data. The definitions of the regressors vary across specifications. Column (1) uses real GDP growth and real public debt growth, as in Table 1. Columns (2) and (3) replace real GDP growth with the log of real GDP and the CBO output gap, respectively. Columns (4)–(8) replace real public debt growth with the log of real public debt, the NIPA nominal deficit, the NIPA deficit-to-GDP ratio, the NIPA nominal primary deficit, and the NIPA primary deficit-to-GDP ratio, respectively. In columns (5) and (7), the reported coefficients measure the change in ΔWAM_t associated with a $1 trillion increase in the total and primary deficit, respectively. All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of WAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Table B.5: Sensitivity to Sample Period

ΔWAM_t	(1)	(2)	(3)	(4)
y_t	0.147**	0.105**	0.183**	0.197***
	(0.058)	(0.044)	(0.071)	(0.069)
D_t	-0.336***	-0.391***	-0.311***	-0.333***
	(0.034)	(0.031)	(0.073)	(0.037)
ρ	0.683***	0.787***	0.692***	0.698***
	(0.065)	(0.039)	(0.068)	(0.063)
N	172	140	165	168
Sample	Full	Ex. 1980s	Ex. GFC	Ex. Covid

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are real GDP growth (y_t) and real public debt growth (D_t). Columns (1) uses the baseline sample of Table 1. Column (2) excludes the 1980s, column (3) excludes the Great Financial Crisis (2007:Q4 to 2009:Q2), and column (4) excludes the Covid-19 episode (2020:Q1 to 2020:Q4). All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses.

B.2. Testing for Informational Sufficiency

A potential concern is that our estimated rule may suffer from omitted-variable bias. If the Treasury systematically responds to macroeconomic or financial conditions beyond those captured by output and borrowing needs, the baseline specification would be misspecified. To address this concern, we augment Equation (2) with an additional regressor, as shown in Equation (4). This exercise allows us to assess both whether an additional variable belongs in the policy rule and whether the estimated relationships between WAM, output, and debt remain stable.

Macroeconomic controls. Table B.6 augments the baseline specification with alternative measures of inflation and the monetary policy rate. Across the four specifications, only GDP deflator inflation enters with a statistically significant coefficient, and only at the 10% significance level. The federal funds rate is never statistically significant, while the coefficients on output and debt remain remarkably stable throughout.

Table B.6: Testing for Informational Sufficiency with Macroeconomic Controls

ΔWAM_t	CPI	GDP def.	3m Tr. rate	1y Tr. rate
y_t	0.142^{**}	0.173^{***}	0.161^{***}	0.168^{***}
	(0.058)	(0.058)	(0.053)	(0.056)
D_t	-0.365^{***}	-0.343^{***}	-0.348^{***}	-0.350^{***}
	(0.043)	(0.033)	(0.024)	(0.025)
x_t	-0.120	-0.270^{*}	-0.005	-0.166
	(0.089)	(0.156)	(0.094)	(0.133)
ρ	0.673^{***}	0.684^{***}	0.680^{***}	0.688^{***}
	(0.063)	(0.068)	(0.064)	(0.062)
N	172	172	172	172

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are real GDP growth (y_t) and real public debt growth (D_t), along with a third macroeconomic variable (x_t). Column (1) includes the CPI inflation rate; column (2) includes the GDP delfator inflation rate; column (3) includes the three-month Treasury rate; column (4) includes the one-year Treasury rate. All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Financial controls. We next augment the baseline rule with additional financial variables. Table B.7 includes alternative measures of long-term interest rates—Treasury yields and Moody's corporate bond yields—which capture the overall cost of borrowing in the economy. Table B.8 instead considers broader indicators of financial conditions, including the S&P 500, the CBOE Volatility Index (VIX), a measure of reserve demand, and a corporate credit spread.

Across both sets of specifications, these financial variables do not emerge as important determinants of the Treasury's maturity decisions. More importantly, the estimated relationships between WAM, output, and public debt growth remain remarkably stable, reinforcing the robustness of our baseline specification.

Table B.7: Testing for Informational Sufficiency with Interest Rates

ΔWAM_t	10y Tr. Yield	30y Tr. Yield	Aaa Yield	Baa Yield
y_t	0.158***	0.151***	0.125***	0.103**
	(0.058)	(0.057)	(0.047)	(0.046)
D_t	-0.348***	-0.348***	-0.382***	-0.391***
	(0.026)	(0.027)	(0.028)	(0.033)
x_t	-0.215	-0.233	-0.086	-0.058
	(0.176)	(0.197)	(0.127)	(0.103)
ρ	0.686***	0.684***	0.723***	0.768***
	(0.062)	(0.062)	(0.058)	(0.040)
N	172	172	166	154

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are real GDP growth (y_t) and real public debt growth (D_t), along with a third macroeconomic variable (x_t) capturing the level of interest rates in the economy. Column (1) includes the 10-year Treasury yield; column (2) includes the 30-year Treasury yield; column (3) includes Moody's Aaa corporate bond yield; column (4) includes Moody's Baa corporate bond yield. All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4.

Table B.8: Testing for Informational Sufficiency with Financial Market Variables

ΔWAM_t	S&P 500	VIX	Reserve Demand	Baa-Aaa Spr.
y_t	0.114*	0.158***	0.149***	0.106***
	(0.069)	(0.061)	(0.055)	(0.036)
D_t	-0.319***	-0.339***	-0.354***	-0.416***
	(0.042)	(0.034)	(0.029)	(0.028)
x_t	0.020	0.001	-0.436	-0.307
	(0.013)	(0.002)	(0.355)	(0.274)
ρ	0.671***	0.684***	0.672***	0.747***
	(0.065)	(0.064)	(0.068)	(0.038)
N	172	172	170	154

Notes: This table reports estimates of Equation (2) using quarterly data. The regressors are real GDP growth (y_t) and real public debt growth (D_t), along with a third macroeconomic variable (x_t) capturing broader financial market conditions. Column (1) includes the log of S&P 500 index; column (2) includes the log of the CBOE volatility index; column (3) includes the spread between the three-month Treasury rate and the federal funds rate—a measure of reserve demand; column (4) includes the Baa-Aaa spread. All specifications include two lags of ΔWAM_t and each included regressor. We report persistence as $\rho = \rho_1 + \rho_2$, where ρ_l is the coefficient on the l-th lag of ΔWAM_t. Heteroskedasticity-robust standard errors are reported in parentheses. The estimation sample spans 1982:Q1–2024:Q4. Columns (3) and (4) have a shorter sample, reflecting data availability.

B.3. Exogeneity

To provide further evidence on the Treasury's response to fluctuations in output and borrowing needs, we conduct an exercise that is free from the endogeneity concerns inherent in estimating the policy rule. Specifically, we trace the response of WAM to externally identified macroeconomic shocks that move output and public debt in directions consistent with the estimated rule.

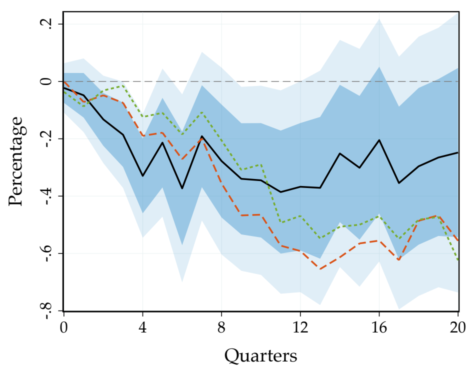
Figure B.1 presents one such exercise using monetary policy shocks identified in the literature. All three shock series are constructed using external instruments within otherwise standard monthly VARs. The instruments are based on the high-frequency identification approach pioneered by Kuttner (2001) and subsequently embedded in a VAR framework by Gertler and Karadi (2015). We estimate the dynamic effects using standard local projections, as specified in Equation (5).

A one standard deviation monetary policy tightening gradually contracts economic activity, with real output reaching its trough between 0.4% and 0.6% below trend roughly three years after the shock. At the same time, total debt rises slowly but persistently, reaching about 3% above trend after five years. In response, the Treasury shortens the maturity structure of its debt. WAM declines by approximately 0.25 months on impact, remains low for about a year, and then gradually returns to its pre-shock level.

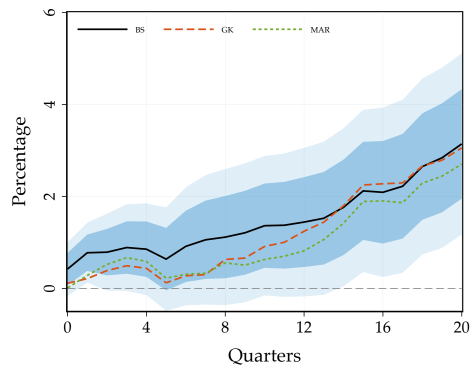
Overall, the evidence in this section reinforces the conclusions from the estimated Treasury maturity rule. When the economy is hit by exogenous shocks that lower output while increasing borrowing needs, the Treasury systematically shortens the maturity structure of new issuance in a manner consistent with the estimated policy rule.

Figure B.1: Impulse Responses to a Contractionary Monetary Policy Shock

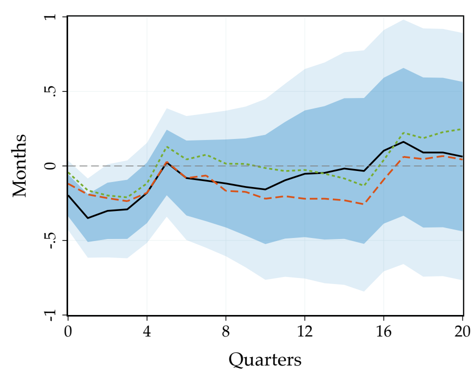
(a) Real GDP



(b) Total Debt



(c) WAM



Notes: Impulse responses of real GDP, total debt, and WAM to a contractionary one standard deviation monetary policy shock (Bauer and Swanson, 2023; Gertler and Karadi, 2015; Miranda-Agrippino and Ricco, 2021). Responses are estimated using Equation (5). The sample spans 1982:Q1-2019:Q4, based on the availability of the shock series. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

C. Model: Additional Proofs

This section collects all the proofs and derivations of Section 3.2.

Optimality. Let $V_{b(\tau)}$ denote the costate on the stock at maturity τ. From the budget constraint in Equation (10), $\partial T_t/\partial\iota(t,\tau) = \lambda(\tau)\iota(t,\tau) - q(\tau)$, so differentiating the objective with respect to $\iota(t,\tau)$ gives:

$$\lambda(\tau)\,\iota(t,\tau) = q(\tau) + m(t,\tau), \qquad m(t,\tau) := -\frac{V_{b(\tau)}}{u'(T_t)} \leq 0. \tag{18}$$

The wedge m is nonpositive because additional debt raises the discounted tax bill. It is larger in absolute value at short maturities, since repayment is nearer and therefore discounted less heavily.

Impact response. Write $\text{WAM} = N/\mathcal{B}$ with $N := \int_0^{\bar{\tau}} \tau\, b\, d\tau$. Differentiating in time,

$$\dot{\text{WAM}} = \frac{\dot{N} - \text{WAM}\,\dot{\mathcal{B}}}{\mathcal{B}} = \frac{1}{\mathcal{B}}\int_0^{\bar{\tau}} \left(\tau - \text{WAM}\right) \partial_t b(t,\tau)\, d\tau.$$

On impact the stock is predetermined, so WAM and $\mathcal{B}$ do not jump and $db = 0$. The law of motion in Equation (6) then gives $d(\partial_t b) = d\iota$, so that:

$$d\,\dot{\text{WAM}} = \frac{1}{\mathcal{B}}\int_0^{\bar{\tau}} \left(\tau - \text{WAM}\right) d\iota(t,\tau)\, d\tau, \tag{19}$$

which is Equation (8) after factoring out $\int_0^{\bar{\tau}} d\iota\, d\tau$.

Impulse responses. Because the disturbances are transitory, the continuation value is flat in these states, so $V_{b(\tau)}$ is fixed on impact and the only moving part in Equation (18) is $u'(T)$. Totally differentiating at the pre-shock allocation,

$$\lambda(\tau)\, d\iota(\tau) = -\iota(\tau)\, d\lambda(\tau) - R(T)\, m(\tau)\, dT, \qquad R(T) := \frac{u''(T)}{u'(T)} > 0. \tag{20}$$

On the budget side $\partial T/\partial G = 1$ and $\partial T/\partial\lambda(\tau)|_\iota = \frac{1}{2}\iota(\tau)^2$, while at the optimum $\partial T/\partial\iota(\tau) = \lambda\iota - q = m(\tau)$. Substituting Equation (20) into:

$$dT = dG + \int_0^{\bar{\tau}} \tfrac{1}{2}\iota(\tau)^2\, d\lambda(\tau)\, d\tau + \int_0^{\bar{\tau}} m(\tau)\, d\iota(\tau)\, d\tau$$

and collecting the terms in dT gives:

$$(1+\Psi)\,dT = dG + \int_0^{\bar{\tau}} \mathcal{T}(\tau)\,d\lambda(\tau)\,d\tau, \tag{21}$$

where:

$$\Psi := R(T)\int_0^{\bar{\tau}} \frac{m(\tau)^2}{\lambda(\tau)}\,d\tau > 0, \qquad \mathcal{T}(\tau) := \iota(\tau)\left(\tfrac{1}{2}\iota(\tau) - \frac{m(\tau)}{\lambda(\tau)}\right) > 0. \tag{22}$$

Setting $d\lambda \equiv 0$ yields $dT/dG = 1/(1+\Psi) \in (0,1)$, so taxes absorb only part of the shock, together with:

$$\frac{d\iota(\tau)}{dG} = \frac{R(T)}{1+\Psi}\,\omega(\tau) \;\geq\; 0, \qquad \omega(\tau) := -\frac{m(\tau)}{\lambda(\tau)} \;\geq\; 0, \tag{23}$$

which is Equation (11). Substituting Equation (23) into Equation (19) gives:

$$\frac{d\,\dot{\mathrm{WAM}}}{dG} = \frac{R(T)}{(1+\Psi)\,\mathcal{B}}\int_0^{\bar{\tau}} \left(\tau - \mathrm{WAM}\right)\omega(\tau)\,d\tau. \tag{24}$$

Setting $dG = 0$ in Equation (21) instead gives $(1+\Psi)\,dT = \int_0^{\bar{\tau}} \mathcal{T}\,d\lambda\,d\tau$, so a price-impact shock moves taxes exactly as a funding shock of that size would. Substituting into Equation (20) and then into Equation (19) gives Equation (12).

Steady state. In the interior the costate obeys $\dot{V}_{b(\tau)} = \tilde{\rho}\,V_{b(\tau)} + \partial_\tau V_{b(\tau)}$, combining discounting with aging. At the steady state $\dot{V}_{b(\tau)} = 0$, so $\partial_\tau \bar{V}_{b(\tau)} = -\tilde{\rho}\,\bar{V}_{b(\tau)}$ and the costate decays geometrically. A unit of face maturing at $\tau = 0$ is repaid out of taxes, which fixes $\bar{V}_{b(0)} = u'(\bar{T})$. Evaluating Equation (18) at $q(\tau) = e^{-\rho\tau}$, and setting $\partial_t b = 0$ in Equation (6) so that $\partial_\tau \bar{b} = -\bar{\iota}$ with $\bar{b}(\bar{\tau}) = 0$, the steady state is:

$$\bar{m}(\tau) = -e^{-\tilde{\rho}\tau},$$
$$\lambda(\tau)\,\bar{\iota}(\tau) = e^{-\rho\tau} - e^{-\tilde{\rho}\tau}, \tag{25}$$
$$\bar{b}(\tau) = \int_\tau^{\bar{\tau}} \bar{\iota}(s)\,ds. \tag{26}$$

The right-hand side of Equation (25) is positive at every $\tau > 0$ if and only if $\rho < \tilde{\rho}$, so impatience relative to the market is what sustains positive issuance across the curve. Integrating Equation (26) by parts, using $\bar{b}' = -\bar{\iota}$ and $\bar{b}(\bar{\tau}) = 0$, [5] gives $\int_0^{\bar{\tau}} \bar{b}\,d\tau = \int_0^{\bar{\tau}} \tau\,\bar{\iota}\,d\tau$

[5] From (26), $\bar{b}(\bar{\tau}) = 0$ for finite $\bar{\iota}(\bar{\tau}) = 0$.

and $\int_0^{\bar{\tau}} \tau\, \bar{b}\, d\tau = \frac{1}{2}\int_0^{\bar{\tau}} \tau^2\, \bar{\imath}\, d\tau$, so that the average maturity of the outstanding stock is:

$$\text{WAM} = \frac{\int_0^{\bar{\tau}} \tau^2\, \bar{\imath}(\tau)\, d\tau}{2\int_0^{\bar{\tau}} \tau\, \bar{\imath}(\tau)\, d\tau}. \tag{27}$$

Each maturity enters the stock with an extra factor τ relative to the issuance flow, because a bond of maturity s remains outstanding for a length of time s.

Proof of Proposition 1. By Equation (24), $d\,\dot{\text{WAM}}/dG < 0$ if and only if the ω-weighted average maturity falls short of the average maturity of the stock. Using Equation (27) and clearing the positive denominators, this holds if and only if:

$$\Delta := \left(\int_0^\infty \omega\, d\tau\right)\left(\int_0^\infty \tau^2\, \bar{\imath}\, d\tau\right) - 2\left(\int_0^\infty \tau\, \omega\, d\tau\right)\left(\int_0^\infty \tau\, \bar{\imath}\, d\tau\right) > 0.$$

Write $a := \rho + s$ and $b := \tilde{\rho} + s$, so that $b - a = \tilde{\rho} - \rho$ for every s. Since $1/\lambda$ is completely monotone, Bernstein's theorem supplies a finite positive measure $\nu \neq 0$ with $1/\lambda(\tau) = \int_0^\infty e^{-s\tau}\, d\nu(s)$. Substituting into $\omega = -\bar{m}/\lambda$ and Equation (25) represents both as mixtures of exponentials:

$$\omega(\tau) = \int_0^\infty e^{-b\tau}\, d\nu(s), \qquad \bar{\imath}(\tau) = \int_0^\infty \left(e^{-a\tau} - e^{-b\tau}\right) d\nu(s).$$

The τ-integrals are elementary and each is bounded uniformly over $s \geq 0$ by a constant depending only on ρ and $\tilde{\rho}$. With ν finite, Fubini's theorem therefore applies, and:

$$\Delta = \iint T(s, s')\, d\nu(s)\, d\nu(s')$$

with the symmetrized kernel:

$$T = y\,(x'^3 - y'^3) + y'\,(x^3 - y^3) - y^2(x'^2 - y'^2) - y'^2(x^2 - y^2),$$

in the shorthand $x := 1/a$, $y := 1/b$, $x' := 1/a'$ and $y' := 1/b'$, where $a' := \rho + s'$ and $b' := \tilde{\rho} + s'$. The common gap $b - a = \tilde{\rho} - \rho$ reads $x - y = (\tilde{\rho} - \rho)xy$, and likewise for the primed pair. Factoring the differences of cubes and squares and substituting these links,

$$T = (\tilde{\rho} - \rho)\, y\, y' \Big[x^3 + x'^3 + (y - y')\Big((x^2 + xy) - (x'^2 + x'y')\Big)\Big].$$

Both x and y are decreasing in s, so $(y - y')$ and $(x^2 + xy) - (x'^2 + x'y')$ share a sign and their product is nonnegative. Hence $T \geq (\tilde{\rho} - \rho)\, y\, y'\, (x^3 + x'^3) > 0$ pointwise, and $\Delta > 0$

strictly. $\square$

Proof of Proposition 2. Under the conditions of Proposition 1, $d\,\dot{\text{WAM}}/dG < 0$. Let $d\lambda(\tau) \geq 0$ be supported on maturities above the current WAM. In Equation (12) the substitution term is:

$$-\frac{1}{\mathcal{B}}\int_0^{\bar{\tau}} \left(\tau - \text{WAM}\right)\frac{\iota(\tau)}{\lambda(\tau)}\, d\lambda(\tau)\, d\tau < 0,$$

because $\tau - \text{WAM} > 0$ on the support of $d\lambda$ while ι, λ and $\mathcal{B}$ are positive. The income term is the product of $\int_0^{\bar{\tau}} \mathcal{T}\, d\lambda\, d\tau > 0$, which is positive because $\mathcal{T} > 0$ by Equation (22), and $d\,\dot{\text{WAM}}/dG < 0$. Both terms are therefore negative and so is their sum. $\square$

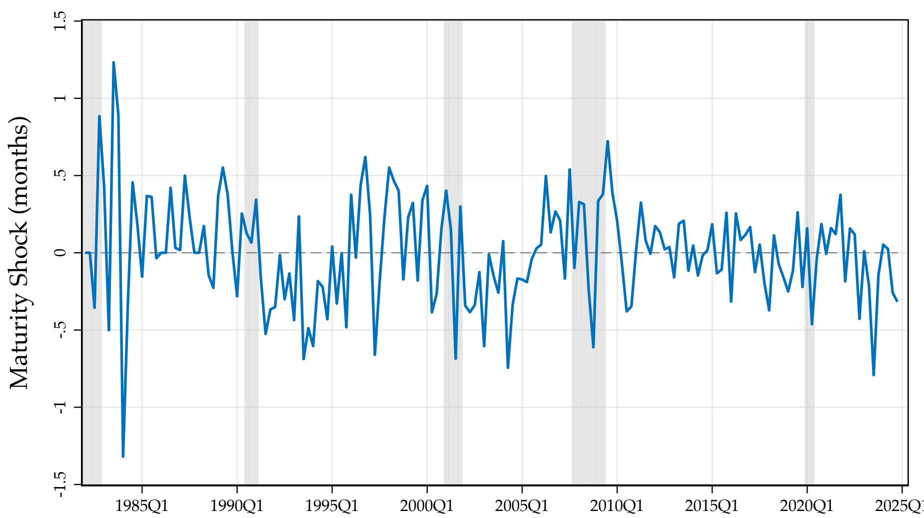
D. Maturity Shocks: Robustness and Additional Results

This appendix first presents additional evidence on the properties of the maturity shock used in Section 4. We examine its time-series behavior, predictability, and correlation with other identified shocks. We then report a battery of robustness checks on the estimated macroeconomic effects of maturity shocks.

D.1. Time-Series Properties

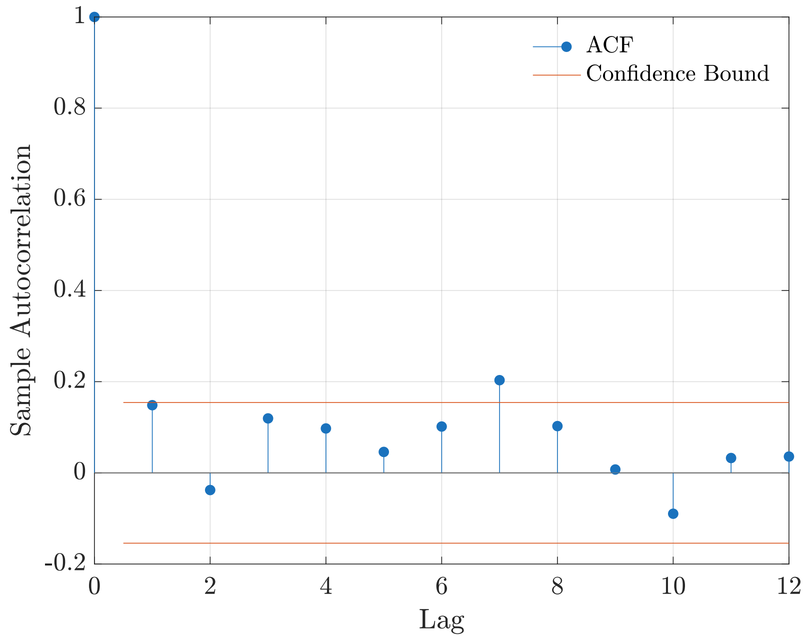
Time-series of the maturity shock. Figure D.1 plots the baseline maturity shock.

Figure D.1: Estimated Maturity Shock



Autocorrelation of the maturity shock. Figure D.2 reports the autocorrelation function of the baseline maturity shock. The autocorrelation estimates provide no evidence of systematic serial dependence in the shock series.

Figure D.2: Autocorrelation Function of the Maturity Shock



D.2. Predictability and Orthogonality

Predictability. Table D.1 reports Wald tests of whether lagged macroeconomic and financial variables predict the maturity shock. The shock's own lags have a p-value of 0.949, while the joint test of macroeconomic predictors has a p-value of 0.912. Among the individual predictors, weighted average maturity has a p-value of 0.079; the remaining p-values are substantially larger. Thus, we find no evidence at the 5 percent level that the shock is predictable using the variables considered.

Table D.1: Predictability of the Maturity Shock

Predictor	Wald statistic	p-value
Shock (Own Lags)	0.719	0.949
Weighted Average Maturity	8.365	0.079
Real GDP	0.593	0.964
Price Level	0.914	0.922
One-year Rate	0.835	0.934
Excess Bond Premium	2.428	0.658
Total Debt	6.805	0.147
Joint Test	15.297	0.912

Orthogonality. Table D.2 compares the maturity shock with commonly used measures of monetary, financial, fiscal, Treasury-auction, uncertainty, and expectations shocks. The correlations are small in absolute value and none is statistically significant at conventional levels. This evidence suggests that the maturity shock captures a distinct source of variation in Treasury policy.

Table D.2: Correlation with Other Identified Shocks

Shock	Source	ρ	p-value	n	Sample
Panel A: Monetary policy shocks					
Monetary policy	Bauer and Swanson	-0.07	0.430	144	1988Q1-2023Q4
	Gertler and Karadi	0.10	0.205	148	1983Q1-2019Q4
	Romer and Romer	-0.09	0.273	148	1983Q1-2019Q4
	Smets and Wouters	-0.02	0.853	88	1983Q1-2004Q4
Panel B: Financial and credit shocks					
Financial conditions	Gilchrist and Zakrajsek	0.04	0.657	162	1983Q1-2023Q2
	Bassett et al.	0.06	0.619	76	1992Q1-2010Q4
Panel C: Fiscal policy shocks					
Government spending	Ramey	-0.00	0.995	124	1983Q1-2013Q4
	Fisher and Peters	0.01	0.958	104	1983Q1-2008Q4
Tax policy	Romer and Romer	0.06	0.532	100	1983Q1-2007Q4
	Mertens and Ravn	-0.08	0.428	100	1983Q1-2007Q4
Panel D: Treasury auction shocks					
Treasury auction: 2-year	Phillot	0.02	0.868	86	1998Q4-2020Q1
Treasury auction: 5-year	Phillot	0.12	0.255	86	1998Q4-2020Q1
Treasury auction: 10-year	Phillot	0.14	0.211	86	1998Q4-2020Q1
Treasury auction: 30-year	Phillot	0.16	0.153	86	1998Q4-2020Q1
Panel E: Expectations and uncertainty					
Uncertainty	Piffer and Podstawski	-0.08	0.299	168	1983Q1-2024Q4
Inflation sentiment	Adams and Barrett	0.11	0.177	166	1983Q1-2024Q2
Technology news	Barsky and Sims	0.06	0.525	99	1983Q1-2007Q3

D.3. Augmented Maturity Rule

In this section, we provide details on the estimation procedure for Table 3. The augmented maturity rule extends the baseline Treasury maturity rule by allowing for a high-dimensional set of additional predictors. Let:

$$m_t \equiv \Delta\mathrm{WAM}_t$$

denote the quarterly change in WAM. The unpenalized part of the rule includes two lags of m_t, current and lagged real GDP growth (y), and current and lagged real public debt growth (D). Specifically, the unpenalized control vector is:

$$C_t = (1, m_{t-1}, m_{t-2}, y_t, y_{t-1}, y_{t-2}, D_t, D_{t-1}, D_{t-2})'.$$

The OLS column estimates the rule using only these unpenalized regressors:

$$m_t = C_t'\theta + u_t.$$

Thus, in Table 1, the reported coefficient on y_t is the contemporaneous coefficient on real GDP growth, the reported coefficient on D_t is the contemporaneous coefficient on real public debt growth, and the persistence coefficient is:

$$\rho = \theta_{m,1} + \theta_{m,2},$$

the sum of the coefficients on m_{t-1} and m_{t-2}.

The ridge specifications add a high-dimensional vector of penalized controls, denoted by Z_t. The estimating equation is:

$$m_t = C_t'\theta + Z_t'\beta + u_t.$$

The vector Z_t contains additional controls. Ridge specification 5 includes the extended SPF forecast-revision block and the change in sentiment indicators; specification 6 adds quarterly seasonal indicators; and specification 7 additionally includes the debt-limit indicator (see Table 2).

The ridge estimator treats the coefficients on the high-dimensional variables, β, as shrinkage coefficients while leaving the coefficients on the low-dimensional variables, θ, unrestricted. This distinction is useful because the variables in C_t are the objects of direct economic interest, while the variables in Z_t are included to absorb additional information from forecasts, sentiment, seasonal effects, and debt limit crises. Before estimation, the dependent variable m_t and the penalized block Z_t are standardized.

The prior is imposed only on the high-dimensional coefficient vector β:

$$\beta \mid \sigma^2, \gamma^2 \sim N\left(0, \gamma^2\sigma^2\Omega\right), \qquad p(\theta) \propto 1.$$

Thus, the prior shrinks the coefficients on the elements of Z_t toward zero, while placing a flat prior on the coefficients of the maturity-rule variables. The scalar γ^2 controls the overall amount of shrinkage: smaller values imply stronger shrinkage of the high-dimensional controls, while larger values make the ridge estimates closer to the corresponding unpenalized least-squares fit.

Let $\mathcal{T}$ denote the estimation sample, and let Z and C denote the matrices obtained by stacking Z_t' and C_t', respectively, in chronological order over $t \in \mathcal{T}$. The full regressor matrix is $X = [Z, C]$, whose row corresponding to quarter t is $x_t' = (Z_t', C_t')$. Let m denote the vector of outcomes m_t stacked in the same order.

In the implementation, we use the G-prior scaling:

$$\Omega = (Z'Z)^{-1},$$

where Z denotes the standardized matrix of penalized regressors in the estimation sample. This scaling accounts for the covariance structure of the penalized regressors and makes the prior invariant to linear rescaling of the columns of Z. Let:

$$b = \begin{pmatrix} \beta \\ \theta \end{pmatrix},$$

and define the block penalty matrix:

$$V = \begin{pmatrix} \Omega^{-1} & 0 \\ 0 & 0 \end{pmatrix}.$$

The zero block in the lower-right corner reflects the fact that no ridge penalty is applied to the controls in C_t.

Conditional on γ^2, the posterior mode solves a penalized least-squares problem:

$$\widehat{b}(\gamma^2) = \arg\min_b \left\{ (m - Xb)'(m - Xb) + \frac{1}{\gamma^2} b'Vb \right\}.$$

Equivalently,

$$\widehat{b}(\gamma^2) = \left(X'X + \frac{1}{\gamma^2} V \right)^{-1} X'm.$$

Because V has zeros in the block corresponding to θ, the penalty affects only the coefficients on Z_t. The coefficients reported in Table 3 are the elements of $\widehat{\theta}$: the contemporaneous coefficients on y_t and D_t, together with the persistence coefficient ρ, defined as the sum of the two coefficients on lagged maturity growth.

The shrinkage parameter γ^2 is chosen by maximizing the marginal likelihood after integrating out the regression coefficients. Once γ^2 is selected, the posterior covariance matrix is computed conditional on this value and used to form approximate posterior-normal standard errors.

D.4. Robustness of Macroeconomic Responses

Shock identification. We begin by investigating alternative identification strategies. In our baseline specification in Equation (15), we assume that the residual from the maturity rule, ε_t^{wam}, corresponds to the structural maturity shock. However, as emphasized by Stock and Watson (2018), such a shock measure may capture only part of the exogenous variation in the maturity structure of public debt. We therefore also use ε_t^{wam} as an instrument for realized changes in Treasury maturity in a local-projection instrumental-variables specification (LP-IV). Specifically, for each horizon h, we estimate:

$$y_{t+h} = \alpha_h + \beta_h \text{WAM}_t + \gamma_h' \mathbf{Z}_{t-p} + u_{t+h} \tag{28}$$

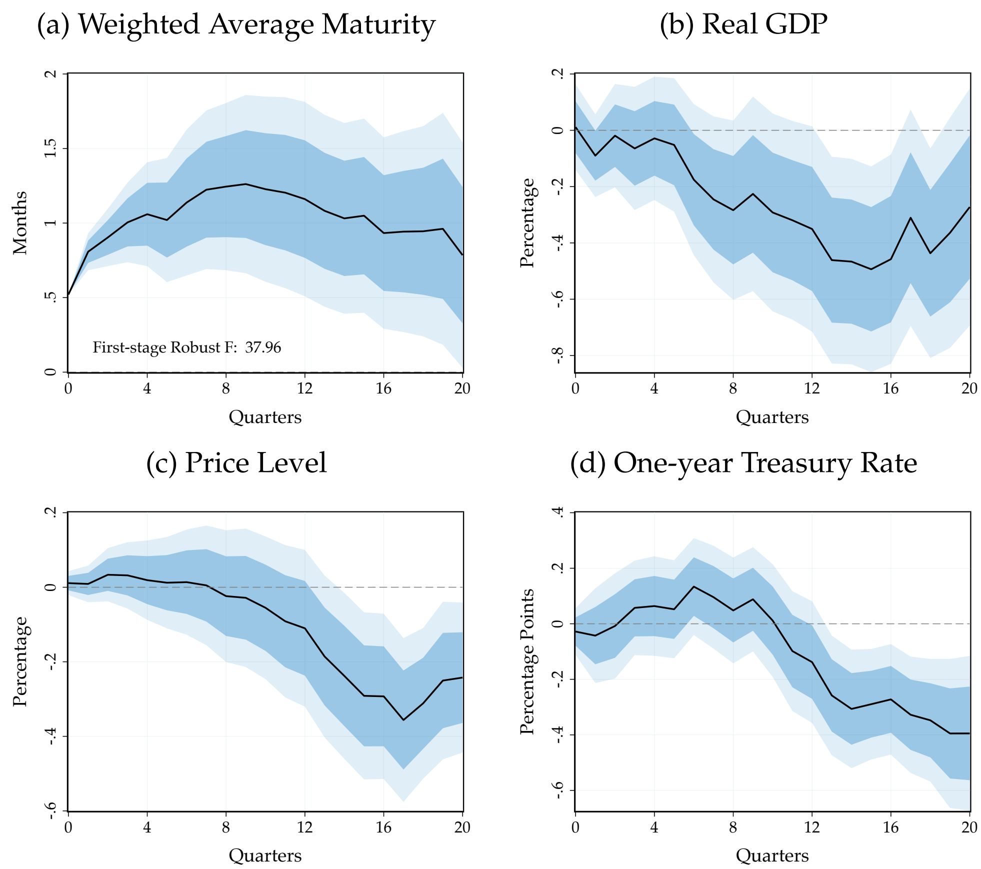
where WAM_t is instrumented by the maturity-rule residual ε_t^{wam}. The vector $\mathbf{Z}_{t-p}$ contains the same lagged controls as in Equation (15) plus the lags of WAM. The coefficient β_h traces the response of y_{t+h} to the exogenous component of WAM induced by the maturity shock.

Figure D.3 reports the results. The robust first-stage F-statistic is approximately 38, well above the conventional thresholds, providing evidence of a strong first-stage relationship between the maturity shock and weighted average maturity. The impulse responses are nearly identical to those reported in Figure 5, indicating that the estimated responses are robust to using the maturity shock as an instrument for weighted average maturity.

We also assess how our rule-augmentation procedure affects the baseline results. Specifically, we extract the residual from the baseline maturity rule reported in specification (1) of Table 2 and use it as the shock in the local projection specified in Equation (15). Figure D.4 shows that, while the direction and shape of the impulse responses are broadly similar to the baseline, the confidence bands are substantially wider. In particular, the response of real GDP is not statistically different from zero at any horizon. This suggests that augmenting the Treasury information set through the ridge procedure helps reduce noise in the shock measure and delivers more precise estimates of the macroeconomic effects of maturity shocks.

Finally, we consider an alternative identification strategy based on a different model of the U.S. economy. Specifically, we estimate a VAR and identify the maturity shock using a recursive restriction on real GDP and public debt. We impose that neither real GDP nor public debt responds contemporaneously to the maturity shock. The VAR includes six variables: WAM, real GDP, the price level, the one-year Treasury rate, the NFCI, and total debt. The sample runs from 1982:Q1 to 2024:Q4, and the specification includes two lags.

Figure D.3: Sensitivity to Estimation Strategy: LP-IV Estimates



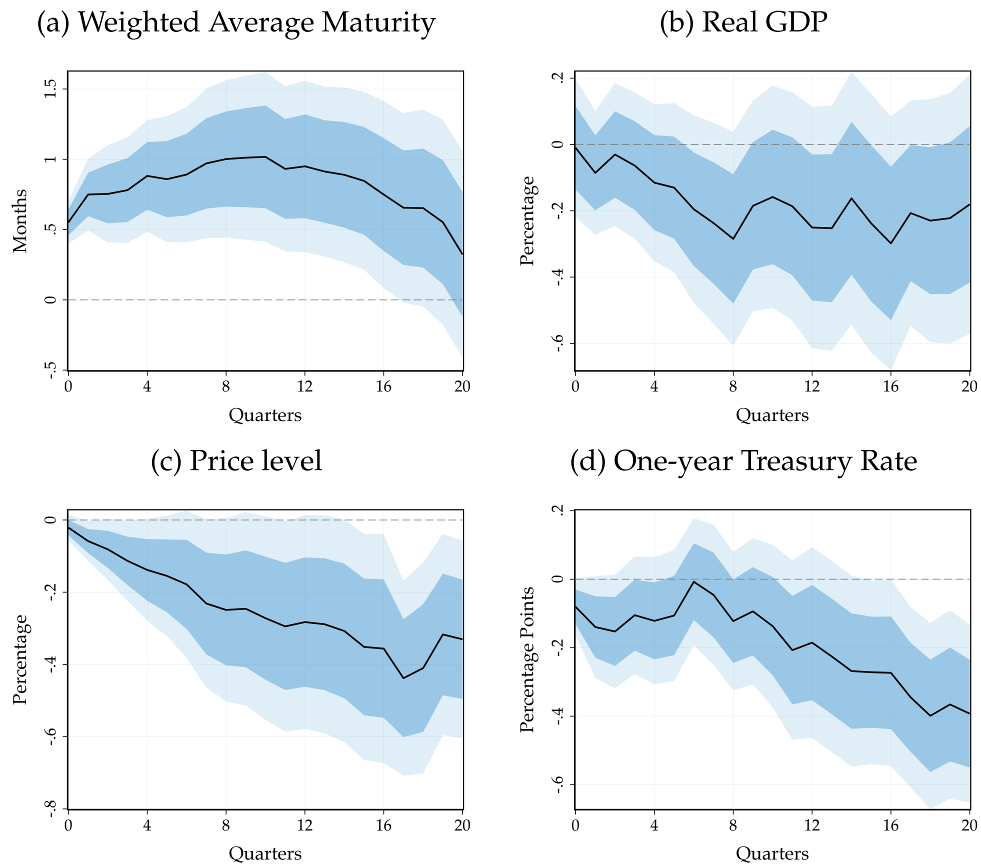
Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (28) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Relative to the four-variable framework used in the local projections, we augment the VAR with two additional variables for two reasons. First, VARs may be particularly susceptible to informational insufficiency, and including financial conditions and public debt helps mitigate this concern. Second, public debt must enter the system in order to impose the recursive identifying restriction.

We estimate the VAR in levels to maintain consistency with the local projection evidence presented in Section 4.2. Accordingly, the identifying restriction is that the levels of real GDP and public debt do not respond contemporaneously to movements in WAM, rather than their growth rates as in the maturity rule. We have verified, however, that the results are similar when the VAR is estimated in first differences.

Figure D.5 shows that the identified shock raises WAM on impact by an amount similar to our baseline estimate. The responses of real GDP and the price level are also quali-

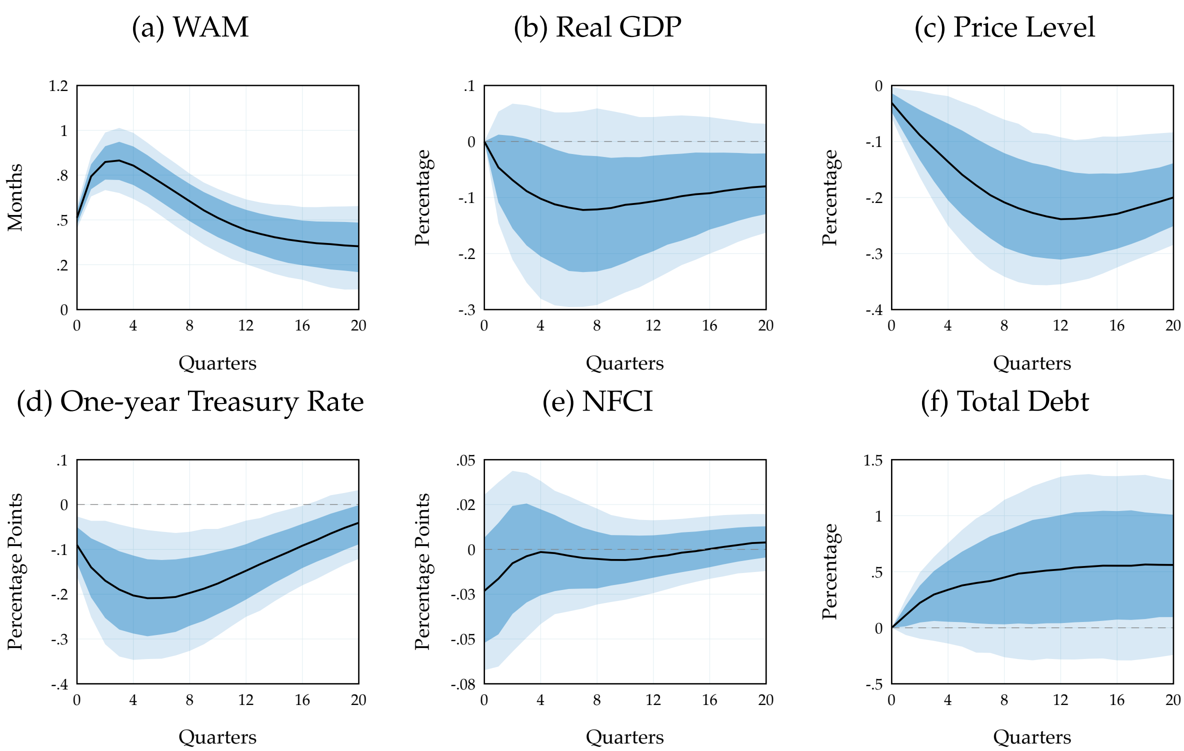
Figure D.4: Shock from Maturity Rule with Only Macro Variables



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock extracted from the maturity rule with only macroeconomic variables in Equation (3). Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

tatively similar, although smaller in magnitude. Two important differences emerge. First, the financial conditions index declines and remains below zero for roughly one year. Second, although total debt cannot respond on impact by construction, it subsequently rises persistently over the full five-year horizon. Both responses are consistent with a positive demand shock for public debt: an exogenous increase in demand for Treasuries improves financial conditions and induces the Treasury to accommodate that demand by issuing additional debt. This evidence suggests that a recursive Cholesky identification in the VAR is likely to confound supply-driven maturity shocks with shifts in the demand for public debt.

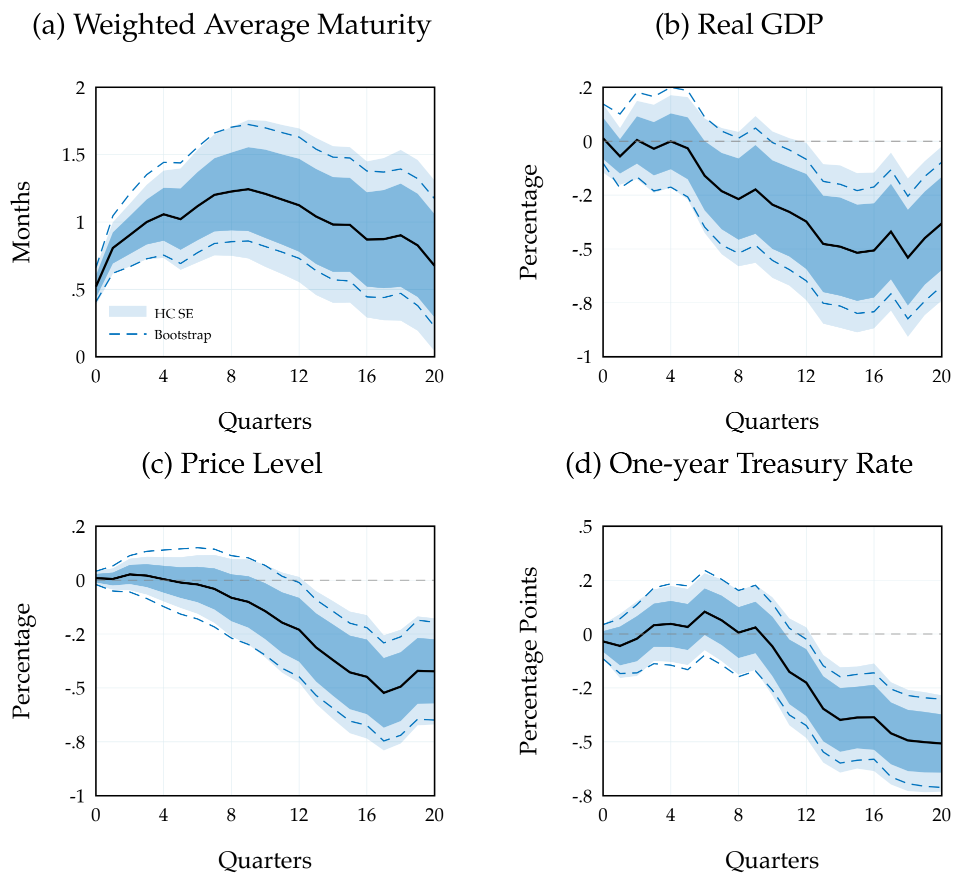
Figure D.5: Sensitivity to Estimation Strategy: Recursive Identification in a VAR



Notes: Impulse responses of WAM, real GDP, price level, one-year Treasury rate, NFCI index of financial conditions, and total debt to a positive one standard deviation debt maturity shock. The shock is identified with a recursive (Cholesky) assumption. Responses are estimated using a VAR over the sample 1982:Q1–2024:Q4. Controls include two lags, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively, based on moving-block bootstrap.

Accounting for uncertainty in shock estimation. The baseline local projections treat the estimated shock as observed and therefore abstract from uncertainty associated with its estimation. While convenient, this simplification may overstate the precision of the impulse responses. We assess this possibility using a paired bootstrap that resamples, with replacement, the estimated shock together with innovations from outcome-specific VAR data-generating processes, and re-estimates the local projections in each of 10,000 replications.

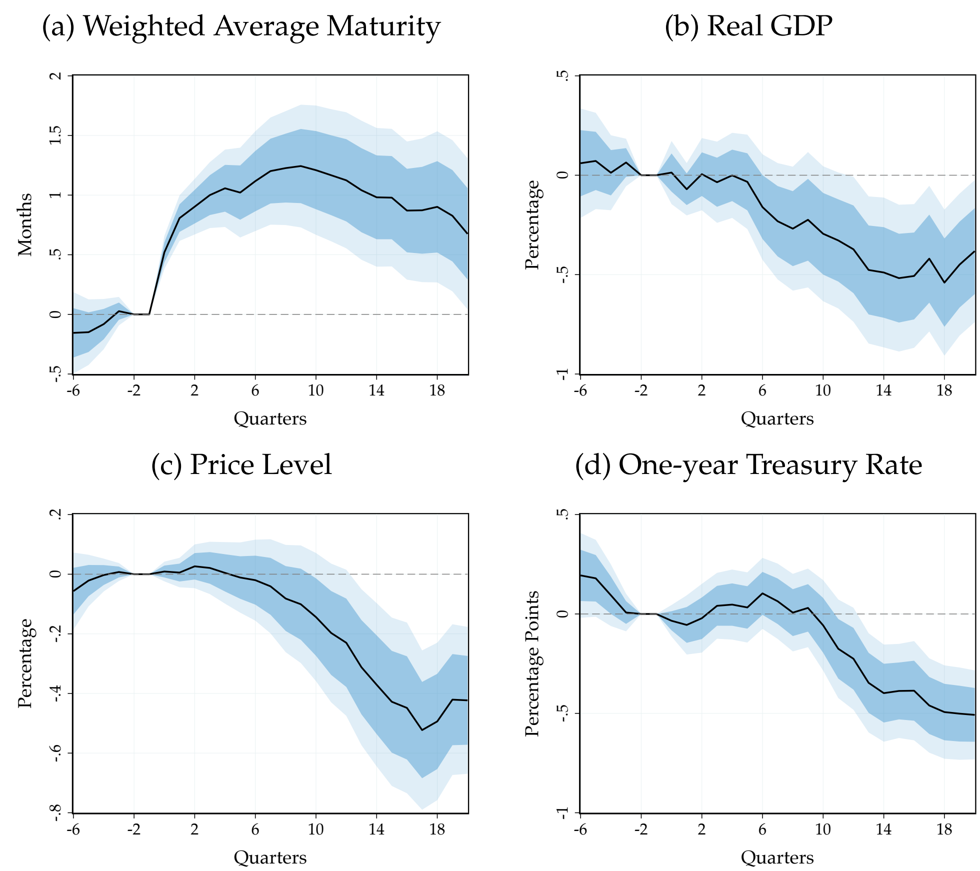
Figure D.6: Inference Accounting for Uncertainty in the Extracted Shock



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Solid lines denote point estimates, dark and light shaded areas denote baseline 68 and 90 percent confidence intervals, respectively, and dashed lines denote 90 percent bootstrap confidence intervals.

Pre-trends and outliers. We further verify that our results are not driven by underlying trends in the data. Specifically, in Figure D.7, we test whether WAM, real GDP, the price level, and the one-year Treasury rate exhibit pre-trends in the eighteen months preceding the shock. As the figure shows, none of the variables displays a statistically significant pre-trend.

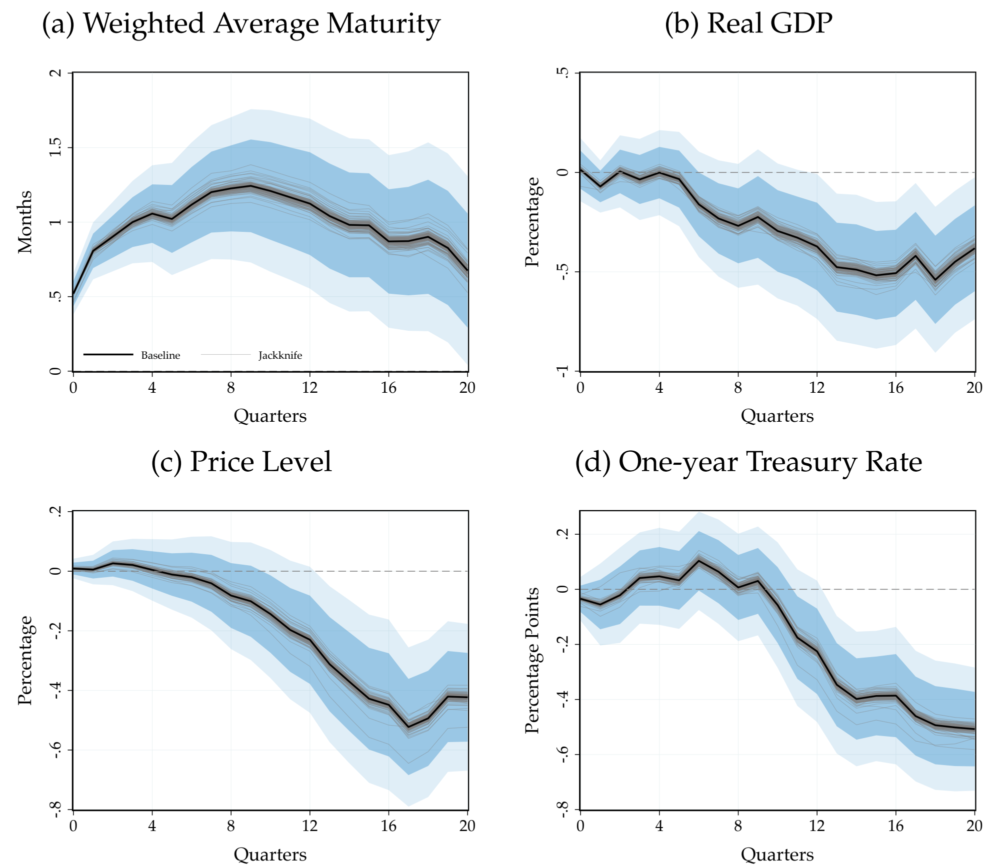
Figure D.7: Testing for Pre-Trends



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock, showing pre-trends for six quarters. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Because the sample used to identify the maturity shock includes episodes of substantial financial market volatility—such as the early 1980s, the Global Financial Crisis, and the COVID-19 recession—we also assess whether our findings are driven by outliers in the shock series. To do so, we conduct a leave-one-out jackknife exercise, setting the shock to zero one quarter at a time while including a dummy for the corresponding quarter. Figure D.8 shows that the impulse responses are remarkably stable across these exercises, indicating that our results are not driven by any individual outlier observation.

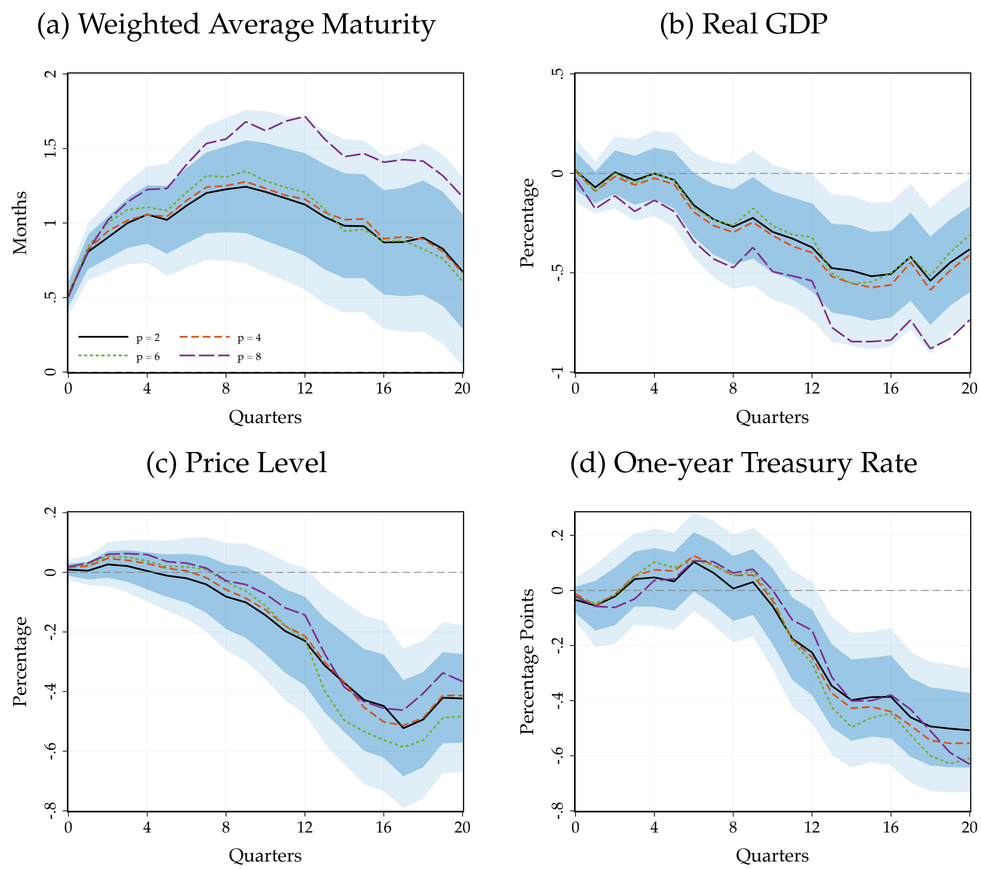
Figure D.8: Testing for Outliers



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. The black solid line denotes the baseline point estimates, while the gray lines denote responses with the shock censored to zero in each quarter. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Dynamic specification. We explore the sensitivity of our results to the specification of the local projections. First, Figure D.9 reports results obtained using alternative lag structures. Increasing the number of lags from two to four or six leaves the impulse responses virtually unchanged. Including two years of lags generates a somewhat more persistent increase in WAM and, correspondingly, a more pronounced contraction in economic activity. The main economic conclusions, however, are preserved, indicating that our results are not sensitive to the choice of lag length.

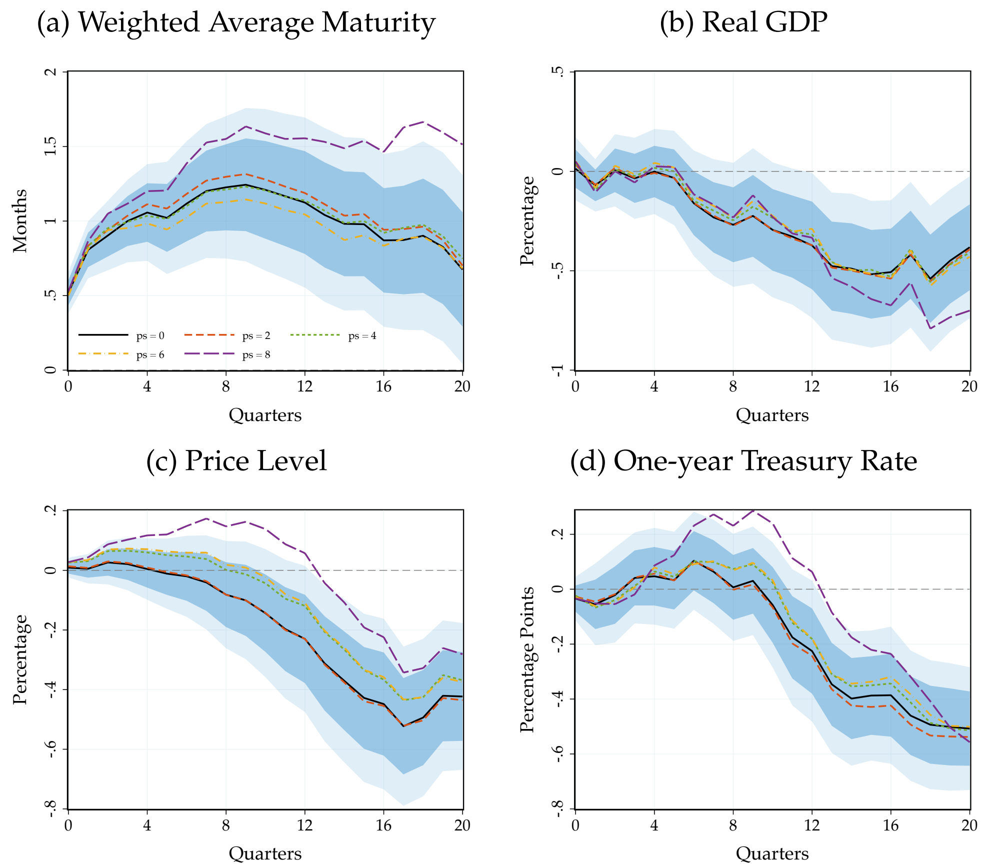
Figure D.9: Alternative Lag Structures of Controls



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock, controlling for different lag structures. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include p lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

We also examine whether including lags of the shock in the local projection specification affects the impulse responses. Figure D.10 shows that the results are again robust to this alternative. Only the specification with two years of lags generates a somewhat larger WAM response, together with a more delayed contraction in the price level and decline in the one-year Treasury rate.

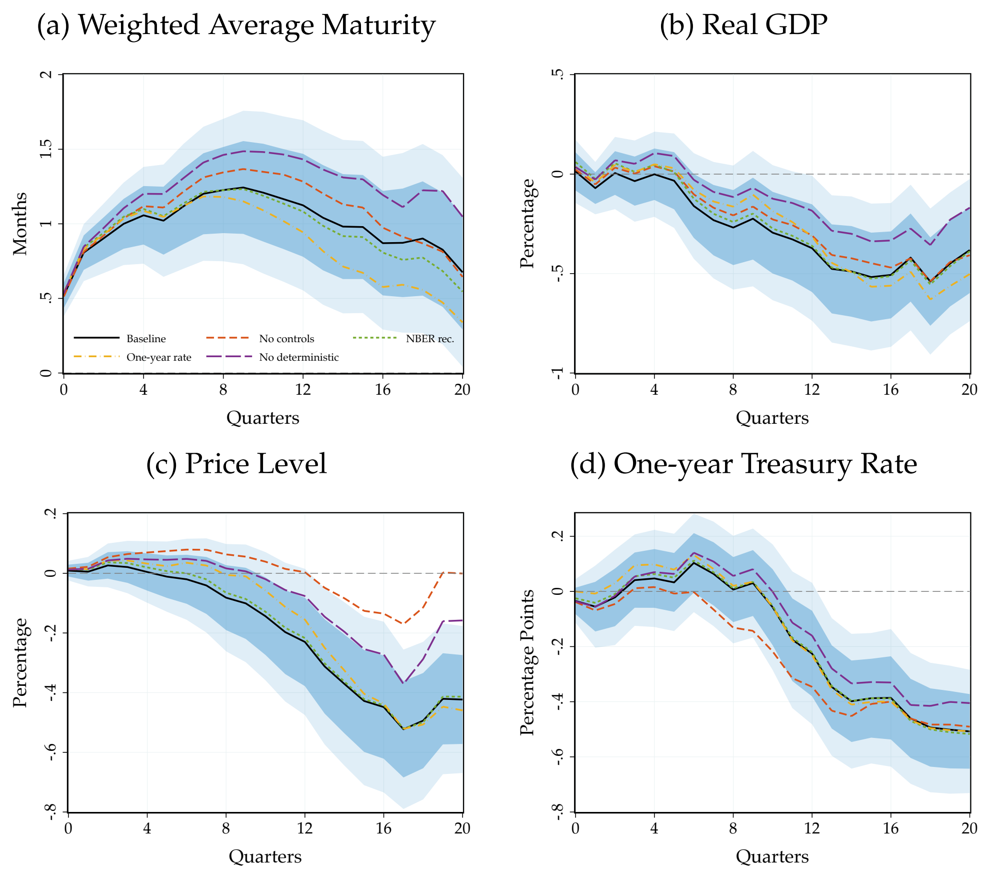
Figure D.10: Alternative Lag Structures of the Shock



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock, controlling for different lag structures of the shock. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

Finally, a key choice in local projections concerns the set of controls included in the specification. Figure D.11 considers several alternatives. We estimate specifications with no controls, with all deterministic controls excluded, and with the baseline set augmented by either NBER recession indicators or the one-year Treasury rate to account for monetary policy. The impulse responses are essentially unchanged across all specifications, indicating that our results are not sensitive to the choice of controls.

Figure D.11: Alternative Controls and Deterministic Terms



Notes: Impulses responses of WAM, real GDP, price level, and one-year Treasury rate to a positive one standard deviation debt maturity shock, with varying control sets. Responses are estimated using Equation (15) over the sample 1982:Q1–2024:Q4. Controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend. Dark and light shaded areas denote 68 and 90 percent confidence intervals, respectively.

E. Policy Counterfactuals

We estimate the responses of output, total debt, and weighted average maturity to the military spending news shock of Ramey and Zubairy (2018). These responses provide the baseline paths under the prevailing Treasury maturity rule used in the policy counterfactuals. The shock is constructed as the present discounted value of expected changes in defense spending, scaled by lagged nominal potential output. Table A.1 reports the data sources and transformations.

Specification. For output and real debt, we use the linear, state-invariant specification of Ramey and Zubairy (2018). At each horizon h, we estimate:

$$x_{t+h} = \alpha_h + \beta_h \varepsilon_t^{RZ} + \sum_{i=1}^{4} \Big(\gamma_{h,i} \varepsilon_{t-i}^{RZ} + \delta_{h,i} y_{t-i} + \phi_{h,i} g_{t-i} \Big) + u_{t+h}. \tag{29}$$

The dependent variable x_t is either output, $y_t = 100(rgdp_t/\bar{y}_t)$, or real debt, $100[\log D_t - \log p_t]$, where $rgdp_t$ is real GDP, $\bar{y}_t$ is potential output, D_t is nominal federal debt held by the public, and p_t is the GDP deflator. Government purchases are defined as $g_t = 100[(ngov_t/p_t)/\bar{y}_t]$, where $ngov_t$ denotes nominal government purchases. Thus, both output and government purchases are expressed as percentages of potential output.[6] Both regressions include four lags of the shock, output, and government purchases, with no deterministic trend or tax controls. Responses are reported per unit of the military news shock, with the output response measured in percentage points of potential output.

For WAM, we retain the baseline local-projection specification in Equation (5). The controls include two lags of the dependent variable, real GDP, and the price level, together with a linear trend.

Sample. We estimate each response over its longest available sample rather than imposing a common estimation window. At impact, the samples span 1890:Q1–2015:Q4 for output, 1890:Q1–2015:Q2 for real debt, and 1981:Q1–2015:Q4 for WAM. The WAM sample begins later because of the availability of the maturity series, while all three samples end with the last available observations of the military news shock and the respective outcome.

[6] We use the potential output series constructed by Ramey and Zubairy (2018), based on a sixth-degree polynomial fitted over 1889:Q1–2015:Q4, excluding the Great Depression and the Second World War.

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