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Government Employment Shocks, Policy Coordination, and Debt Structure*

Hyeongwoo Kim†, Ren Zhang‡, and Shuwei Zhang§

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Abstract

The labor market effects of government employment shocks in the United States have varied markedly over the postwar period. Using a Bayesian structural VAR with max-share identification, we identify three distinct regimes: public hiring crowded in private employment, raised real wages, and reduced unemployment before the Volcker disinflation; became contractionary during the Great Moderation; and had largely muted effects after the Global Financial Crisis (GFC). We explain these shifts using a New Keynesian DSGE model with public employment, alternative monetary–fiscal regimes, and government debt maturity. The model shows that the pre-Volcker and post-GFC periods share passive monetary and active fiscal policy but differ in debt structure. Longer maturity weakens fiscal transmission even under passive monetary policy, while aggressive anti-inflationary monetary policy makes government employment shocks contractionary regardless of debt maturity.

Keywords: Debt Maturity; Government Employment; Max-Share Identification; Policy Coordination; Time-varying Effectiveness

JEL Classification: E32; E61; E62

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1 Introduction

This paper examines how monetary–fiscal policy coordination and government debt maturity shape the labor market effects of government employment shocks. Using postwar U.S. data, we document substantial changes in these effects across major episodes in U.S. macroeconomic history and develop a theoretical framework to explain the underlying forces.

We focus on government employment as a distinct fiscal instrument. More than 60% of U.S. government consumption consists of public employee compensation, yet this component remains relatively understudied.[1] Much of the existing literature treats government spending as an aggregate fiscal instrument (see Monacelli et al. 2010; Brückner and Pappa 2012; Kim et al. 2023). Although government employment shocks may have effects similar to those of broader spending shocks, examining public employment separately allows us to isolate this distinct fiscal instrument and investigate its implications for private-sector labor markets.

Focusing on public hiring also provides a useful perspective on the interactions between public and private labor markets, particularly the extent to which government employment affects private-sector labor demand and wages (see Finn 1998; Linnemann 2009; Ramey 2013; Michaillat 2014). This distinction helps shed light on conflicting evidence regarding whether public hiring crowds in or crowds out private employment.

We first estimate a Bayesian structural vector autoregression (SVAR) using postwar quarterly U.S. data and the max-share approach of Francis et al. (2014) and Kurmann and Sims (2021) to identify government employment shocks. This approach nests conventional recursive identification but allows the structural disturbance of interest to be a latent common shock, expressed as a linear combination of reduced-form innovations rather than the innovation associated with any single observable variable.

This identification strategy is motivated by the institutional determination of federal employment, which is driven primarily by discretionary budgetary and personnel decisions rather than contemporaneous economic conditions, extending the decision-lag argument of Blanchard and Perotti (2002) to the budget cycle. Specifically, we identify the orthogonal disturbance that explains the largest share of federal employment variation over the first four quarters, allowing other shocks to influence employment beyond this horizon as budgetary decisions increasingly respond to economic conditions.[2] It therefore identifies the economically most relevant shock without requiring a theoretically justified set of zero restrictions.[3]

[1] Based on the authors' calculations using data from the U.S. Bureau of Economic Analysis (BEA)'s National Income and Product Accounts (NIPA).

[2] Kurmann and Sims (2021) apply the max-share approach to identify technology (TFP) news shocks; related max-share approaches have since been applied to other structural shocks. See, for example, Antolin-Diaz and Surico (2025) and Yang et al. (2025).

[3] Our results are robust to alternative identification schemes, including recursive identification. See the

Our results reveal pronounced time variation in the effects of government employment shocks. In the pre-Volcker era (1960Q1–1979Q3), these shocks stimulate aggregate demand, raising private employment and real wages while reducing unemployment. During the Great Moderation (1984Q1–2007Q2), public hiring generates more-than-complete crowding out of private employment and lowers real wages. In the post-GFC era (2008Q4–2025Q1), crowding-out effects weaken, but the pre-1980 expansionary responses do not return despite the reemergence of accommodative monetary policy. These findings suggest that changes in monetary–fiscal coordination alone cannot account for the full evolution of fiscal transmission, pointing to an additional role for government debt maturity.

To explain these findings, we develop a unified New Keynesian (NK) dynamic stochastic general equilibrium (DSGE) model featuring an explicit public employment sector, alternative monetary–fiscal regimes as in Leeper et al. (2017), and government debt maturity following Woodford (2001).[4] Building on the regime framework established by Leeper (1991) and further developed by Leeper et al. (2017), we recognize monetary–fiscal policy coordination as a first-order determinant of fiscal transmission. We extend this framework by examining how government debt maturity interacts with the policy regime to shape the effects of public hiring.

The model explains the time variation in labor market responses through three mechanisms. First, under active fiscal policy, passive monetary policy, and short-term debt financing (Regime $\mathrm{F_{SD}}$), government employment expansions stimulate aggregate demand and improve labor market outcomes, consistent with the pre-Volcker evidence, when debt maturity was comparatively short and falling. Second, when monetary policy responds aggressively to inflation (Regime M), public hiring becomes contractionary largely regardless of debt maturity, consistent with the Great Moderation (GM). Third, even under passive monetary policy, longer-term debt financing (Regime $\mathrm{F_{LD}}$) substantially attenuates the expansionary effects of government employment, consistent with the muted post-GFC responses. Higher public hiring lowers the present value of surpluses, so the real market value of debt must fall. With short-term debt, this occurs only through current inflation, which lowers real interest rates under passive monetary policy, whereas longer-term debt absorbs part of the revaluation via an immediate fall in bond prices, postponing inflation and weakening the wealth effect.

This paper makes two main contributions. Empirically, we provide novel evidence that the labor market effects of government employment shocks vary substantially over time,

Online Appendix for details.

[4]Existing research finds that increases in government employment tend to raise real wages and private employment, consistent with NK models emphasizing aggregate demand channels (see Pappa 2009; Linnemann 2009; Brückner and Pappa 2012; Bermperoglou et al. 2017). Our empirical results likewise show nonnegative comovement between private employment and real wages across all subsamples.

shifting from crowding in before 1980 to crowding out during the GM and becoming muted after the GFC. Although previous studies document time variation in the effects of aggregate government spending (e.g., Perotti 2005; Brückner and Pappa 2012), to our knowledge, this paper is the first to isolate government employment as a distinct fiscal instrument and link its changing effects to monetary–fiscal policy regimes. Our findings help reconcile the longstanding debate over whether government hiring crowds in or crowds out private employment.[5]

Theoretically, we show that the interaction between monetary–fiscal regimes and government debt maturity is central to explaining these empirical patterns. In particular, debt maturity critically affects fiscal effectiveness even under accommodative monetary policy. While previous NK models incorporating rule-of-thumb consumers (e.g., Forni et al. 2009) or search and matching frictions (e.g., Michaillat 2014; Bermperoglou et al. 2017) generate small or mildly positive effects of public hiring, our framework highlights the importance of jointly considering monetary–fiscal regimes and debt maturity to explain the time variation in labor market responses. Two recent related studies are Mao and Yang (2020) and Ghomi et al. (2025), which highlight government debt maturity as a determinant of the fiscal multiplier. However, both focus on aggregate government spending rather than employment and do not examine variation across monetary–fiscal regimes.

The remainder of the paper is organized as follows. Section 2 presents the econometric framework and empirical results. Sections 3 and 4 develop the theoretical model and examine the mechanisms underlying the time-varying effects. Section 5 concludes.

2 The Empirics

This section presents the empirical model and identification strategy used to identify government employment shocks through the max-share approach. We then report our main results, which reveal pronounced time variation in the labor market effects of government employment shocks across three subsample periods: the pre-Volcker era, the GM, and the post-GFC era.

2.1 The Empirical Model and Identification Strategy

We estimate a Bayesian SVAR model that identifies government employment shocks using the max-share approach similar to the work by Francis et al. (2014), Kurmann and Sims

[5]For evidence of crowding-in, see Fatás and Mihov (2001), Jofre-Monseny et al. (2020), and Faggio et al. (2025). For evidence of crowding-out, see Algan et al. (2002), Behar and Mok (2019), and Becker et al. (2021).

(2021), and Antolin-Diaz and Surico (2025).

Let $\mathbf{y}_t$ be a $k \times 1$ vector of endogenous variables. Consider the following reduced-form moving average (MA) representation:

$$\mathbf{y}_t = \mathbf{B}(L)\mathbf{u}_t, \tag{1}$$

where $\mathbf{B}(L) = \sum_{i=0}^{\infty} \mathbf{B}_i L^i$ is a lag polynomial with $\mathbf{B}_0 = \mathbf{I}$. $\mathbf{u}_t$ represents a $k \times 1$ vector of forecast errors satisfying $E(\mathbf{u}_t \mathbf{u}'_t) = \mathbf{\Sigma}$. We assume that there exists a *linear* mapping between forecast errors and structural shocks, $\mathbf{u}_t = \mathbf{A}\varepsilon_t$, where ε_t is a $k \times 1$ vector of structural shocks, which are mutually orthonormal: $E(\varepsilon_t \varepsilon'_t) = \mathbf{I}$.

Equation (1) can be expressed in its structural MA representation as:

$$\mathbf{y}_t = \mathbf{C}(L)\varepsilon_t, \tag{2}$$

where $\mathbf{C}(L) = \mathbf{B}(L)\mathbf{A}$ and $\mathbf{A}\mathbf{A}' = \mathbf{\Sigma}$. Note that $\mathbf{A}$ is not uniquely identified. The entire space of permissible matrices can be characterized by $\mathbf{A} = \mathbf{P}\mathbf{D}$, where $\mathbf{P}$ is the unique lower-triangular Cholesky factor of $\mathbf{\Sigma}$, and $\mathbf{D}$ is a $k \times k$ orthonormal matrix such that $\mathbf{D}\mathbf{D}' = \mathbf{I}$.[6]

The h-period-ahead forecast error of $\mathbf{y}_t$ is written as:

$$\mathbf{y}_{t+h} - \hat{\mathbf{y}}_{t+h|t-1} = \sum_{\tau=0}^{h} \mathbf{B}_\tau \mathbf{P}\mathbf{D}\varepsilon_{t+h-\tau} \tag{3}$$

The share of the h-period-ahead forecast error variance of variable i attributable to shock j is:

$$\text{FEV}_{i,j}(h) = \frac{\mathbf{i}'_i \left[\sum_{\tau=0}^{h} \mathbf{B}_\tau \mathbf{P}\mathbf{D}\mathbf{i}_j \mathbf{i}'_j \mathbf{D}'\mathbf{P}'\mathbf{B}'_\tau\right] \mathbf{i}_i}{\mathbf{i}'_i \left[\sum_{\tau=0}^{h} \mathbf{B}_\tau \mathbf{\Sigma}\mathbf{B}'_\tau\right] \mathbf{i}_i} = \frac{\sum_{\tau=0}^{h} \mathbf{b}'_{i,\tau}\mathbf{P}\mathbf{d}_j\mathbf{d}'_j\mathbf{P}'\mathbf{b}_{i,\tau}}{\sum_{\tau=0}^{h} \mathbf{b}'_{i,\tau}\mathbf{\Sigma}\mathbf{b}_{i,\tau}}, \tag{4}$$

where $\mathbf{i}_s$ (selection vector) is the s^{th} column of the identity matrix $\mathbf{I}$ ($s = i, j$), $\mathbf{d}_j$ denotes the j^{th} column of $\mathbf{D}$, and $\mathbf{b}_{i,\tau}$ is the i^{th} column of $\mathbf{B}_\tau$.

The max-share approach generalizes recursive identification via the Cholesky decomposition by relaxing the strict zero-restriction constraints. Without loss of generality, we order government employment (n_t^g) first in $\mathbf{y}_t$ and identify the government employment shock as

[6] For every real symmetric, positive-definite matrix $\mathbf{\Sigma}$, there exists a unique lower triangular matrix $\mathbf{P}$ with positive diagonal entries such that $\mathbf{\Sigma} = \mathbf{P}\mathbf{P}'$. However, $\mathbf{A}$ is not restricted to be lower triangular, so the factorization $\mathbf{A}\mathbf{A}' = \mathbf{\Sigma}$ is not unique.

the column $\mathbf{d}_j$ that maximizes

$$\max_{\mathbf{d}_j} \text{FEV}_{1,j}(h) = \frac{\sum_{\tau=0}^{h} \mathbf{b}_{1,\tau}' \mathbf{P} \mathbf{d}_j \mathbf{d}_j' \mathbf{P}' \mathbf{b}_{1,\tau}}{\sum_{\tau=0}^{h} \mathbf{b}_{1,\tau}' \boldsymbol{\Sigma} \mathbf{b}_{1,\tau}} \tag{5}$$

subject to $\mathbf{d}_j' \mathbf{d}_j = 1$. The identified shock is thus the linear combination of innovations that maximizes its contribution to the h-period-ahead forecast error variance.

We set the forecast horizon to $h = 4$ quarters (one year) in our baseline model. Government employment adjusts gradually due to budgeting, authorization, and hiring procedures, implying that most of the response to structural shocks unfolds over several quarters rather than within a single quarter. A one-year horizon therefore captures the economically relevant adjustment window. This choice is also consistent with Antolin-Diaz and Surico (2025).[7]

2.2 Data and Regime Specifications

Let $\mathbf{y}_t$ denote a vector of five endogenous variables: (1) federal government employment (n_t^g); (2) real GDP per capita (gdp_t); (3) one of three labor market variables (lab_t): private employment (n_t^p), the unemployment rate ($urat_t$), or the real wage ($wage_t$); (4) the effective federal funds rate (int_t); and (5) the monetary base (mon_t). All quarterly data are from FRED and cover $1960Q1$–$2025Q1$. Detailed data descriptions are provided in the Online Appendix.

Government employment comprises federal civilian and military employees.[8] All variables except $urat_t$ and int_t enter in log levels (multiplied by 100). Each series is demeaned and detrended using a quadratic trend. We estimate the VAR with two lags under a conjugate normal-inverse-Wishart prior and construct credible intervals from the resulting posterior distribution.

The extraordinary fluctuations at the onset of COVID-19 can distort conventional VAR estimates (Lenza and Primiceri 2022; Cascaldi-Garcia 2022). Accordingly, we report post-GFC results for both the pre-COVID sample ending in $2019Q4$ and the full sample using the Pandemic Priors of Cascaldi-Garcia (2022). Further details on post-COVID outlier treatment appear in the Online Appendix.

We divide the sample into three periods:

1. **pre-Volcker era** ($1960Q1$–$1979Q3$): Characterized by accommodative monetary policy, rising inflation expectations, and recurring inflationary pressures associated with

[7] Our results are robust to alternative choices of the forecast horizon h. Results are available in the Online Appendix.

[8] Results are robust to using the federal government wage bill as the fiscal variable. Estimates are reported in the Online Appendix.

fiscal expansion and oil price shocks.

2. **Great Moderation** (1984Q1–2007Q2): Characterized by a stronger commitment to price stability, better-anchored inflation expectations, and lower macroeconomic volatility.[9]

3. **post-GFC era** (2008Q4–2025Q1): Characterized by the zero lower bound and extensive use of unconventional monetary policies, including large-scale asset purchases and forward guidance.

As emphasized by Leeper et al. (2017), monetary–fiscal policy regimes are central to understanding fiscal transmission. Our periodization reflects two major shifts in U.S. monetary policy: the Volcker disinflation beginning in 1979, described by Goodfriend and King (2005) as "the most widely discussed and visible macroeconomic event of the last 50 years of U.S. history," and the GFC, when the Federal Reserve rapidly lowered its policy rate to near zero.[10]

Despite broadly accommodative and coordinated fiscal and monetary policies, the post-GFC and pre-Volcker eras differ importantly in government debt maturity. As Figure 1 shows, average maturity declined in the pre-Volcker era but generally increased after the GFC, interrupted by sharp temporary declines in 2008 and 2020.

These declines reflect emergency fiscal responses to the GFC and COVID-19, which required substantial short-term Treasury bill issuance. The subsequent increase reflects Treasury efforts to lock in low interest rates and reduce rollover risk through longer-term borrowing. These actions partly offset the Federal Reserve's Quantitative Easing (QE) and Operation Twist, creating a "policy tug-of-war" over debt maturity.[11] This divergence indicates weaker coordination in debt management despite broadly aligned fiscal and monetary policy stances.

[9] We exclude the Volcker disinflation (1979Q4–1983Q4), consistent with Regime M in Ascari et al. (2023). Results are robust to including this period; see the Online Appendix. We thank an anonymous referee for this suggestion.

[10] This periodization is consistent with structural breaks documented by Bernanke and Mihov (1998), Judd and Rudebusch (1998), Stock and Watson (2002), and Galí and Gambetti (2009), among others, which identify the Volcker disinflation and transition to the GM as major regime shifts. Klose (2014) further identifies breaks in Fed Taylor-rule coefficients during the GFC, with estimated dates concentrated between 2007 and 2009.

[11] In February 2009, the Treasury introduced monthly 7-year note auctions and increased 30-year bond issuance. As markets stabilized, it reduced reliance on short-term bills in favor of longer-term notes and bonds (see the October 2010 press release). By December 2016, average debt maturity had risen from 46 months in 2008Q4 to 63 months in 2016Q4 (Figure 1). Treasury officials noted that maturity extension reduced debt-service cost volatility and exposure to higher refinancing rates (see the December 6, 2016, press release).

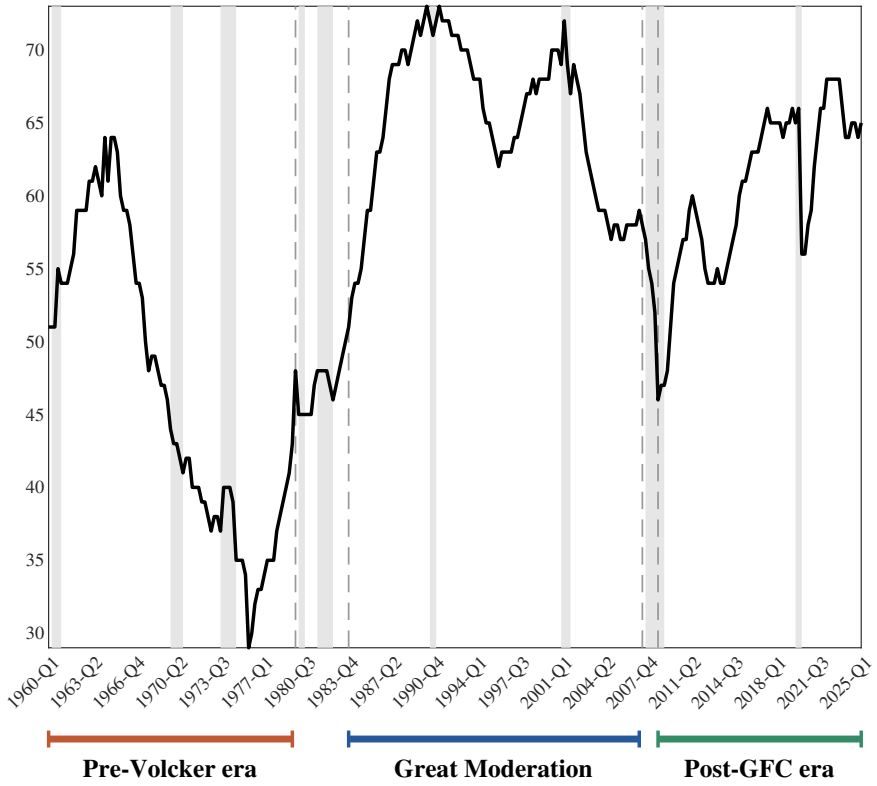


Figure 1: Average Maturity of Public Debt Outstanding

Notes: Average term-to-maturity (months) of marketable, interest-bearing public debt held by private investors, excluding Federal Reserve holdings and inflation-indexed securities. Source: Office of Market Finance, Office of the Under Secretary for Domestic Finance.

2.3 Estimation Results

2.3.1 Bayesian SVAR Estimates Using the Max-Share Approach

Our central finding is that the labor market effects of government employment shocks vary substantially over time: public hiring crowds in private employment before 1980, crowds it out during the GM, and has muted effects after the GFC. Figures 2, 3, and 4 report the impulse response functions (IRFs) of private employment, unemployment, and real wages, respectively. Solid lines denote posterior medians and shaded areas indicate 68% credible intervals. Panels (a)–(c) show estimates for the pre-Volcker, GM, and post-GFC subsamples.

During the pre-Volcker era, government employment shocks significantly increase private employment and real wages while reducing unemployment (Figures 2(a), 3(a), and 4(a)). These responses indicate positive comovement between private employment and real wages, consistent with a New Keynesian mechanism in which fiscal expansion stimulates aggregate demand and shifts labor demand outward.

During the GM, these responses reverse sharply. Government employment persistently crowds out private employment (Figure 2(b)), while unemployment rises significantly (Figure 3(b)). The persistent rise in the unemployment rate is consistent with private-sector job losses exceeding the increase in public employment, suggesting potentially more-than-complete crowding out. This contrasts with the pre-Volcker results and with studies documenting less-than-complete displacement of private employment by public hiring (Behar and Mok 2019; Michaillat 2014; Becker et al. 2021; Ramey 2013).

Real wages initially rise but subsequently decline sharply and persistently (Figure 4(b)). Thus, the positive comovement between private employment and real wages persists during the GM. Under the anti-inflationary monetary policies of the Volcker–Greenspan period, declining private employment is accompanied by falling real wages, suggesting that public hiring no longer stimulates the broader labor market.

Following the GFC, accommodative monetary policy partially offsets, but does not reverse, the crowding-out effects observed during the GM. Neither private employment nor unemployment responds significantly to government employment shocks (Figures 2(c) and 3(c)). Real wages increase modestly and persistently when post-COVID observations are included but return to near zero within approximately one year when those observations are excluded (Figure 4(c)). These findings are robust to alternative treatments of the pandemic, including the Pandemic Priors of Cascaldi-Garcia (2022) and exclusion of post-COVID observations.[12] We also conduct formal equality tests of these IRFs, reported in the Online

[12]We also use the shadow rate as an alternative interest rate measure to account for nonlinearities associated with the zero/effective lower bound since 2008. The results remain robust (see the Online Appendix).

Appendix, which confirm differences in the IRFs across regimes.

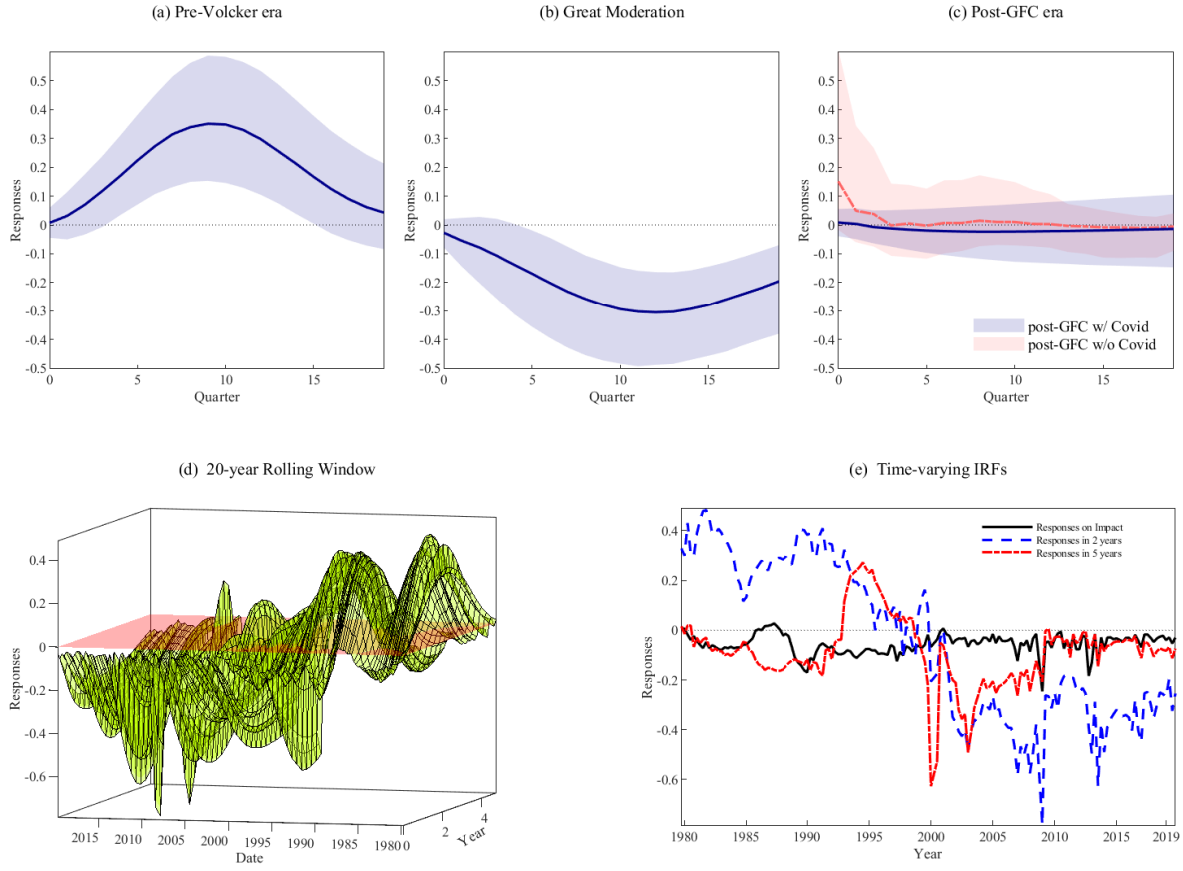


Figure 2: IRFs of Private Employment to Government Employment Shocks

Notes: IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, n_t^p, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach of Francis et al. (2014) and Kurmann and Sims (2021). Panels (a)–(c) show posterior median IRFs (solid lines) and 68% credible intervals (shaded areas). Panel (d) presents IRFs estimated using a 20-year fixed-size rolling window; panel (e) shows the responses at horizons of 0, 2, and 5 years. "post-GFC w/ Covid" uses the Pandemic Priors of Cascaldi-Garcia (2022).

We further examine time variation using fixed-size rolling-window estimates.[13] Panels (d) and (e) of Figures 2, 3, and 4 report results from 20-year windows ($T_0 = 80$ quarters), with the initial window approximately corresponding to the pre-Volcker era.[14] The rolling windows cover pre-COVID endpoints from 1979Q4 to 2019Q4. In panel (d), the axes represent the

[13]Starting with the first T_0 observations, we sequentially advance the sample by one quarter, dropping the earliest observation and adding the next while maintaining a constant window length. This produces $T - T_0 + 1$ sets of IRFs.

[14]Results using 30- and 40-year windows are qualitatively similar (see the Online Appendix).

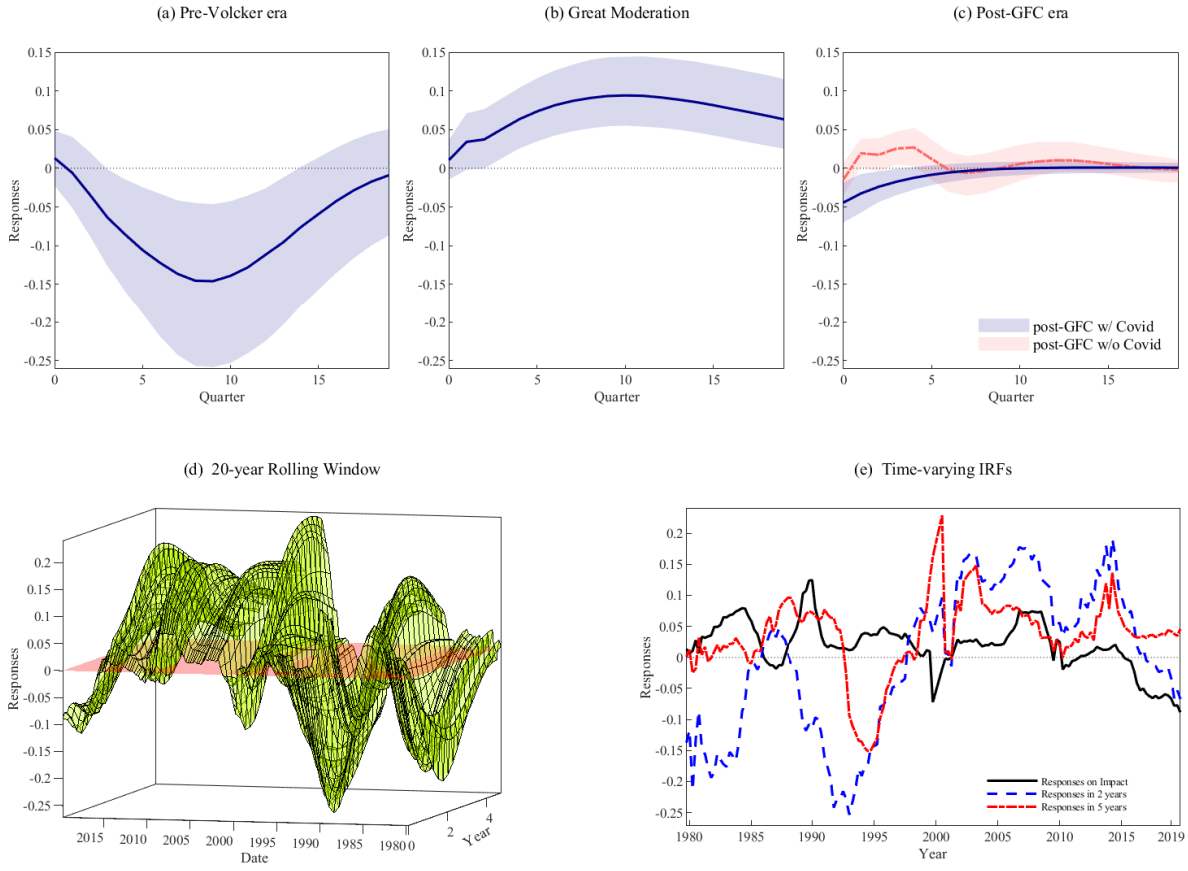


Figure 3: IRFs of the Unemployment Rate to Government Employment Shocks

Notes: IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, urat_t, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach of Francis et al. (2014) and Kurmann and Sims (2021). Panels (a)–(c) show posterior median IRFs (solid lines) and 68% credible intervals (shaded areas). Panel (d) presents IRFs estimated using a 20-year fixed-size rolling window; panel (e) shows the responses at horizons of 0, 2, and 5 years. "post-GFC w/ Covid" uses the Pandemic Priors of Cascaldi-Garcia (2022).

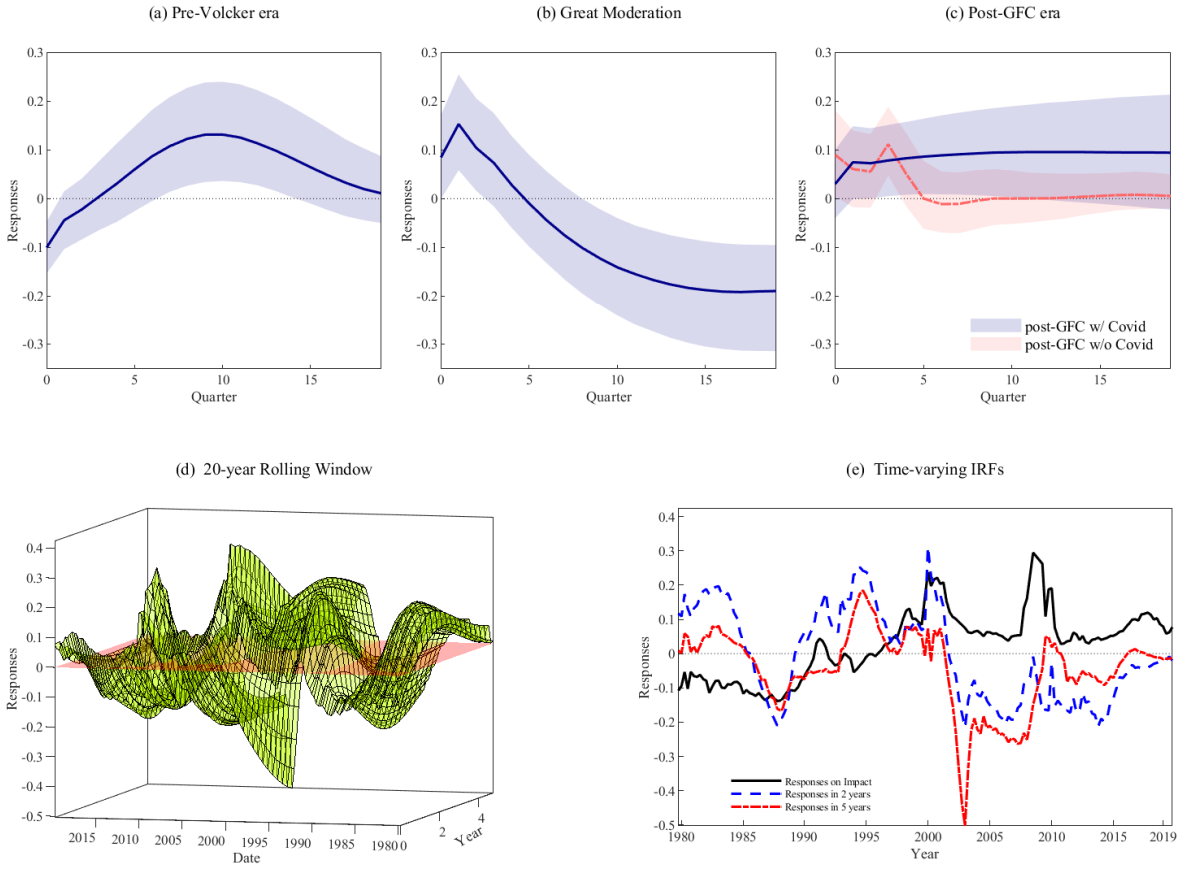


Figure 4: IRFs of Real Wages to Government Employment Shocks

Notes: IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, wage_t, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach of Francis et al. (2014) and Kurmann and Sims (2021). Panels (a)–(c) show posterior median IRFs (solid lines) and 68% credible intervals (shaded areas). Panel (d) presents IRFs estimated using a 20-year fixed-size rolling window; panel (e) shows the responses at horizons of 0, 2, and 5 years. "post-GFC w/ Covid" uses the Pandemic Priors of Cascaldi-Garcia (2022).

window endpoint, response horizon (0–5 years), and IRF magnitude, respectively.

The surface plots reveal a pronounced decline in fiscal effectiveness over time. The initially positive responses of private employment and real wages, and negative response of unemployment, weaken through the 1980s and 1990s before partially recovering after the GFC.

Panel (e) highlights this evolution by presenting short-, medium-, and long-run responses at horizons of 0, 2, and 5 years, respectively. While impact responses remain relatively stable, medium- and long-run responses exhibit pronounced time variation: they deteriorate during the GM but show signs of reversal as the rolling window enters the post-GFC period.

2.3.2 Testing the Mechanism: Shock–Maturity Interactions

As shown above, the labor market effects of government employment shocks differ markedly between the pre-Volcker and GM eras but less so between the pre-Volcker and post-GFC eras. Despite similarities in monetary–fiscal policy coordination, government hiring stimulated the labor market in the pre-Volcker era but had more muted effects after the GFC. This contrast suggests that differences in policy regimes alone cannot fully explain the divergent labor market responses.

Debt maturity also differed substantially: average U.S. government debt maturity shortened during the pre-Volcker era but lengthened considerably after 2008 (Figure 1). This motivates the DSGE framework in Section 3, which incorporates debt maturity to explain why fiscal stimulus may be weaker even under accommodative monetary policy.

We examine the joint roles of policy regimes and debt maturity using a state-dependent local projection, following Ramey and Zubairy (2018).[15]

$$\begin{aligned} lab_{t+h} - lab_{t-1} = {} & I^F_{t-1}\left[\alpha_{F,h} + \beta_{F,h}\, shock_t + \gamma_{F,h}\left(shock_t\, \widetilde{AD}_{t-1}\right) + \delta_{F,h}\, \widetilde{AD}_{t-1}\right] \\ & + \left(1 - I^F_{t-1}\right)\left[\alpha_{M,h} + \beta_{M,h}\, shock_t + \gamma_{M,h}\left(shock_t\, \widetilde{AD}_{t-1}\right) + \delta_{M,h}\, \widetilde{AD}_{t-1}\right] \\ & + \Psi_h\, \mathbf{z}_{t-1} + q_h(t) + \varepsilon_{t+h} \end{aligned} \tag{6}$$

Here, I^F_{t-1} equals one for pre-Volcker observations (Regime F) and zero for the GM observations (Regime M). The post-GFC era is excluded from the baseline analysis because of its relatively small sample size.[16] $shock_t$ is the VAR-identified government employment shock, and $\widetilde{AD}_{t-1}$ is lagged, demeaned average debt maturity within each regime. $\mathbf{z}_{t-1}$ contains the baseline VAR controls, and $q_h(t)$ is a time trend. The coefficients of interest, $\gamma_{F,h}$ and

[15] We thank an anonymous referee for this suggestion.

[16] Results are robust to including the post-GFC era in Regime F and are available in the Online Appendix.

$\gamma_{M,h}$, capture how the horizon-h response to government employment shocks varies with debt maturity under each regime.

Figure 5 shows that under Regime F, longer debt maturity dampens the private employment response from around quarter 7 onward, raises unemployment, and lowers real wages at medium to long horizons. Thus, longer maturity attenuates the labor market stimulus from government hiring. Under Regime M, however, estimates for all three variables fluctuate around zero and are largely insignificant, indicating a limited role for debt maturity. These findings suggest that debt maturity shapes fiscal transmission under Regime F but plays a negligible role under Regime M. Section 3 develops a DSGE model to replicate these results.

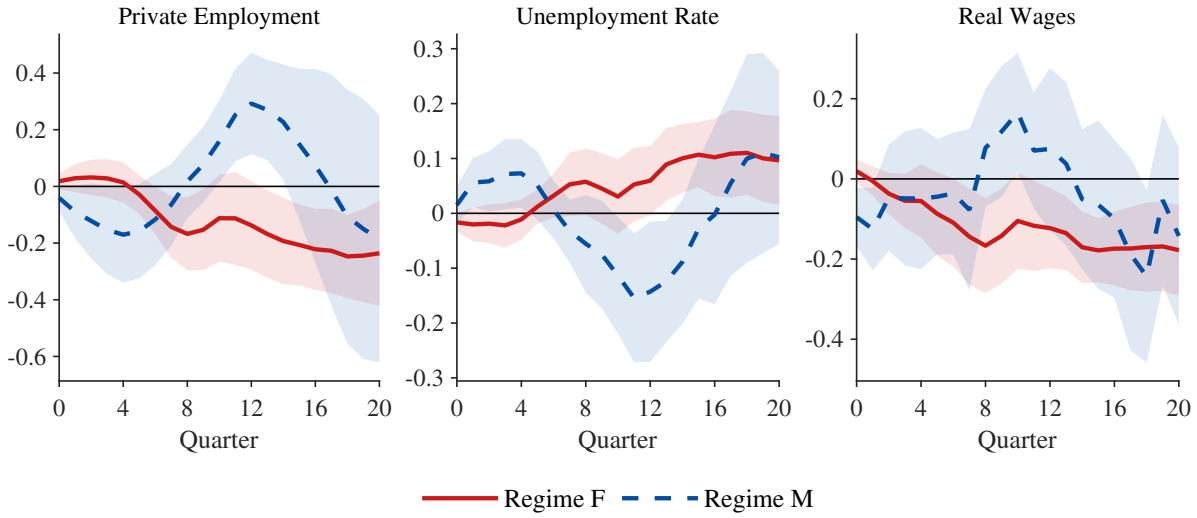


Figure 5: Interaction Effects between Government Employment Shocks and Debt Maturity

Notes: Estimates of $\gamma_{F,h}$ and $\gamma_{M,h}$ from equation (6). Regime F denotes the pre-Volcker era; Regime M, the GM. Shaded areas indicate 90% confidence bands based on Newey–West standard errors.

2.4 Robustness Checks

This subsection presents two robustness exercises. First, we assess sensitivity to additional fiscal controls. Since our baseline VAR excludes fiscal deficits and imposes no restrictions on contemporaneous tax revenue responses, we add either tax revenues or government debt (as a share of GDP) as an endogenous variable. Our findings remain robust, as reported in the Online Appendix.

Second, we identify fiscal shocks using a recursive scheme. Following Blanchard and Perotti (2002), we assume decision and implementation lags exceeding one quarter, so government employment does not respond contemporaneously to other variables. We therefore

apply a Cholesky identification scheme, retaining the benchmark variable ordering. The resulting impulse responses are consistent with our baseline findings (Online Appendix).[17]

3 Theoretical Model

We develop a New Keynesian DSGE model to explain the time-varying labor market effects of government employment shocks documented in Section 2. The model incorporates public employment and two sources of variation across historical episodes.

First, following Leeper (1991), we consider alternative monetary–fiscal regimes. Under Regime F, fiscal policy does not stabilize debt, while monetary policy responds weakly to inflation. Under Regime M, monetary policy responds aggressively to inflation, and fiscal policy stabilizes debt. Second, following Woodford (2001), government debt features a parameterized maturity structure.

Other model features are common across regimes. Prices face Rotemberg adjustment costs, and wage setting combines nominal rigidity with a slow-moving real wage target, following Blanchard and Galí (2007). Monetary policy follows a Taylor rule, while fiscal instruments follow explicit feedback rules.

3.1 Households

The economy is populated by a large number of identical households. Lifetime utility of each household i is a separable function of its composite consumption $c_t^*(i)$ and labor $n_t(i)$ given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\ln \left(c_t^*(i) - h c_{t-1}^* \right) - \frac{n_t(i)^{1+\eta}}{1+\eta} \right) \tag{7}$$

where $\beta \in (0,1)$ is the discount factor. $h \in (0,1)$ is an external habit formation parameter in aggregate composite consumption.

Households receive after-tax wage and rental income, lump-sum transfers from the government ($z_t(i)$) and profits from firms (D_t). They spend income on consumption ($c_t(i)$), investment in future capital ($i_t(i)$), and government bonds. The nominal flow budget con-

[17] Jia et al. (2022) include total government expenditures, including transfers, which incorporate automatic stabilizers. They therefore place g_t adjacent to y_t in the VAR ordering, obtaining qualitatively similar results.

straint of households is given by:

$$(1+\tau_t^c)P_t c_t(i) + P_t i_t(i) + R_t^{-1} B_t^s(i) + P_t^m B_t^m(i) \leq B_{t-1}^s(i) + \left(1+\rho P_t^m\right) B_{t-1}^m(i)$$
$$+(1-\tau_t^n)W_t(i)\left[n_t^p(i)+n_t^g(i)\right] + P_t\left[\left(1-\tau_t^k\right) r_t^k u_t(i) - a\left(u_t(i)\right)\right] k_{t-1}(i) + D_t(i) + P_t z_t(i), \tag{8}$$

where nominal private consumption, $P_t c_t(i)$, is subject to a consumption tax τ_t^c. Labor income, $W_t(i)\left[n_t^p(i)+n_t^g(i)\right]$, is taxed at the rate τ_t^n. Capital income, $P_t r_t^k u_t(i) k_{t-1}(i)$, is taxed at the rate τ_t^k, where $u_t(i)$ denotes capital utilization.[18] $a\left(u_t(i)\right) k_{t-1}(i)$ describes the cost associated with variations in the degree of capacity utilization, which is parameterized by a quadratic function $a\left(u_t\right) = A_1\left(u_t - 1\right) + \frac{A_2}{2}\left(u_t - 1\right)^2$.[19] Note that $u = 1$ and $a(1) = 0$ in the steady state and $\frac{a''(1)}{a'(1)} \equiv \frac{\zeta_2}{1-\zeta_2}$ following Smets and Wouters (2007). The law of motion for capital is:

$$k_t(i) = (1-\delta) k_{t-1}(i) + \left[1 - S\left(\frac{i_t(i)}{i_{t-1}(i)}\right)\right] i_t(i) \tag{9}$$

where δ is the depreciation rate and $S\left(\cdot\right)$ denotes an adjustment cost function, proposed by Christiano et al. (2005), such that $S\left(1\right) = S'\left(1\right) = 0$, and $\kappa \equiv S''\left(1\right) > 0$. We now describe the key elements of the model in detail.

3.1.1 Composite Consumption

Composite consumption in (7) is defined as:

$$c_t^*(i) \equiv c_t(i) + \alpha_g s_t^g, \tag{10}$$

where s_t^g denotes government services and the parameter α_g governs the degree of substitutability between private consumption ($c_t(i)$) and public services. Note that when $\alpha_g > 0$, $\frac{\partial}{\partial s_t^g}\left(\frac{\partial U_t}{\partial c_t(i)}\right) = -\frac{\alpha_g}{\left(c_t(i)+\alpha_g s_t^g - h c_{t-1}^*\right)^2} < 0$, implying that $c_t(i)$ and s_t^g are substitutes, whereas they are complements when $\alpha_g < 0$. We adopt the substitution specification ($\alpha_g > 0$) below.[20]

[18] We adopt the *end-of-period stock* timing convention, under which variables are dated according to when they are determined. For example, the capital stock, k, used in the production function for y_t at time t is determined by investment at time $t-1$.

[19] $A_1 = (1-\bar{\tau}^k)\bar{r}^k$, $A_2 = A_1 \frac{\zeta_2}{1-\zeta_2}$.

[20] Empirical evidence on the substitution elasticity between private consumption and government services is mixed. Fiorito and Kollintzas (2004) and Bermperoglou et al. (2017) find that public services such as justice and defense tend to be substitutes for private consumption. Because our empirical analysis focuses on federal government employment, much of which consists of military and defense personnel, the substitution case is the more relevant one for our analysis.

3.1.2 Household Labor Supply

Households supply labor to both private-sector firms and the government, with preferences defined over total labor supply as follows:

$$n_t = n_t^p + \alpha_{n^g} n_t^g, \tag{11}$$

where n_t^p and n_t^g denote employment in the private and public sectors, respectively. From the contemporaneous labor disutility function in (7),

$$\frac{\partial}{\partial n_t^g}\left(\frac{\partial U_t}{\partial n_t^p(i)}\right) = -\eta\alpha_{n^g}(n_t^p(i) + \alpha_{n^g} n_t^g)^{\eta-1} < 0,$$

where α_{n^g} is a strictly positive share coefficient.[21] Note that the marginal disutility of private labor increases when the government employment shock occurs, implying a *contemporaneous* decline in n_t^p.

One strand of the literature adopts the common-wage assumption across the public and private sectors (e.g., Cavallo 2005; Forni et al. 2009; Linnemann 2009; Pappa 2009; Becker et al. 2021), while another treats public wages as an exogenous policy instrument set by the government (e.g., Gomes 2010; Ardagna 2007; Bermperoglou et al. 2017; Jofre-Monseny et al. 2020). We adopt the former approach, which is consistent with evidence that public-sector hourly wages broadly track those in the private sector over the medium term.[22] Under this assumption, we calibrate α_{n^g} to match the average share of public employment in total employment, as we do not explicitly model occupational choice between the private and public labor markets.

More generally, our theoretical framework abstracts from an explicit unemployment margin and instead focuses on private employment as the primary labor market outcome. Accordingly, the model is designed to capture the responses of private employment and the reallocation of labor between the private and public sectors following government employment shocks under different institutional environments.[23]

[21] Let total labor be defined as $\sigma n_t^p + (1-\sigma) n_t^g$. Normalizing by σ, this can be rewritten as $n_t^p + \alpha_{n^g} n_t^g$, where $\alpha_{n^g} = \frac{1-\sigma}{\sigma} > 0$.

[22] Controlling for education, occupation, experience, geographic location, and other observables, the Congressional Budget Office (2024) estimates that federal wages were about 3% higher during 2011–2015 but about 4% lower in 2022. The estimated federal–private wage differential is thus relatively modest.

[23] One possible extension would be to incorporate search-and-matching frictions and equilibrium unemployment, thereby allowing the model to capture more directly the effects of government employment shocks on unemployment. We leave this extension for future research.

3.1.3 Government Debt Maturity Structure

There are two types of bonds: one-period nominal bonds, $B_t^s(i)$, in zero net supply with price R_t^{-1}, where R_t is the gross nominal interest rate set by the monetary authority; and a more general portfolio of nominal bonds, $B_t^m(i)$, in non-zero net supply with price P_t^m.

Following Woodford (2001), long-term government bonds are modeled as consols with coupon payments that decay exponentially at a constant rate ρ. Specifically, a bond issued in period t pays ρ^T dollars in period $t+T+1$ for $T \geq 0$, where the decay factor satisfies $0 \leq \rho < \beta^{-1}$. Denoting $\hat{x}_t \equiv \ln x_t - \ln x$ as the log deviation from steady state, the corresponding long-term bond pricing relation is given by

$$\hat{R}_t = -\left(\hat{P}_t^m - \frac{\rho\beta}{\bar{\pi}} E_t \hat{P}_{t+1}^m\right) \tag{12}$$

Equation (12) represents a no-arbitrage condition: the return on the one-period bond equals the expected holding-period return on the long-term bond.[24]

Solving equation (12) forward and using the transversality condition yields the following term structure relation:

$$\hat{P}_t^m = -\sum_{j=0}^{\infty} \left(\frac{\rho\beta}{\bar{\pi}}\right)^j E_t \hat{R}_{t+j} \tag{13}$$

Equation (13) shows that the long-term bond price is determined by the expected present discounted value of future one-period interest rates. The average maturity of government debt, defined as the present-value-weighted average time to payment, the measure used by Woodford (2001) and Leeper et al. (2017), can therefore be expressed as

$$AD = 1 + \sum_{j=0}^{\infty} j \cdot \frac{\left(\frac{\rho\beta}{\bar{\pi}}\right)^j}{\sum_{j=0}^{\infty}\left(\frac{\rho\beta}{\bar{\pi}}\right)^j} = \frac{\bar{\pi}}{\bar{\pi} - \rho\beta} \tag{14}$$

The maturity structure of government debt is governed by the parameter ρ. When $\rho = 0$, government debt takes the form of a one-period (one-quarter) bond that repays its principal in the next period, with no subsequent payments. When $\rho = 1$, it becomes a consol (perpetuity) that pays a constant coupon indefinitely. A central focus of our analysis is to examine how changes in the maturity structure of government debt affect the propagation of government employment shocks through the labor market.

[24] Details on the derivation of the equilibrium system are provided in the Online Appendix.

3.2 Production

Private-sector firms produce differentiated intermediate goods, $y_t(j)$, which are assembled into a final good, y_t, by a perfectly competitive final-goods firm. Intermediate firm j produces output according to

$$y_t(j) = [n_t^p(j)]^{1-\alpha} [k_t^s(j)]^{\alpha} \tag{15}$$

where $k_t^s(j) \equiv u_t(j)k_{t-1}(j)$ denotes effective capital services and $n_t^p(j)$ private employment. Cost minimization yields the following conditions:

$$mc_t = \Upsilon w_t^{1-\alpha}(r_t^k)^{\alpha}, \tag{16}$$

$$\frac{w_t}{r_t^k} = \frac{1-\alpha}{\alpha}\frac{k_t^s(j)}{n_t^p(j)}, \tag{17}$$

where $\Upsilon = \alpha^{-\alpha}(1-\alpha)^{\alpha-1}$.

Consistent with the deep-habits mechanism of Ravn et al. (2006), we allow the demand elasticity and the markup charged by intermediate firms to vary endogenously. Let $abs_t \equiv c_t + i_t + g_t$ denote the component of final absorption subject to deep habits. The associated habit stock, s_t, evolves according to

$$s_t = \rho_{dh}s_{t-1} + (1-\rho_{dh})abs_t, \qquad x_t = abs_t - \theta_{dh}s_{t-1}, \tag{18}$$

where ρ_{dh} governs the persistence of the habit stock, while θ_{dh} measures the strength of habit formation.

The variable x_t represents the price-elastic component of demand, whereas $\theta_{dh}s_{t-1}$ captures the component inherited from past purchases, which is locally price-insensitive. Deep habits make the firm's pricing problem dynamic, with the desired markup governed by two forces: the contemporaneous elasticity of demand, $\eta_{dh}\frac{x_t}{abs_t} = \eta_{dh}\left(1 - \theta_{dh}\frac{s_{t-1}}{abs_t}\right)$, where $\frac{x_t}{abs_t}$ is the price-sensitive share, and the value of expanding the future customer base. We set $\eta_{dh} = \frac{\theta_p}{(1-\theta_{dh})\Omega_{dh}}$ and $\Omega_{dh} = 1 + \frac{(1-\rho_{dh})\beta\theta_{dh}}{1-\beta[\rho_{dh}+(1-\rho_{dh})\theta_{dh}]}$ so that the steady-state markup coincides with the constant-elasticity case, $\theta_p/(\theta_p - 1)$.[25]

Each intermediate firm faces a Rotemberg price-adjustment cost $\frac{\phi_p}{2}\left(\frac{P_t(j)}{P_{t-1}(j)} - \bar{\pi}\right)^2 y_t$ (see Rotemberg 1982). Firm j chooses its price $P_t(j)$ to maximize the expected discounted value

[25] The envelope condition for the shadow value of the customer base and the pricing first-order condition are relegated to the Online Appendix.

of real profits:

$$\max_{P_t(j)} E_t \sum_{s=0}^{\infty} Q_{t,t+s} \left[\frac{P_{t+s}(j)}{P_{t+s}} y_{t+s}(j) - mc_{t+s} y_{t+s}(j) - \frac{\phi_p}{2} \left(\frac{P_{t+s}(j)}{P_{t+s-1}(j)} - \bar{\pi} \right)^2 y_{t+s} \right] \tag{19}$$

subject to the deep-habits demand described above. $Q_{t,t} = 1$, $Q_{t,t+s} = \beta^s \frac{\lambda_{t+s}}{\lambda_t}$ is the stochastic discount factor.

3.3 Private Labor Agency and Wage Setting

A competitive labor agency combines differentiated labor services into a homogeneous composite input, which is then sold to private intermediate firms according to

$$n_t^p = \left[\int_0^1 n_t^p(i)^{\frac{\theta_w - 1}{\theta_w}} di \right]^{\frac{\theta_w}{\theta_w - 1}}, \tag{20}$$

where $\theta_w > 1$ is the elasticity of substitution among different types of labor. Profit maximization, taking all differentiated wages ($W_t(i)$) and the aggregate wage (W_t) as given, yields:

$$n_t^p(i) = \left(\frac{W_t(i)}{W_t} \right)^{-\theta_w} n_t^p \tag{21}$$

where $W_t \equiv \left(\int_0^1 W_t^{1-\theta_w}(i) di \right)^{\frac{1}{1-\theta_w}}$.

Similar to the price rigidity, nominal wage rigidity is represented by a Rotemberg-form wage Phillips curve. Following Blanchard and Galí (2007), we introduce additional real wage rigidity by allowing wage setters to adjust toward a slow-moving target.[26]

$$w_t^{\text{tgt}} = \phi_{bg} w_{t-1}^{\text{tgt}} + \phi_{bg}^f E_t w_{t+1}^{\text{tgt}} + \lambda_{bg} w_t^{\text{flex}}, \tag{22}$$

where $w_t^{\text{flex}} = \frac{\theta_w n_t^p n_t^\eta}{(1-\tau_t^n)\lambda_t \left[(\theta_w - 1) n_t^p - n_t^g \right]}$ is the frictionless real wage. $\phi_{bg} = \frac{(1+\theta_w \eta)\gamma_w}{1+\gamma_w[\theta_w \eta(1+\beta)+\beta\gamma_w]}$, $\phi_{bg}^f = \beta \phi_{bg}$, and $\lambda_{bg} = 1 - \phi_{bg} - \phi_{bg}^f$. γ_w governs the persistence of the real wage target. The actual real wage, $w_t \equiv W_t / P_t$, adjusts toward w_t^{tgt} according to the Rotemberg-form wage Phillips curve, which is reported in the Online Appendix.

[26] The existence of real wage rigidities has been widely documented in the literature as both a feature needed to account for a number of labor market facts and a natural source of inflation inertia underlying the good empirical fit of the Phillips curve (see, e.g., Hall 2005 and Blanchard and Galí 2007). Incorporating real wage rigidity improves the empirical fit of the theoretical model.

3.4 Fiscal Policy

The government combines government employment (n_t^g) and goods purchased from the private sector (g_t) to provide public services (s_t^g) using the following production function:

$$s_t^g = (n_t^g)^{1-\gamma_g} g_t^{\gamma_g}, \quad \gamma_g \in (0,1) \tag{23}$$

In each period, the government's income consists of proceeds from sales of bonds and tax revenues to finance its expenditures that include repayment of bonds, salaries and wages ($W_t n_t^g$), government goods purchases (g_t) and transfer payments (z_t). The government's nominal flow budget constraint is

$$(1+\rho P_t^m) B_{t-1}^m + W_t n_t^g + P_t g_t + P_t z_t = P_t^m B_t^m + \tau_t^n W_t (n_t^p + n_t^g) + P_t \tau_t^k r_t^k u_t k_{t-1} + \tau_t^c P_t c_t \tag{24}$$

Following Leeper et al. (2017), the fiscal rule includes a response of fiscal instruments to the debt-to-GDP ratio to ensure equilibrium determinacy and a nonexplosive solution for debt, and an autoregressive term to allow for serial correlation.[27] Specifically, government employment follows the rule

$$\hat{n}_t^g = \psi_{n^g} \hat{n}_{t-1}^g - (1-\psi_{n^g}) \gamma_{n^g} \hat{s}_{t-1}^b + \nu_t^{n^g} \tag{25}$$

where $s_{t-1}^b \equiv \frac{P_{t-1}^m B_{t-1}^m}{P_{t-1} Y_{t-1}}$. The parameter $\psi_{n^g} \in (-1,1)$ governs the degree of persistence of the process and $\gamma_{n^g} > 0$ triggers a correction of fiscal expansion when debt deviates from its steady state. The government employment shock ($\nu_t^{n^g}$) follows a stationary ($\rho_{n^g} < 1$) AR(1) process:

$$\nu_t^{n^g} = \rho_{n^g} \nu_{t-1}^{n^g} + \varepsilon_t^{n^g}, \quad \varepsilon_t^{n^g} \sim \mathbb{N}(0, \sigma_{n^g}^2) \tag{26}$$

3.5 Monetary Policy

The central bank sets the interest rate according to the Taylor rule:

$$R_t = R_{t-1}^{\psi_r} \left[\bar{R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{\phi_\pi} \left(\frac{y_t}{\bar{y}} \right)^{\phi_y} \right]^{1-\psi_r} \tag{27}$$

[27] With the exception of the consumption tax τ_t^c, other fiscal instruments—government purchases g_t, transfers z_t, and labor and capital taxes τ_t^n and τ_t^k—similarly belong to the debt-stabilizing fiscal rule in Regime M, responding to the lagged debt-to-GDP ratio. In our benchmark calibration, however, the debt-feedback parameters for g_t and τ_t^n are set to zero. As Leeper et al. (2017) note, U.S. consumption taxes average only 1% of GDP.

where $\bar{R}$ is the steady-state gross nominal interest rate and $0 \leq \psi_r < 1$ is the interest rate smoothing parameter. ϕ_π and ϕ_y are the central bank's (long-run) responses to inflation and the output gap, respectively. In Regime F, $\phi_\pi < 1$ (passive monetary policy); in Regime M, $\phi_\pi > 1$ (active monetary policy).

3.6 Market Clearing and Aggregation

Aggregate consumption is $c_t = \int_0^1 c_t(i)di$ and aggregate bonds, private capital, investment, and dividends satisfy $x_t = \int_0^1 x_t(j)dj$ for $x = \{b, k, i, d\}$. Goods market clearing is

$$y_t = c_t + i_t + g_t + adj_t \tag{28}$$
$$adj_t = a\left(u_t\right) k_{t-1} + \frac{\phi_p}{2}\left(\pi_t - \bar{\pi}\right)^2 y_t$$

We solve the model by approximating the equilibrium conditions around the nonstochastic steady state using the Sims (2002) gensys algorithm.[28] In the next section, we calibrate and simulate the model under each policy regime.

4 Calibration and Simulation

This section describes the model calibration, distinguishing between standard structural parameters and regime-specific policy rules. We then present simulated impulse responses to government employment shocks across different regime–maturity combinations and assess their consistency with the empirical patterns documented in Section 2. Our model highlights the critical role of debt maturity in shaping the regime-dependent effectiveness of fiscal policy.

4.1 Calibration

Our model is calibrated at a quarterly frequency. The discount factor (β) is set to 0.99, the external habit parameter is $h = 0.95$, and the quarterly depreciation rate is $\delta = 0.025$. We set the capital share to $\alpha = 0.33$ and the benchmark intermediate-goods demand elasticity to $\theta_p = 6$, implying a steady-state markup of 1.2. The wage elasticity of substitution is $\theta_w = 5$.

Following Ravn et al. (2006), the deep-habit strength and persistence are set to $\theta_{dh} = 0.70$ and $\rho_{dh} = 0.85$. The investment adjustment cost is set to $\kappa = 5$ and the capital utilization curvature parameter is $\zeta_2 = 0.36$ following Smets and Wouters (2007).

[28] The full set of equilibrium conditions is provided in the Online Appendix.

We set the inverse Frisch elasticity to $\eta = 2$. The weight on public services in composite consumption is $\alpha_g = 0.2$, and the weight on government employment in the labor index is $\alpha_{n^g} = 0.23$, which matches the sample mean.[29] The production share of government employment in public services is $1 - \gamma_g = 0.64$, which is the sample average of the share of government employee compensation in government consumption.

The Rotemberg price adjustment cost (ϕ_p) is set to match an average price duration of more than one year, as implied by an equivalent Calvo pricing formulation. The wage adjustment cost (ϕ_w) is calibrated analogously. The real-wage rigidity parameter is set to $\gamma_w = 0.80$. The steady-state inflation rate ($\bar{\pi}$) is set to 1.

Following Christiano et al. (2005), we choose the regime-specific monetary policy parameters to minimize the distance between the empirical impulse response functions and the analogous objects (i.e., private employment and the real wage) in our model, subject to policy rule restrictions and equilibrium determinacy. This yields $(\phi_\pi, \phi_y, \psi_r) = (0.70, 0.10, 0.69)$ for the pre-Volcker era, $(2.14, 0.33, 0.90)$ for the GM, and $(0.54, 0.50, 0.89)$ for the post-GFC period. The post-GFC policy rule estimates use the shadow short rate of Krippner (2013).[30] The fiscal rule in Regime F includes only an autoregressive term ($\psi_{n^g} = 0.98$). In Regime M, it also responds to the debt-to-GDP ratio following Leeper et al. (2017). The steady-state debt-to-GDP ratio is set to match the era average, which gives 0.98 for the pre-Volcker era, 1.38 for the GM, and 2.47 for the post-GFC era.[31]

The remaining fiscal parameters are calibrated to match the postwar U.S. averages: the government purchases-to-GDP ratio (g/y) is 0.052, the average federal labor tax rate (τ^n) is 0.217, the capital tax rate (τ^k) is 0.25 and the consumption tax rate is 0.023. The full list of our parameter choices is given in Table 1.

4.2 Simulation Results

Figures 6 and 7 show simulated IRFs to a 1% increase in government employment under two policy regimes: (1) **Regime F**, with an *active fiscal authority* that sets policy independently of budget conditions and a monetary authority that responds weakly to inflation; and (2) **Regime M**, with an *active monetary authority* that aggressively raises nominal interest rates to stabilize inflation and a fiscal authority that ensures debt stability.

We further distinguish short-term debt (**Regime $\mathbf{F_{SD}}$**) from long-term debt (**Regime $\mathbf{F_{LD}}$**)

[29] $\alpha_{n^g} = \frac{1-n^p/n}{n^p/n}$ is calibrated based on our VAR data. While the era-specific values are 0.26 (pre-Volcker), 0.22 (GM), and 0.20 (post-GFC), setting a common $\alpha_{n^g} = 0.23$ or using the era-specific values yields virtually identical results.

[30] See the Online Appendix for the policy rule estimation and impulse response matching procedure.

[31] The debt-to-GDP ratio is calibrated as the mean of privately held gross federal debt at market value divided by quarterly GDP.

Table 1: Baseline Calibration

Preference and HHs	
β, discount factor	0.99
h, habit formation	0.95
η, inverse Frisch labor elast.	2
δ, depreciation rate	0.025
α_g, subs. of private/public cons.	0.2
α_{n^g}, govt employment share	$\frac{1-n^p/n}{n^p/n}$
Frictions and Production	
α, capital share	0.33
$1-\gamma_g$, production share of n^g	0.64
θ_p, price elast. of subs.	6
θ_w, wage elast. of subs.	5
$\phi_i, i=p,w$, price/wage adjustment cost	$\frac{\omega_i(\theta_i-1)}{(1-\omega_i)(1-\omega_i\beta)}$
κ, investment adj. cost	5
γ_w, real wage rigidity	0.80
θ_{dh}, deep-habit strength	0.70
ρ_{dh}, deep-habit persistence	0.85
Monetary/Fiscal Calibrations	
g/y, *steady-state* govt purchase-to-GDP ratio	0.052
s^b, *steady state* debt-to-GDP ratio (pre-Volcker/GM/post-GFC)	0.98/1.38/2.47
ψ_{n^g}, lagged resp. for govt employment	0.98
τ^n, τ^k, τ^c, labor/capital/consumption tax rates	0.217, 0.25, 0.023
Regime F	
Monetary Policy	
ϕ_π, interest rate resp. to inflation (pre-Volcker/post-GFC)	0.70/0.54
ϕ_y, interest rate resp. to output (pre-Volcker/post-GFC)	0.10/0.50
ψ_r, resp. to lagged interest rate (pre-Volcker/post-GFC)	0.69/0.89
Fiscal Policy	
γ_{n^g}, govt employment resp. to debt	0
Regime M	
Monetary Policy	
ϕ_π, interest rate resp. to inflation	2.14
ϕ_y, interest rate resp. to output	0.33
ψ_r, resp. to lagged interest rate	0.90
Fiscal Policy	
γ_{n^g}, govt employment resp. to debt	0.21

Note: Parameters are calibrated at a quarterly frequency.

under Regime F. Responses are percentage deviations from steady states. To ensure comparability, all models share identical structural parameters and differ only in their monetary and fiscal policy settings.

The simulations yield two main findings. First, under Regime F, government hiring generates a strong, persistent labor market stimulus, which is strongest with short-term debt; long-term debt substantially attenuates this stimulus despite accommodative monetary policy. Second, under Regime M, government employment shocks fail to stimulate private employment and produce persistent labor market contractions, regardless of debt maturity. Thus, transmission depends critically on the interaction between policy regimes and debt maturity.

We next compare these simulations with the empirical patterns for the pre-Volcker, GM, and post-GFC eras documented in Section 2.

4.2.1 Labor Market Effects under Regime F

Short-term Debt (Regime F_{SD}): Figure 6 (solid red lines) shows that under Regime F, short-term debt financing produces sharp increases in private employment and real wages, which build over subsequent quarters before gradually returning to steady state. Total employment closely follows private employment. These responses indicate strong labor market stimulus from government hiring under passive monetary policy and short-term debt financing.

The positive comovement of private employment and real wages highlights the aggregate-demand channel. As shown in the middle panels of Figure 6, weak monetary responses to inflation lower the real interest rate, stimulating economic activity and improving labor market conditions.

These dynamics are consistent with the pre-Volcker evidence ($1960Q1$–$1979Q3$), when the average maturity of U.S. government debt was comparatively short and falling (Figure 1).

Long-term Debt (Regime F_{LD}): The dotted green line in Figure 6 shows that extending average debt maturity to 20 quarters substantially weakens responses of total employment, private employment, and real wages, eliminating the pronounced hump-shaped dynamics observed with short-term debt. Thus, long-term bond financing reduces fiscal stimulus effectiveness.[32]

[32]The attenuation effect remains strong even when holding the debt-to-GDP ratio in Regime F_{LD} fixed at its Regime F_{SD} value (see the Online Appendix for details).

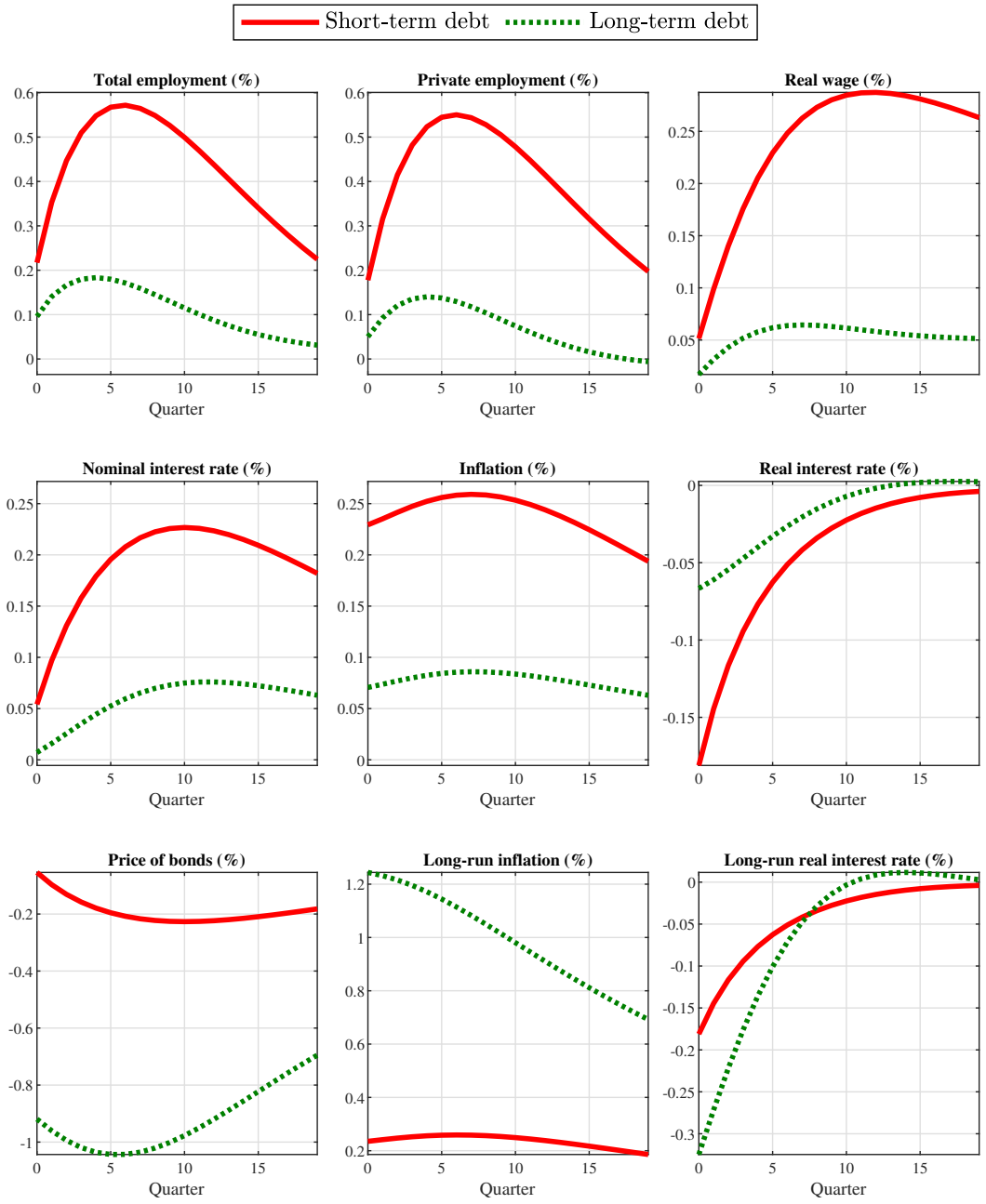


Figure 6: Simulated Impulse Responses to Government Employment Shocks in Regime F

Notes: We report simulated responses over 20 quarters to a 1% government employment shock in Regime F. Short-term debt corresponds to $AD = 1$ (solid red line) and long-term debt corresponds to $AD = 20$ (dotted green line).

Private job creation remains negligible following a government hiring shock, with similarly muted real wage responses. This attenuation, even under accommodative monetary policy, is consistent with the muted labor market effects observed in the post-GFC period ($2008Q4$–$2025Q1$), when average government debt maturity increased (Figure 1).

The Role of Debt Maturity under Regime F: Why does longer debt maturity systematically weaken the stimulative effects of government employment shocks, even when monetary policy remains accommodative? To answer this question, we derive the government's intertemporal budget constraint and express it in the following log-linearized form:[33]

$$\hat{b}_{t-1} = \underbrace{-\rho\beta\hat{P}_t^m + \hat{P}_{t-1}^m}_{\text{long-term debt}} + \hat{\pi}_t + (1-\beta)\, E_t \sum_{j=0}^{\infty} \beta^j\, \widehat{PS}_{t+j} - E_t \sum_{j=1}^{\infty} \beta^j\, \hat{r}_{t+j}^m, \tag{29}$$

where $\widehat{PS}_t$ denotes the primary surplus and $\hat{r}_t^m \equiv \rho\beta\hat{P}_t^m - \hat{P}_{t-1}^m - \hat{\pi}_t$ denotes the *ex post* real return on government bonds.[34,35]

In Regime F, government hiring does not generate sufficient expected future primary surpluses to stabilize debt. Debt stabilization therefore relies heavily on *debt revaluation*. Equation (29) shows how debt maturity shapes this adjustment: longer-term debt shifts fiscal adjustment from current inflation toward bond-price movements.

Following a government employment shock, the sharp decline in long-term bond prices reflects higher expected future inflation, which erodes the real value of outstanding debt (Figure 6, bottom row). Consequently, less current inflation is needed to satisfy the government budget constraint, allowing inflation to remain initially subdued before rising later. This mechanism is consistent with Cochrane (2001), Sims (2013), and Leeper and Leith (2016), who emphasize how long-term debt reshapes inflation dynamics.

The muted inflation response produces a smaller decline in real interest rates (Figure 6, middle row), dampening aggregate demand through the *IS* equation.[36] Falling bond prices also reduce government debt's market value and bondholders' wealth, further dampening consumption. This wealth effect operates mainly under Regime F: because primary surpluses do not provide sufficient debt stabilization, valuation losses need not be fully offset

[33] See the Online Appendix for the derivation of this expression.

[34] The primary surplus is defined as the sum of tax revenues less all government expenditures $\widehat{PS}_t \equiv \frac{\tau^k r^k k}{PS}\left(\hat{\tau}_t^k + \hat{r}_t^k + \hat{u}_t + \hat{k}_{t-1}\right) + \frac{\tau^c c}{PS}\left(\hat{\tau}_t^c + \hat{c}_t\right) + \frac{\tau^n w}{PS}\left[(n^p + n^g)\left(\hat{\tau}_t^n + \hat{w}_t\right) + n^p\hat{n}_t^p + n^g\hat{n}_t^g\right] - \frac{wn^g}{PS}\left(\hat{w}_t + \hat{n}_t^g\right) - \frac{g}{PS}\hat{g}_t - \frac{z}{PS}\hat{z}_t$.

[35] Under short-term debt, equation (29) becomes $\hat{b}_{t-1} = -\beta\hat{R}_t + \hat{\pi}_t + (1-\beta)\widehat{PS}_t + \beta\hat{b}_t$.

[36] The *IS* equation in our model is $\hat{c}_t^* = \frac{1}{1+h}E_t\hat{c}_{t+1}^* + \frac{h}{1+h}\hat{c}_{t-1}^* - \frac{1-h}{1+h}(\hat{R}_t - E_t\hat{\pi}_{t+1}) - \frac{1-h}{1+h}\kappa_\tau\left(\hat{\tau}_t^c - E_t\hat{\tau}_{t+1}^c\right)$, where $\kappa_\tau \equiv \frac{\tau^c}{1+\tau^c}$.

by compensating future fiscal adjustments, leaving government debt as net wealth. Under Regime M, future primary surplus adjustments absorb these valuation shocks, substantially weakening this channel.

Weaker aggregate demand affects labor markets through two channels. It limits upward pressure on sticky real wages and reduces firms' incentives to expand production and capacity utilization, shifting private labor demand inward. Consequently, private employment increases less or may decline, despite more muted real wage growth.

With short-term debt, by contrast, current inflation erodes the real value of outstanding obligations with fixed nominal repayments. Fiscal adjustment therefore occurs through unexpected current inflation rather than bond-price revaluation. The next part of this section shows that debt maturity plays a substantially smaller role in fiscal adjustment under Regime M.

4.2.2 Labor Market Effects under Regime M

Figure 7 shows that employment and real wage responses under Regime M are similar across debt maturities. Compared with Regime F, maturity-related differences are substantially smaller, although longer maturities slightly mitigate adverse labor market effects.[37] Thus, debt maturity plays a much weaker role in fiscal transmission under Regime M.

This difference reflects the limited role of debt revaluation under Regime M (equation 29). In this Ricardian regime, future primary surpluses adjust to stabilize debt, so bond-price revaluation need not absorb the shock, shifting fiscal adjustment toward future spending reductions. As Corsetti et al. (2012) emphasize, spending reversals are central to fiscal transmission under Regime M.

Government employment shocks are contractionary across all maturities because hawkish monetary policy offsets fiscal expansion by containing inflation, which keeps real interest rates close to steady state. Figure 7 shows persistent crowding out of private employment, with the largest decline occurring about three years after the shock. Real wages also fall persistently. Total employment initially rises with public hiring but subsequently declines as private employment contracts.

Building on Finn (1998), who documents labor reallocation from the private to the government sector, our results suggest that public hiring under active monetary policy can generate more-than-proportional private employment losses. Overall, the Regime M predictions closely match the GM evidence ($1984Q1$–$2007Q2$).

[37] Leeper et al. (2017) find that, under Regime M, maturity plays no role in the short run and a longer maturity tends to raise multipliers at longer horizons, with differences small relative to Regime F.

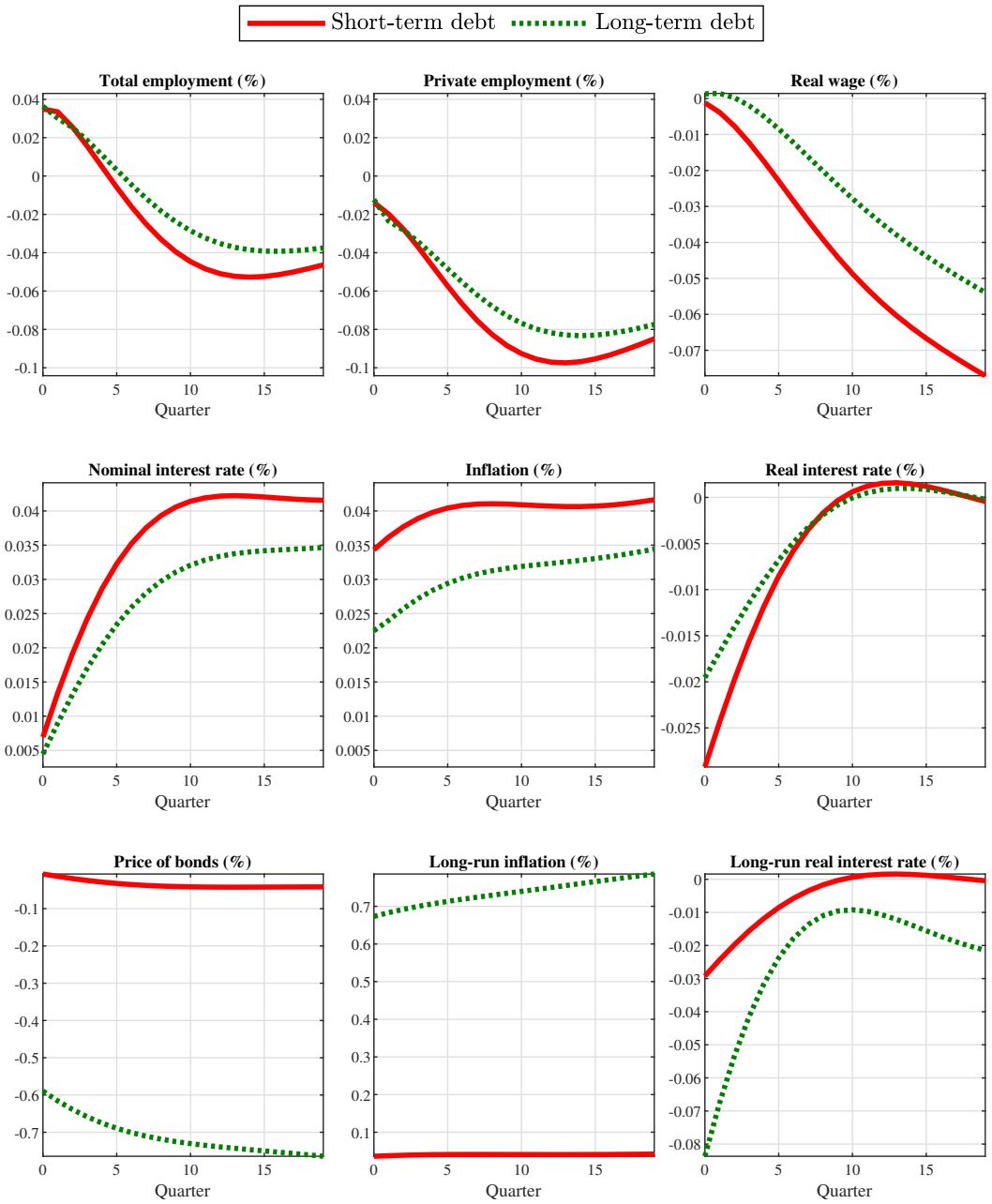


Figure 7: Simulated Impulse Responses to Government Employment Shocks in Regime M

Notes: We report simulated responses over 20 quarters to a 1% government employment shock in Regime M. Short-term debt corresponds to $AD = 1$ (solid red line) and long-term debt corresponds to $AD = 20$ (dotted green line).

4.2.3 Matching the VAR and DSGE Models

This subsection compares DSGE-implied and SVAR-estimated impulse responses across eras. Figure 8 overlays the two sets of responses.[38]

Under Regime F_{SD}, the model reproduces the hump-shaped private employment response and the gradual real wage increase. Under Regime M, it captures the reversal: government hiring crowds out private employment, with a trough at nearly the same horizon as in the data, while real wages decline persistently. This crowding out occurs under both debt maturities, with a trough about 15% smaller under long-term debt.

Under Regime F_{LD}, private employment remains near zero in both the model and the data. The model's modest real wage increase lies within the SVAR credible band. Overall, the DSGE model closely replicates the SVAR estimates across all three eras.

4.2.4 Robustness to Unconventional Monetary Policies

During the post-GFC era, the Fed's unconventional policies, such as QE, together with the Treasury's maturity management, directly affected the maturity and scarcity of privately held government debt (d'Amico et al. 2012; Wu and Xie 2025). The federal funds rate also remained near the effective lower bound (ELB), where debt maturity influences monetary accommodation and fiscal transmission (Bhattarai et al. 2023).

Thus, a standard Regime F may not fully capture post-GFC monetary–fiscal interactions. Following Bianchi and Melosi (2017), we characterize this period as an accommodative regime with policy rate inertia and muted monetary responses to fiscal expansions, making debt maturity central to fiscal effectiveness.

To test whether longer debt maturity dampens labor market responses beyond the standard Regime F specification, we consider alternative monetary policy frameworks. Table 2 reports peak and cumulative attenuation ratios for private employment and real wages as average debt maturity increases from short to long term.[39]

$$A^{lab}_{\text{peak}} = 1 - \frac{|\,\text{IRF}^{lab}_{peak}(LD)|}{|\,\text{IRF}^{lab}_{peak}(SD)|}, \qquad A^{lab}_{\text{cum}} = 1 - \frac{\left|\sum_{h=0}^{19} \text{IRF}^{lab}_{h}(LD)\right|}{\left|\sum_{h=0}^{19} \text{IRF}^{lab}_{h}(SD)\right|}$$

Across the post-GFC specifications, longer debt maturity reduces peak and cumulative labor market responses in all cases considered, with the reductions ranging from 29% to 62%.

[38] We rescale the DSGE responses by the least-squares factor s^*_e from the policy rule calibration. In the first-order solution, this factor adjusts only the shock size, which is analogous to estimating shock standard deviations in impulse response matching in Christiano et al. (2010).

[39] The Online Appendix details each specification's policy rules, bond-pricing relations, and parameter calibrations.

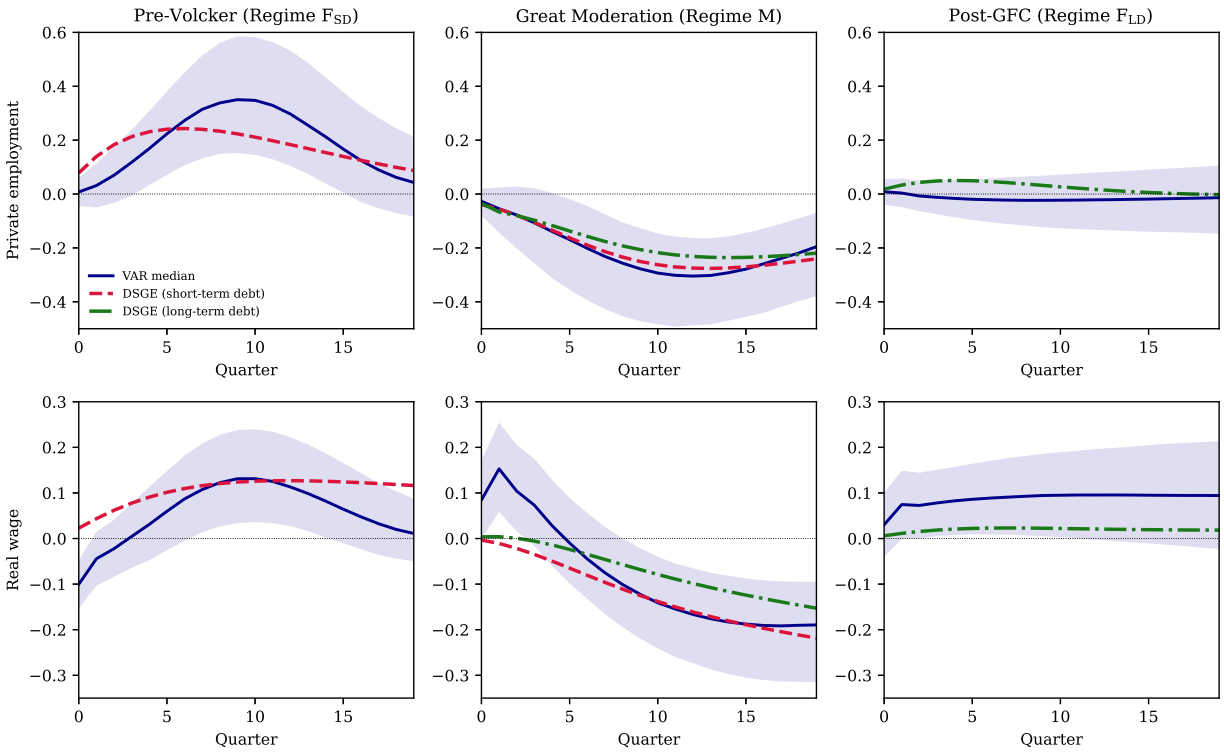


Figure 8: IRFs from the VAR and DSGE Models

Notes: Blue solid lines show VAR posterior medians and 68% credible intervals. Red dashed and green dash-dotted lines show DSGE IRFs for $AD = 1$ and $AD = 20$, rescaled by the least-squares factor s_e^* fitting VAR medians for private employment and real wages ($s_e^* = 0.44$, 2.83, and 0.36 for the pre-Volcker, GM, and post-GFC eras). Both GM cases use the $AD = 1$ factor. The scaling factors s_e^* affect only shock size.

These findings confirm the robustness of the maturity-attenuation mechanism.

Table 2: Maturity Attenuation under Alternative Monetary Regimes

Specification	**Monetary Rule**	**Private Employment**		**Real Wage**	
		A_{peak}	A_{cum}	A_{peak}	A_{cum}
Baseline Regime $\mathbf{F_{LD}}$	$\phi_\pi = 0.54$, $\psi_r = 0.89$	57.6%	61.7%	50.7%	49.7%
Regime $\mathbf{F_{LD}}$ + ELB	R pegged for 8 qtrs	32.4%	34.0%	30.0%	28.8%
Regime $\mathbf{F_{LD}}$ + ELB + QE	peg 8 qtrs + QE	39.2%	41.2%	36.3%	34.8%

Note: Regime F_{LD} denotes Regime F with long-term debt ($AD = 20$). The effective lower bound (ELB) specification imposes a fixed nominal interest rate for eight quarters, following the standard linear representation of an ELB episode (e.g., Laséen and Svensson 2011). The quantitative easing (QE) specification introduces a maturity premium on long-term bonds, following Krishnamurthy and Vissing-Jorgensen (2011).

4.2.5 Prior Predictive Analysis

To further assess whether monetary–fiscal regimes and debt maturity explain the time-varying empirical responses, we conduct a prior predictive analysis following Leeper et al. (2017) and Bermperoglou et al. (2017).

Holding regime-specific parameters for Regimes F_{SD}, M, and F_{LD} at benchmark values, we divide the remaining parameters into θ_1, fixed to avoid indeterminacies or match steady-state targets, and θ_2, which we vary across draws, applying each draw to all three regimes.

We draw 10,000 independent θ_2 vectors from uniform distributions over literature-based ranges encompassing the benchmark values in Table 1, re-solving the model for each draw. The ranges are: habit formation, $h \in [0.85, 0.99]$; real wage rigidity, $\gamma_w \in [0.70, 0.90]$; inverse Frisch elasticity, $\eta \in [1, 4]$; wage markup elasticity, $\theta_w \in [3, 6]$; price stickiness, $\omega_p \in [0.75, 0.90]$; private–public consumption substitution, $\alpha_g \in [0, 0.4]$; government employment share, $\alpha_{n^g} \in [0.05, 0.30]$; nominal wage stickiness, $\omega_w \in [0.60, 0.85]$; deep-habit strength, $\theta_{dh} \in [0.50, 0.70]$; and persistence, $\rho_{dh} \in [0.70, 0.90]$.

Following Bermperoglou et al. (2017), Figure 9 plots the 16^{th}–84^{th} percentile ranges for the responses of private employment (top row) and real wages (bottom row) to a 1% government employment shock. Responses cluster tightly within each regime but remain clearly distinct across them. Private employment rises under Regime F_{SD} and falls under Regime M. Under Regime F_{LD}, it still rises, but the median peak reaches only 26% of that under Regime F_{SD}.

Real wages show similar regime differences: the median peak under Regime F_{LD} is only 24% of its Regime F_{SD} counterpart. These results indicate that the importance of policy regime and debt maturity for the time variation documented in Section 2 is robust across a wide range of other parameter values.

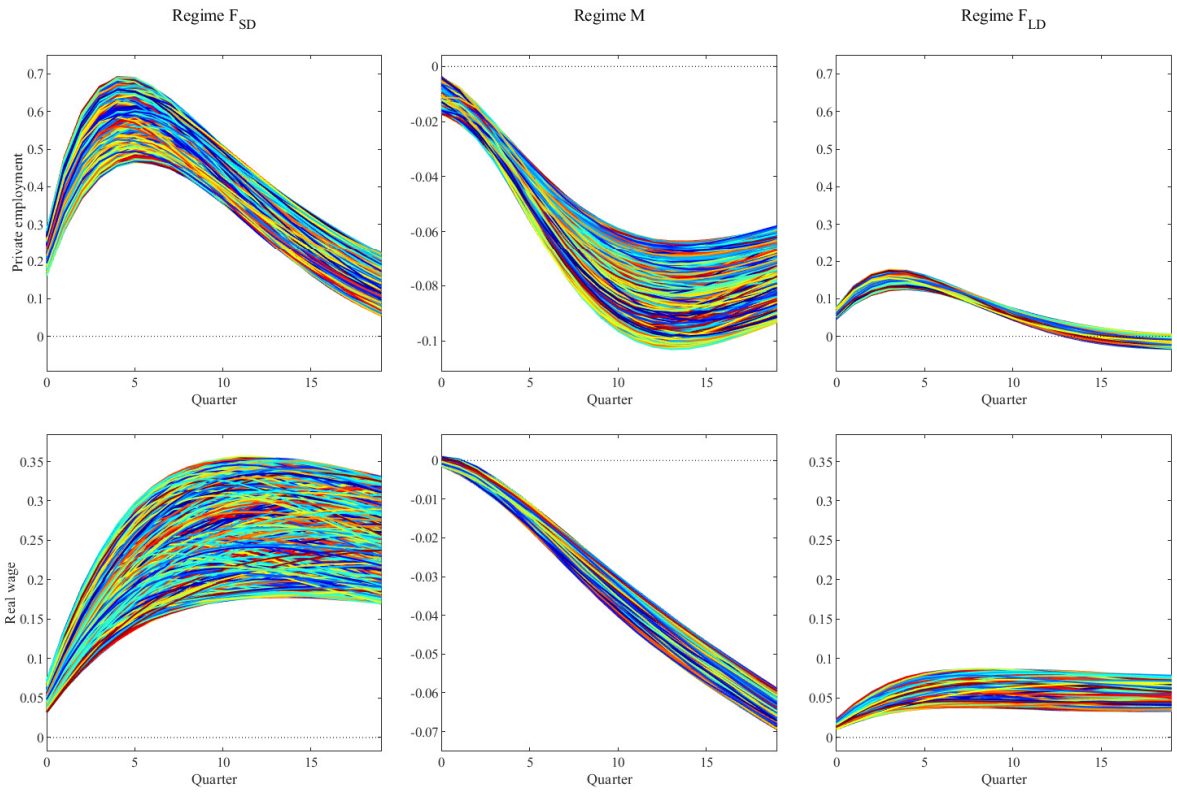


Figure 9: Sensitivity Analysis across Regimes

Notes: Each line is one draw of θ_2 whose path lies within the 16^{th}–84^{th} percentile range at every horizon.

5 Concluding Remarks

Using a Bayesian SVAR estimated on postwar U.S. data, we document changes in private-sector labor market responses to government employment shocks across major historical episodes. To interpret these findings, we develop a New Keynesian DSGE model combining alternative monetary–fiscal regimes, following Leeper (1991), with government debt maturity, following Woodford (2001). The model explains the differences across subsamples through the interaction of monetary–fiscal coordination and debt maturity.

Three findings emerge. First, under active fiscal policy and short-term debt financing, government hiring crowds in private employment and raises real wages, consistent with the pre-Volcker evidence (1960Q1–1979Q3). Second, shifting to long-term debt substantially attenuates these stimulative effects, even under accommodative monetary policy. This mechanism helps explain the muted responses in the post-GFC era (2008Q4–2025Q1), as debt maturity shapes fiscal transmission through bond prices, inflation, household wealth, and aggregate demand. Third, under active inflation-targeting monetary policy, government employment shocks become contractionary regardless of debt maturity, consistent with the Great Moderation evidence (1984Q1–2007Q2).

These findings underscore that the labor market effects of fiscal policy depend on monetary policy institutions and public debt management. Both must be considered when assessing whether public hiring is expansionary or contractionary.

Future research could introduce heterogeneous households and occupational choice between public and private employment, or incorporate search-and-matching frictions in both sectors to endogenize unemployment. Such extensions would enrich the model's labor market structure and deepen our understanding of the crowding-in and crowding-out effects of government employment shocks.

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Online Appendix to "Government Employment Shocks, Policy Coordination, and Debt Structure"

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1 Data Description

Variable	Description	Data source
Government employment	Federal general government total employees + armed forces	Valerie A. Ramey's website
Real GDP per capita	Gross domestic product	FRED
Private employment	Nonprofit institutions + Private nonfarm sector	Valerie A. Ramey's website
Unemployment rate	Unemployment rate	FRED
Real wages	Compensation of employees: Wages and salaries (Private industries)	FRED
Shadow short rate (SSR)	Shadow short rate estimates	LJKmfa.com
Central bank policy rate	Federal funds effective rate	FRED
Monetary base	Monetary base	FRED
Gov't debt	Gross federal debt-to-GDP ratio	Market Value of U.S. Government Debt
Taxes	Average tax rate	Ramey and Zubairy (2018)
Government wage	Compensation of federal government employees	FRED

2 VAR Estimation Accounting for the Pandemic Period

The onset of COVID-19 generated a small number of extreme observations that lie far outside historical experience. In conventional Bayesian VARs, such outliers can distort the estimation of reduced-form persistence and cross-variable dynamics, potentially contaminating structural inference. To address this concern, we follow Cascaldi-Garcia (2022) and augment our Bayesian SVAR with pandemic-specific time dummies. Starting from our baseline reduced-form specification,

$$y_t = \sum_{i=1}^{K} B_i y_{t-i} + u_t$$

we estimate the augmented model

$$y_t = \sum_{i=1}^{K} B_i y_{t-i} + \sum_{s=1}^{h} \mathbf{1}_{t=t_s} d_s + u_t$$

where y_t is the 5×1 vector of endogenous variables defined in the main text, $\mathbf{1}_{t=t_s}$ is an indicator function equal to one in pandemic quarter t_s and zero otherwise, and d_s is a 5×1 vector capturing intercept shifts during that quarter. In our implementation, $h = 2$ and $t_s \in \{2020Q1, 2020Q2\}$, corresponding to the collapse and initial rebound of economic activity. These dummies allow the model to accommodate temporary deviations from historical regularities without forcing the autoregressive coefficients $\{B_i\}_{i=1}^{K}$ to absorb pandemic-specific dynamics.

Following Cascaldi-Garcia (2022), we impose shrinkage on the dummy coefficients through

$$d_s \mid \Sigma \sim \mathcal{N}\left(0,\ \Sigma/\phi^2\right),$$

where $\phi > 0$ governs the degree of shrinkage. The parameter ϕ determines how much information is extracted from the pandemic observations. As $\phi \to 0$, the prior becomes diffuse and the time dummies absorb most of the abnormal variation, effectively downweighting the pandemic quarters in the estimation of $\{B_i\}$ and Σ. As $\phi \to \infty$, the dummies shrink toward zero and the model converges to the standard Minnesota-prior VAR, treating the pandemic observations as ordinary data points. Hence, the specification nests the boundary cases of fully downweighting versus fully incorporating pandemic information. We select ϕ in a data-driven manner by maximizing the marginal likelihood over a discrete grid, as in Cascaldi-Garcia (2022). This balances model fit against overfitting of extreme realizations. The overall tightness parameter is set to 0.2, and the prior on deterministic terms is diffuse.

3 Testing the Equality of IRFs

For each response, we compute the difference between the two IRFs at each horizon and average these differences over 20 horizons. Since the subsamples are estimated separately, the posterior distribution of differences between response paths is obtained by differencing independent posterior draws.

Table 1 reports the posterior probability that the horizon-averaged difference is positive, along with its posterior median and 68% credible interval. To assess differences across horizons jointly, we also construct 68% Bayesian sup-t credible bands for the difference paths, following Montiel Olea and Plagborg-Møller (2019). The last column reports the number of horizons at which the simultaneous bands exclude zero.

The differences between the pre-Volcker and the GM responses are pronounced across all three labor market variables. The posterior probabilities of higher average private employment and real wage responses and a lower average unemployment response in the pre-Volcker era are 0.988, 0.923, and 0.992, respectively. The corresponding directional probabilities for the pre-Volcker era relative to the post-GFC era are 0.887, 0.732, and 0.947. For the post-GFC era relative to the GM, they are 0.917, 0.888, and 0.964, respectively, favoring more expansionary responses after the GFC.

The sup-t band excludes zero in 12, 9, and 11 of the 20 horizons for private employment, real wages, and the unemployment rate, respectively, when comparing the pre-Volcker and GM eras. For the remaining comparisons, we find no or very few statistically significant differences. Overall, the evidence against equality is strongest for the pre-Volcker and GM eras. Comparisons involving the post-GFC era provide directional evidence of differences in average responses, but more limited evidence of differences at individual horizons, which may partly reflect the shorter post-GFC sample.

Table 1: Posterior Tests of Equality of Impulse Responses Across Subsamples

Response	Comparison	P(diff >0)	Median diff.	# of Sig. Horiz.
Private Employment	preV $-$ GM	0.988	$+0.413$ $[+0.252, +0.620]$	12/20
	preV $-$ postGFC	0.887	$+0.170$ $[+0.037, +0.336]$	0/20
	postGFC $-$ GM	0.917	$+0.233$ $[+0.091, +0.431]$	0/20
Real Wage	preV $-$ GM	0.923	$+0.143$ $[+0.048, +0.244]$	9/20
	preV $-$ postGFC	0.732	$+0.036$ $[-0.024, +0.100]$	1/20
	postGFC $-$ GM	0.888	$+0.106$ $[+0.022, +0.198]$	2/20
Unemployment Rate	GM $-$ preV	0.992	$+0.153$ $[+0.092, +0.228]$	11/20
	postGFC $-$ preV	0.947	$+0.083$ $[+0.033, +0.148]$	0/20
	GM $-$ postGFC	0.964	$+0.066$ $[+0.031, +0.109]$	3/20

Notes: Differences in average responses (20 horizons) are computed from independent posterior draws. Brackets report 68% credible intervals.

4 Robustness of VAR & Local Projection

4.1 Recursive (Cholesky) Identification

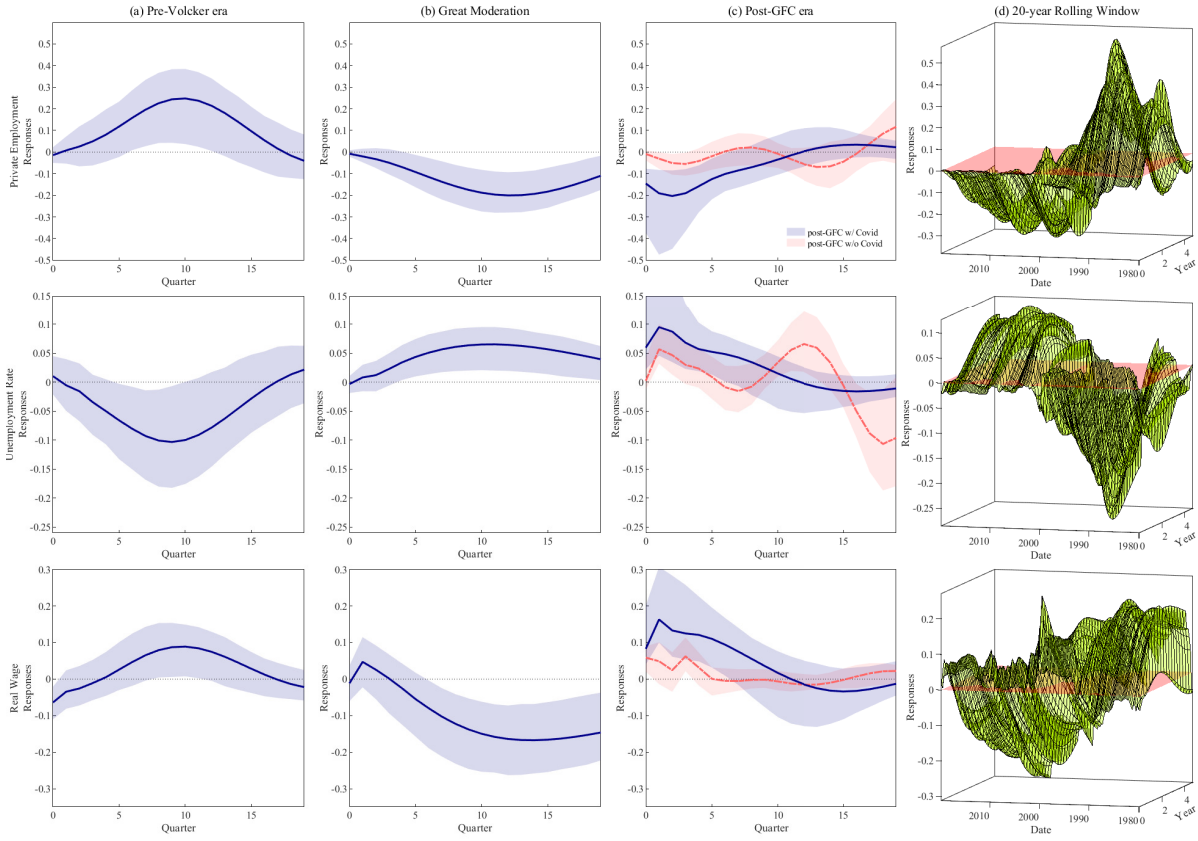


Figure 1: IRFs with Recursive Identification

Notes: We present the IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t]'$ to a positive government employment shock using the recursive identification method. Panels (a)–(c) report the point estimates (solid line) of a labor market variable along with its 68% confidence intervals (shaded areas) computed by a nonparametric bootstrap based on 1000 replications. Panel (d) reports an array of IRFs to the fiscal shock with a 20-year fixed-size rolling window scheme.

4.2 Controlling for Taxes

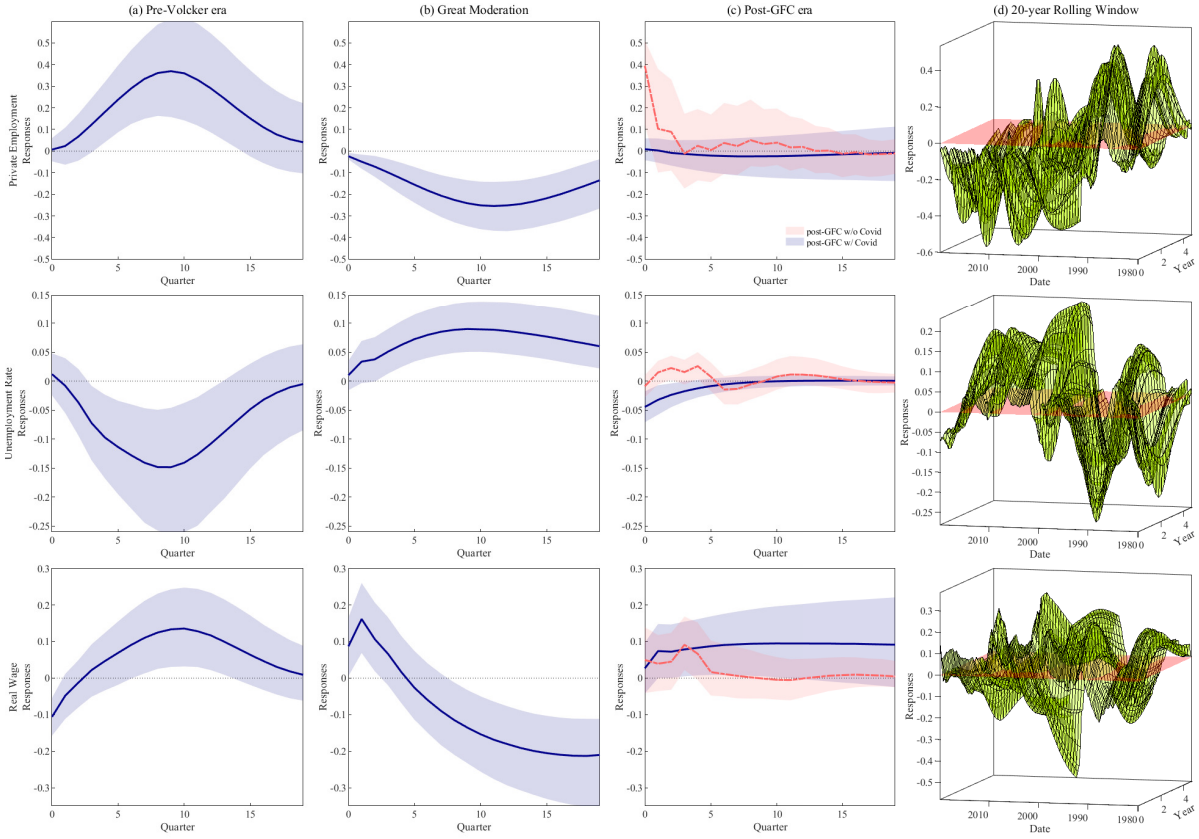


Figure 2: IRFs with Taxes Included as an Additional Control Variable

Notes: We present the IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t, tax_t]'$ to a positive government employment shock identified using the max-share approach. Panels (a)–(c) report posterior medians (solid line) of a labor market variable along with its 68% credible intervals (shaded areas), constructed from draws from the posterior distribution. Panel (d) reports an array of IRFs to the fiscal shock with a 20-year fixed-size rolling window scheme.

4.3 Controlling for Government Debt

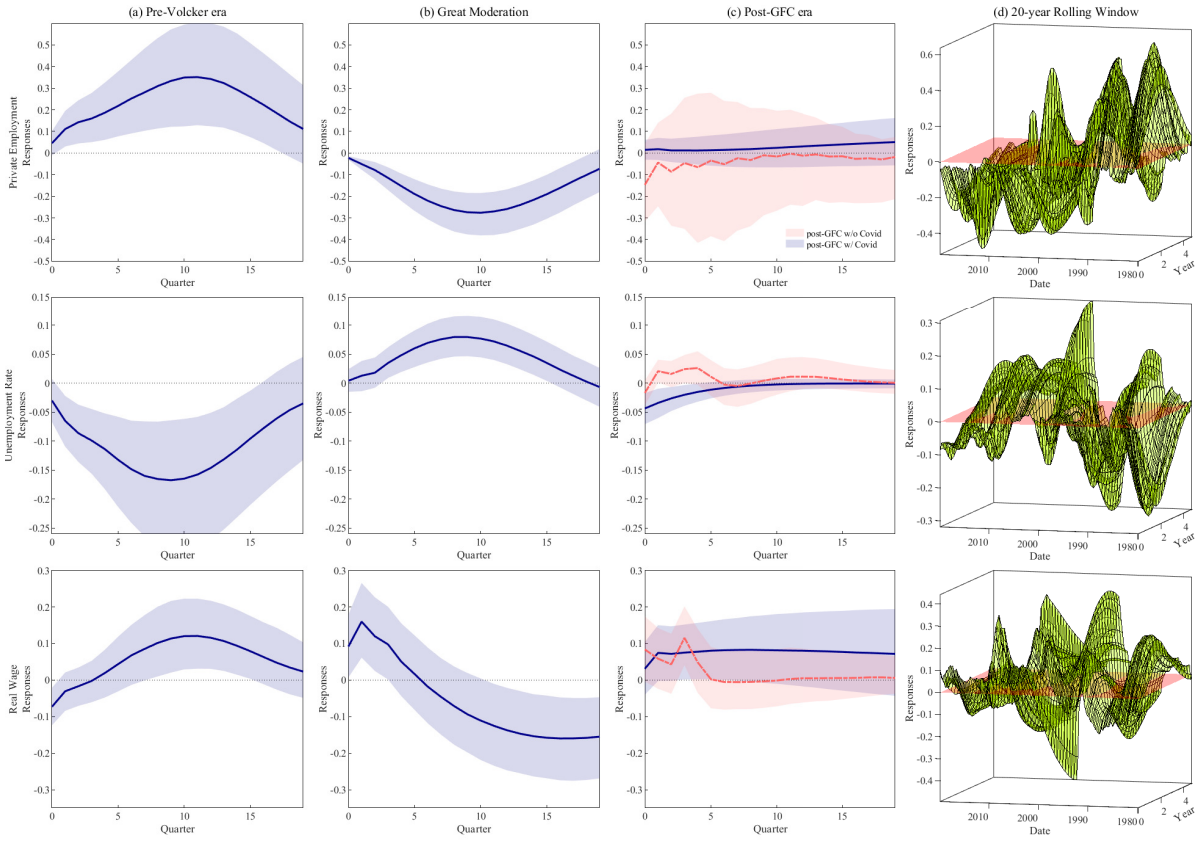


Figure 3: IRFs with Gov't Debt Included as an Additional Control Variable

Notes: We present the IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t, debt_t]'$ to a positive government employment shock identified using the max-share approach. Panels (a)–(c) report posterior medians (solid line) of a labor market variable along with its 68% credible intervals (shaded areas), constructed from draws from the posterior distribution. Panel (d) reports an array of IRFs to the fiscal shock with a 20-year fixed-size rolling window scheme.

4.4 Shadow Short Rate (SSR)

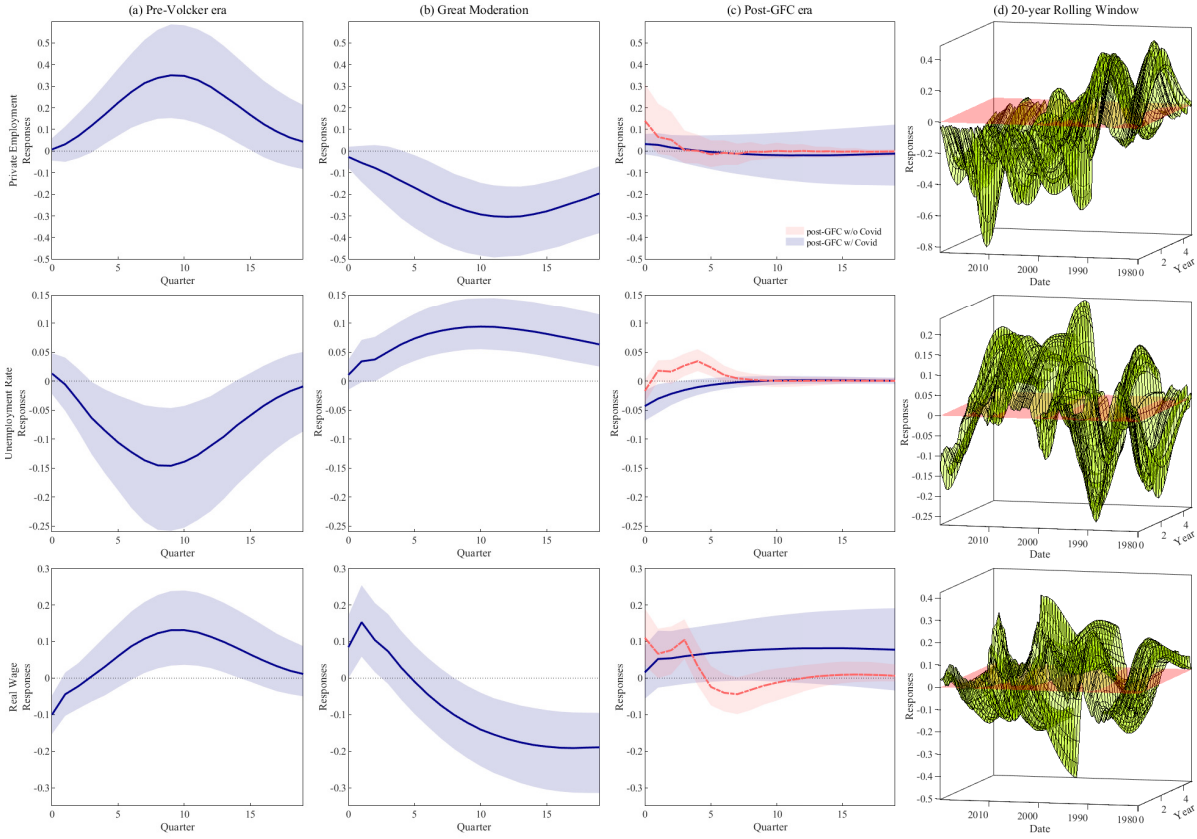


Figure 4: IRFs with SSR

Notes: We present the IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach with $int_t = SSR$.

4.5 Alternative Rolling Windows

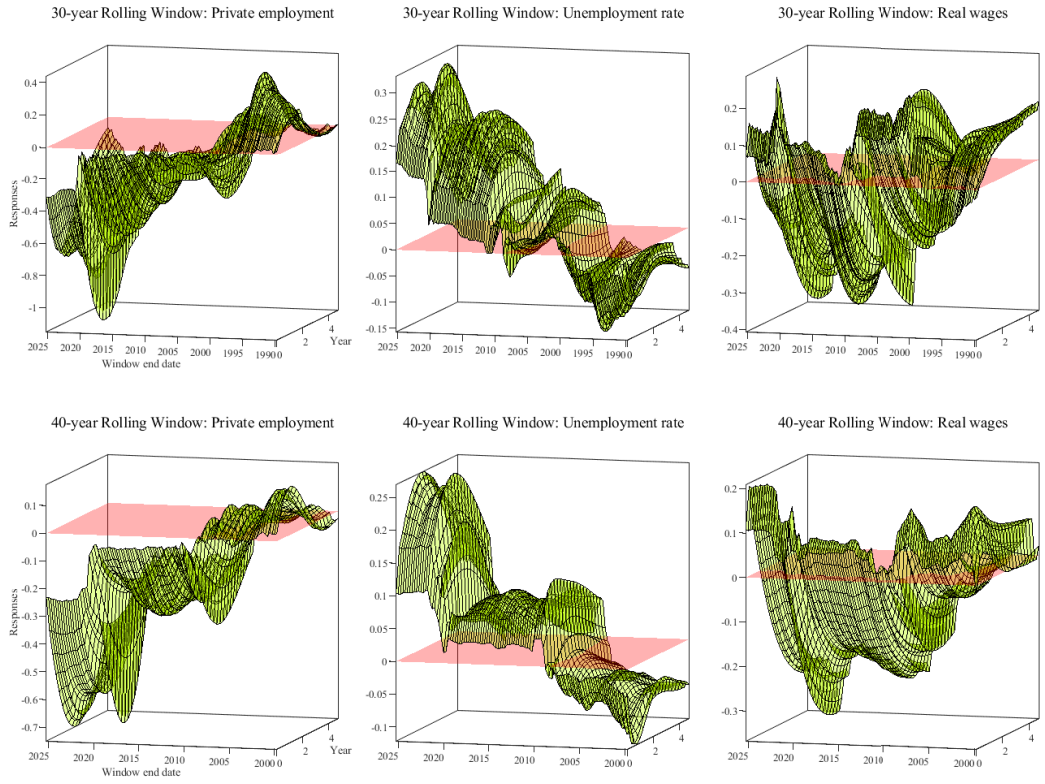


Figure 5: 30- and 40-Year Rolling Windows

Notes: We present the IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach, estimated over 30- and 40-year rolling windows.

4.6 Great Moderation (Including the Volcker Disinflation)

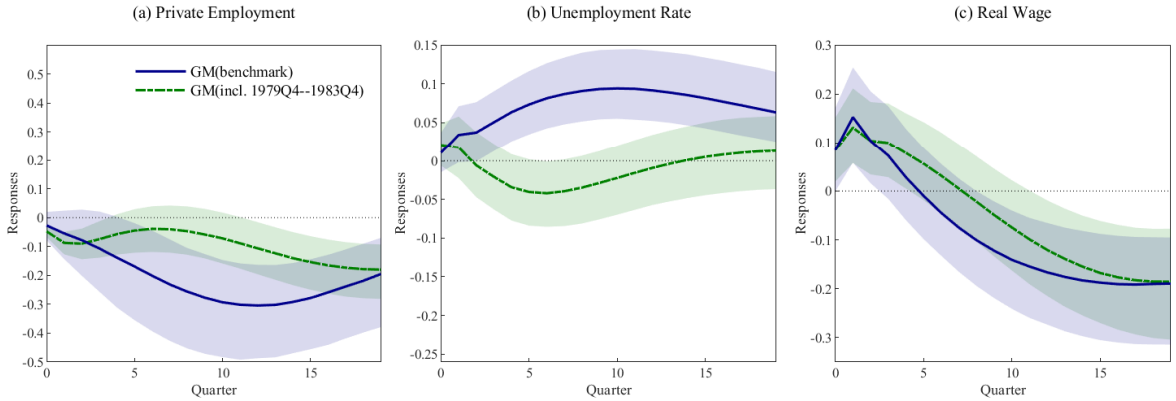


Figure 6: Great Moderation (including 1979Q4–1983Q4)

Notes: We present the subsample (i.e., Great Moderation including 1979Q4–1983Q4) IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach.

4.7 Alternative Choices of Forecast Horizon

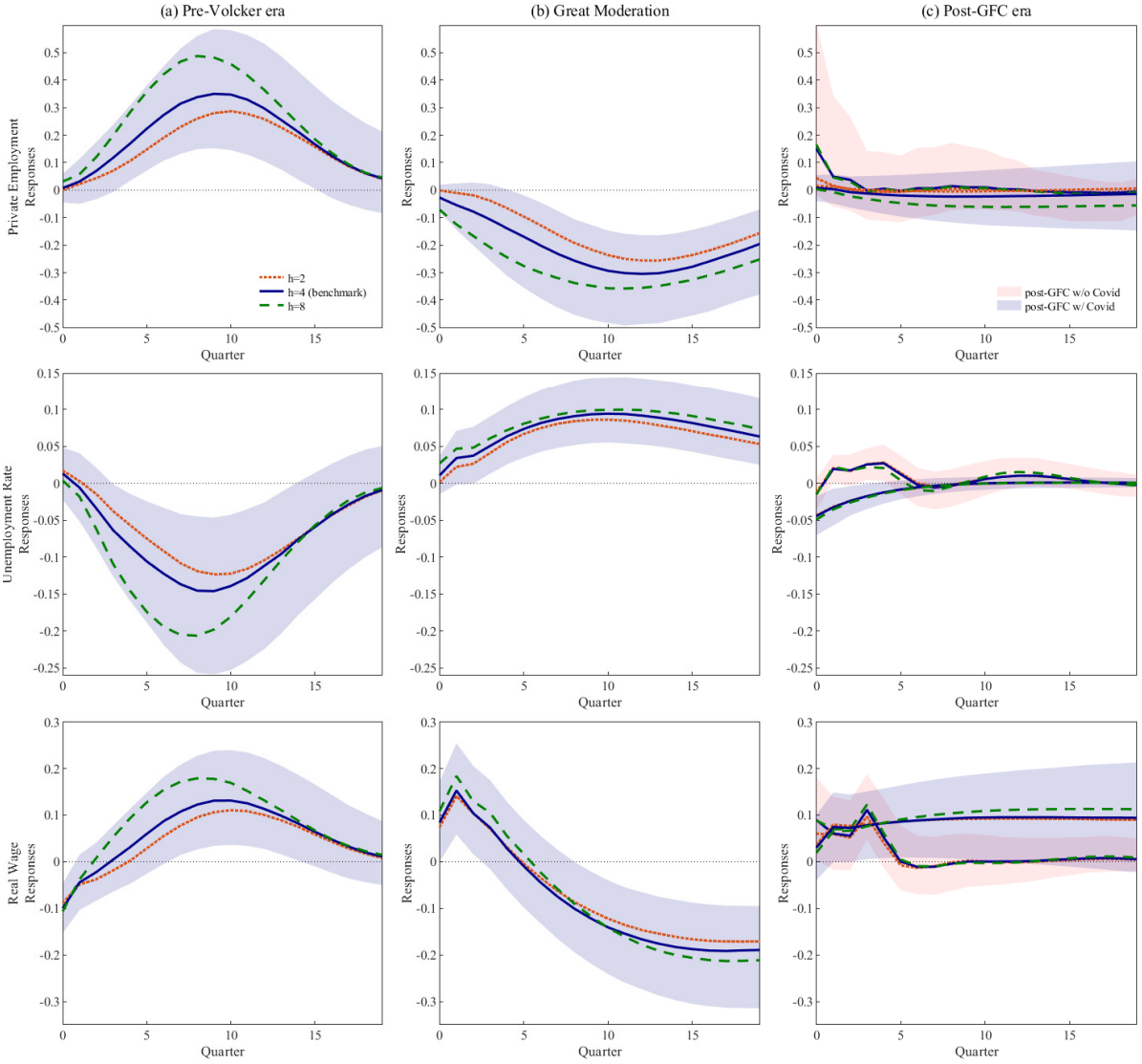


Figure 7: Alternative Choices of Forecast Horizon

Notes: We present the IRFs from $\mathbf{y}_t = [n_t^g, gdp_t, lab_t, int_t, mon_t]'$ to a positive government employment shock identified using the max-share approach with alternative choices of forecast horizon.

4.8 Alternative Fiscal Shock: Wage Bill

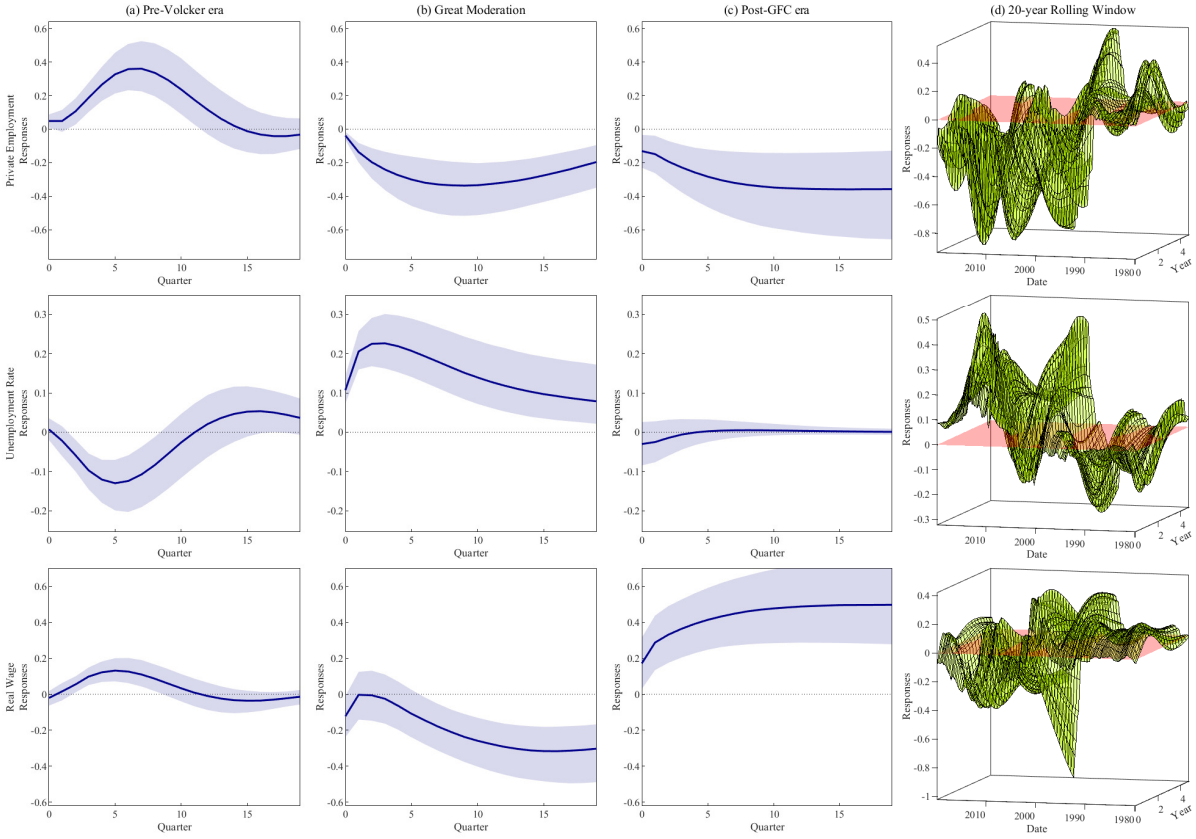


Figure 8: IRFs to a Federal Wage Bill Shock

Notes: We present the IRFs from $\mathbf{y}_t = [fwag_t, gdp_t, lab_t, int_t, mon_t]'$, where $fwag_t$ is the log real per-capita compensation of federal employees, to a positive government wage shock identified using the max-share approach. Panel (c) uses the full post-GFC sample with the Pandemic Priors.

4.9 Local Projection Including the Post-GFC Era in Regime F

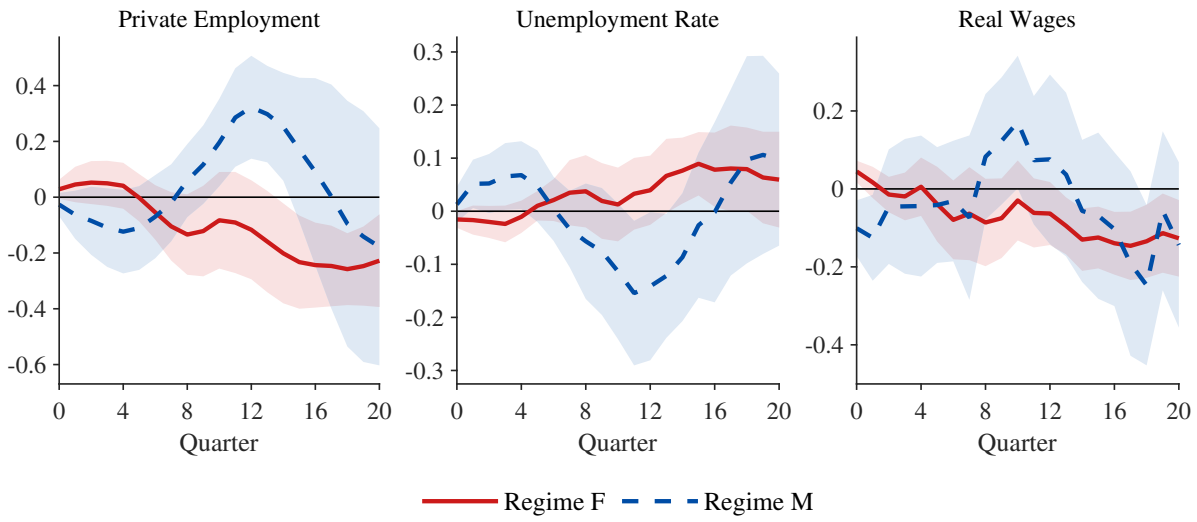


Figure 9: Interaction Effects between Government Employment Shocks and Debt Maturity (Including the Post-GFC Era)

Notes: Regime F = pre-Volcker + post-GFC; Regime M, the GM. Shaded areas indicate 90% confidence bands based on Newey–West standard errors.

5 Derivation of the Log-Linearized Model

5.1 The Equilibrium System

5.1.1 Households We define the real market value of government debt as $b_t = \frac{P_t^m B_t^m}{P_t}$ and λ_t as the Lagrange multiplier associated with the households' budget constraint.

- FOC for consumption:

$$\lambda_t(1+\tau_t^c) = \frac{1}{c_t^* - hc_{t-1}^*} \tag{1}$$

- c^* definition:

$$c_t^* = c_t + \alpha_g s_t^g \tag{2}$$

$$s_t^g = \left(n_t^g\right)^{1-\gamma_g} g_t^{\gamma_g} \tag{3}$$

- Euler equation for one-period private bonds:

$$R_t{}^{-1} = \beta E_t\left[\frac{\lambda_{t+1}}{\lambda_t}\frac{1}{\pi_{t+1}}\right] \tag{4}$$

- Price relation between long and short bonds:

$$P_t^m = E_t\left(\frac{1+\rho P_{t+1}^m}{R_t}\right) \tag{5}$$

- FOC for capacity utilization:

$$a'\left(u_t\right) = \left(1-\tau_t^k\right) r_t^k \tag{6}$$

where $a\left(u_t\right) = A_1\left(u_t - 1\right) + \frac{A_2}{2}\left(u_t - 1\right)^2$ with $A_1 = \left(1-\tau^k\right) r^k$ and $A_2 = A_1 \frac{\zeta_2}{1-\zeta_2}$, so that $u = 1$, $a(1) = 0$ and $\frac{a''(1)}{a'(1)} = \frac{\zeta_2}{1-\zeta_2}$ in the steady state.

- FOC for capital:

$$q_t = \beta E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\left[\left(1-\tau_{t+1}^k\right) r_{t+1}^k u_{t+1} - a\left(u_{t+1}\right) + q_{t+1}\left(1-\delta\right)\right]\right\} \tag{7}$$

where the (marginal) Tobin's Q is defined as $q_t = \frac{Q_t}{\lambda_t}$.

• FOC for investment:

$$1 = q_t \left[1 - S\left(\frac{i_t}{i_{t-1}}\right) - S'\left(\frac{i_t}{i_{t-1}}\right)\frac{i_t}{i_{t-1}}\right] + \beta E_t q_{t+1} \frac{\lambda_{t+1}}{\lambda_t} S'\left(\frac{i_{t+1}}{i_t}\right)\left(\frac{i_{t+1}}{i_t}\right)^2 \quad (8)$$

• Law of motion for capital:

$$k_t = (1-\delta)\, k_{t-1} + \left[1 - S\left(\frac{i_t}{i_{t-1}}\right)\right] i_t \quad (9)$$

where $S\left(\frac{i_t}{i_{t-1}}\right) = \frac{\kappa}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2$, so that $S(1) = S'(1) = 0$ and $S''(1) = \kappa$.

5.1.2 Private Labor Agency and Wage Setting

• Frictionless real wage: the real wage w_t^{flex} that would prevail in the absence of nominal and real wage rigidities solves the households' wage-setting condition

$$(1-\tau_t^n)\left(n_t^p + n_t^g - \theta_w n_t^p\right) + \theta_w \frac{n_t^p n_t^\eta}{\lambda_t\, w_t^{\text{flex}}} = 0 \quad (10)$$

where

$$w_t^{\text{flex}} = \frac{\theta_w n_t^p n_t^\eta}{(1-\tau_t^n)\,\lambda_t\left[(\theta_w - 1)\, n_t^p - n_t^g\right]}, \quad (11)$$

$$n_t = n_t^p + \alpha_{n^g} n_t^g. \quad (12)$$

• Real wage target: following Blanchard and Galí (2007), wage setters adjust toward a slow-moving target:

$$w_t^{\text{tgt}} = \phi_{bg}\, w_{t-1}^{\text{tgt}} + \phi_{bg}^f\, E_t w_{t+1}^{\text{tgt}} + \lambda_{bg}\, w_t^{\text{flex}}, \quad (13)$$

where $\phi_{bg} = \frac{(1+\theta_w\eta)\gamma_w}{1+\gamma_w[\theta_w\eta(1+\beta)+\beta\gamma_w]}$, $\phi_{bg}^f = \beta\phi_{bg}$, and $\lambda_{bg} = 1 - \phi_{bg} - \phi_{bg}^f$. Because the three coefficients sum to one, $w^{\text{tgt}} = w^{\text{flex}}$ in the steady state.

• Wage Phillips curve: the actual real wage, $w_t \equiv W_t / P_t$, adjusts toward w_t^{tgt} through a Rotemberg-form wage Phillips curve:

$$\begin{aligned}\phi_w \frac{\pi_t^w}{\bar\pi}\left(\frac{\pi_t^w}{\bar\pi} - 1\right) &= (\theta_w - 1)\left(\frac{w_t^{\text{tgt}}}{w_t} - 1\right) \\ &\quad + \beta E_t\left[\frac{\lambda_{t+1}}{\lambda_t}\phi_w \frac{\pi_{t+1}^w}{\bar\pi}\left(\frac{\pi_{t+1}^w}{\bar\pi} - 1\right)\frac{w_{t+1} n_{t+1}^p}{w_t n_t^p}\right],\end{aligned} \quad (14)$$

where

$$\pi_t^w \equiv \frac{w_t}{w_{t-1}}\pi_t \tag{15}$$

is gross nominal wage inflation. We set $\phi_w = \frac{\omega_w(\theta_w-1)}{(1-\omega_w)(1-\omega_w\beta)}$ so that the linearized wage Phillips curve has the same slope as a Calvo model with non-reset probability ω_w. Thus, γ_w governs the persistence of the real wage target, while ϕ_w governs nominal wage adjustment.

5.1.3 Intermediate Goods Firms

• Production function:

$$y_t = (u_t k_{t-1})^{\alpha} (n_t^p)^{1-\alpha} \tag{16}$$

• Capital-labor ratio:

$$\frac{u_t k_{t-1}}{n_t^p} = \frac{\alpha}{1-\alpha}\frac{w_t}{r_t^k} \tag{17}$$

• Real marginal cost:

$$mc_t = \Upsilon w_t^{1-\alpha}\left(r_t^k\right)^{\alpha} \tag{18}$$

where $\Upsilon = \alpha^{-\alpha}(1-\alpha)^{\alpha-1}$.

• Deep habits: following Ravn et al. (2006), let $abs_t \equiv c_t + i_t + g_t$ denote the component of final absorption entering the deep-habit block. The habit stock, s_t, and the price-elastic component of demand, x_t, evolve as

$$s_t = \rho_{dh} s_{t-1} + (1-\rho_{dh})\, abs_t \tag{19}$$

$$x_t = abs_t - \theta_{dh} s_{t-1} \tag{20}$$

• Envelope condition for the shadow value of the customer base: let v_t^{dh} denote the value, in units of current output, of an additional unit of the customer base s_t. A unit of s_t raises next period's demand by θ_{dh}, earning a margin of $1 - mc_{t+1}$ per unit, and carries over into s_{t+1} with weight $\rho_{dh} + (1-\rho_{dh})\theta_{dh}$:

$$v_t^{dh} = \beta E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\left[\theta_{dh}(1-mc_{t+1}) + (\rho_{dh} + (1-\rho_{dh})\,\theta_{dh})\, v_{t+1}^{dh}\right]\right\} \tag{21}$$

• Pricing condition under deep habits: the desired real marginal cost, mc_t^* (the in-

verse of the desired markup), satisfies

$$abs_t \;=\; \eta_{dh}\, x_t \left[(1 - mc_t^*) + (1 - \rho_{dh})\, \nu_t^{dh} \right], \tag{22}$$

or equivalently $1 - mc_t^* = \left(\eta_{dh} \frac{x_t}{abs_t} \right)^{-1} - (1 - \rho_{dh})\, \nu_t^{dh}$. The desired markup is therefore governed by the contemporaneous elasticity of demand, $\eta_{dh} \frac{x_t}{abs_t}$, and by the value of expanding the future customer base, $(1 - \rho_{dh})\, \nu_t^{dh}$. As in the main text, $\eta_{dh} = \frac{\theta_p}{(1-\theta_{dh})\Omega_{dh}}$ and $\Omega_{dh} = 1 + \frac{(1-\rho_{dh})\beta\theta_{dh}}{1-\beta[\rho_{dh}+(1-\rho_{dh})\theta_{dh}]}$, so that $mc^* = \frac{\theta_p - 1}{\theta_p}$ in the steady state.

• Intermediate firm's FOC for price: the effective demand elasticity $\varepsilon_t \equiv \frac{1}{1-mc_t^*}$ replaces the constant elasticity θ_p in the Rotemberg pricing condition:

$$\phi_p\, (\pi_t - \bar{\pi})\, \pi_t \;=\; (1 - \varepsilon_t) + \varepsilon_t\, mc_t + \beta E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \phi_p\, (\pi_{t+1} - \bar{\pi})\, \pi_{t+1} \frac{y_{t+1}}{y_t} \right] \tag{23}$$

In the steady state, $\varepsilon = \theta_p$, so the steady-state markup coincides with the constant-elasticity case, $\theta_p / (\theta_p - 1)$.

5.1.4 Fiscal and Monetary Policy

• Government budget constraint:

$$b_t + \tau_t^n w_t \left(n_t^p + n_t^g \right) + \tau_t^k r_t^k u_t k_{t-1} + \tau_t^c c_t \;=\; \frac{(1 + \rho P_t^m)}{P_{t-1}^m} \frac{b_{t-1}}{\pi_t} + w_t n_t^g + g_t + z_t \tag{24}$$

where the debt-to-GDP ratio is $s_t^b \equiv \frac{b_t}{y_t}$.

• Fiscal rules: government employment follows (equations (25)–(26) in the main text)

$$\frac{n_t^g}{n^g} \;=\; \left(\frac{n_{t-1}^g}{n^g} \right)^{\psi_{ng}} \left(\frac{s_{t-1}^b}{s^b} \right)^{-(1-\psi_{ng})\gamma_{ng}} \nu_t^{ng} \tag{25}$$

$$\ln \nu_t^{ng} \;=\; \rho_{ng} \ln \nu_{t-1}^{ng} + \varepsilon_t^{ng} \tag{26}$$

With the exception of the consumption tax τ_t^c, the other fiscal instruments—government purchases g_t, transfers z_t, and the labor and capital tax rates τ_t^n and τ_t^k—similarly belong to the debt-stabilizing fiscal rule in Regime M and are specified as responses to the lagged debt-to-GDP ratio:

$$\frac{g_t}{g} = \left(\frac{s_{t-1}^b}{s^b} \right)^{-\gamma_G}, \qquad \frac{z_t}{z} = \left(\frac{s_{t-1}^b}{s^b} \right)^{-\gamma_Z}, \tag{27}$$

$$\frac{\tau_t^n}{\tau^n} = \left(\frac{s_{t-1}^b}{s^b} \right)^{\gamma_{\tau^n}}, \qquad \frac{\tau_t^k}{\tau^k} = \left(\frac{s_{t-1}^b}{s^b} \right)^{\gamma_{\tau^k}} \tag{28}$$

The consumption tax rate does not respond to debt and stays at its steady-state value, $\tau_t^c = \tau^c$. In Regime F, all debt-feedback coefficients are zero.

- Monetary policy rule:

$$R_t = R_{t-1}^{\psi_r} \left[\bar{R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{\phi_\pi} \left(\frac{y_t}{\bar{y}} \right)^{\phi_y} \right]^{1-\psi_r} \tag{29}$$

where $\phi_\pi < 1$ in Regime F and $\phi_\pi > 1$ in Regime M.

- Aggregate resource constraint:

$$y_t = c_t + i_t + g_t + a(u_t) k_{t-1} + \frac{\phi_p}{2} (\pi_t - \bar{\pi})^2 y_t \tag{30}$$

5.2 Steady State

In the steady state, $\pi = \bar{\pi} = 1$, $u = 1$, and $q = 1$. Given the average maturity of government debt, denoted as AD, the parameter ρ is $\rho = \left(1 - \frac{1}{AD}\right)\frac{\bar{\pi}}{\beta}$. Given these values and the steady-state fiscal policy calibration, the variables are defined by the following system:

$$
\begin{aligned}
R &= \frac{\bar{\pi}}{\beta} \\
P^m &= \frac{\beta}{1-\rho\beta} \\
r^k &= \frac{\frac{1}{\beta} - 1 + \delta}{1-\tau^k} \\
A_1 &= a'(1) = r^k\left(1-\tau^k\right), \qquad A_2 = A_1\frac{\zeta_2}{1-\zeta_2} \\
mc &= mc^* = \frac{\theta_p - 1}{\theta_p} \\
w &= \left[(1-\alpha)^{1-\alpha}(\alpha)^{\alpha} mc\left(r^k\right)^{-\alpha}\right]^{\frac{1}{1-\alpha}} \\
\frac{k}{n^p} &= \frac{\alpha}{1-\alpha}\frac{w}{r^k} \\
\frac{i}{n^p} &= \frac{\delta k}{n^p} \\
\frac{y}{n^p} &= (\frac{k}{n^p})^{\alpha} \\
\frac{c}{n^p} &= \frac{y}{n^p}(1-\frac{g}{y}) - \frac{i}{n^p} \\
\frac{s^g}{n^p} &= \left(\frac{n^g}{n^p}\right)^{1-\gamma_g}(\frac{g}{y}\frac{y}{n^p})^{\gamma_g} \\
\frac{c^*}{n^p} &= \frac{c}{n^p} + \alpha_g\frac{s^g}{n^p} \\
\frac{n}{n^p} &= 1 + \alpha_{n^g}\frac{n^g}{n^p} \\
\frac{z}{n^p} &= \left(1 - \frac{1+\rho P^m}{\pi P^m}\right)\frac{b}{y}\frac{y}{n^p} + \tau^n w\left(1+\frac{n^g}{n^p}\right) + \tau^k r^k\frac{k}{n^p} + \tau^c\frac{c}{n^p} - w\frac{n^g}{n^p} - \frac{g}{y}\frac{y}{n^p} \\
n^p &= \left[\frac{(1-\tau^n)\left(\theta_w - 1 - n^g/n^p\right)w}{(1+\tau^c)(1-h)\theta_w\left(c^*/n^p\right)\left(n/n^p\right)^{\eta}}\right]^{\frac{1}{1+\eta}} \\
\lambda &= \frac{1}{(1+\tau^c)(1-h)c^*}
\end{aligned}
$$

The levels of the remaining real variables follow by multiplying the ratios above by n^p. In the wage block, $w^{\text{tgt}} = w^{\text{flex}} = w$ and $\pi^w = \bar{\pi}$. Since the adjustment costs are zero in the steady state, $abs = c + i + g = y$, and the deep-habit block satisfies $s = abs$, $x = (1 - \theta_{dh})\, abs$, and $\nu^{dh} = \frac{\beta\theta_{dh}(1-mc)}{1-\beta[\rho_{dh}+(1-\rho_{dh})\theta_{dh}]}$. With $mc^* = mc$, these values imply $(1 - mc^*) + (1 - \rho_{dh})\, \nu^{dh} = (1 - mc)\, \Omega_{dh}$, so the pricing condition reduces to $1 = \eta_{dh}\, (1 - \theta_{dh})\, \Omega_{dh}\, (1 - mc) = \theta_p\, (1 - mc)$, which holds at $mc = \frac{\theta_p - 1}{\theta_p}$.

5.3 The Log-Linearized System

We define the log deviation of a variable from its steady state as $\hat{x}_t = \ln x_t - \ln x$. The equilibrium system in the log-linearized form consists of the following equations:

• FOC for consumption:

$$\hat{\lambda}_t + \frac{\tau^c}{1+\tau^c}\hat{\tau}_t^c + \frac{1}{1-h}\hat{c}_t^* = \frac{h}{1-h}\hat{c}_{t-1}^* \tag{31}$$

• Consumption in utility:

$$\hat{c}_t^* - \frac{c}{c+\alpha_g s^g}\hat{c}_t - \frac{\alpha_g s^g}{c+\alpha_g s^g}\hat{s}_t^g = 0 \tag{32}$$

$$\hat{s}_t^g - \gamma_g \hat{g}_t - (1-\gamma_g)\hat{n}_t^g = 0 \tag{33}$$

• Euler equation:

$$E_t\hat{\lambda}_{t+1} - E_t\hat{\pi}_{t+1} - \hat{\lambda}_t + \hat{R}_t = 0 \tag{34}$$

• Long-term bond pricing (no-arbitrage) relation (equation (12) in the main text, using $R = \bar{\pi}/\beta$):

$$\frac{\rho\beta}{\bar{\pi}}E_t\hat{P}_{t+1}^m - \hat{R}_t - \hat{P}_t^m = 0 \tag{35}$$

• FOC for capacity utilization:

$$\frac{\zeta_2}{1-\zeta_2}\hat{u}_t - \hat{r}_t^k + \frac{\tau^k}{1-\tau^k}\hat{\tau}_t^k = 0 \tag{36}$$

• FOC for capital:

$$E_t\hat{\lambda}_{t+1} - \hat{\lambda}_t + \beta\left(1-\tau^k\right)r^k E_t\hat{r}_{t+1}^k - \beta\tau^k r^k E_t\hat{\tau}_{t+1}^k + \beta\left(1-\delta\right)E_t\hat{q}_{t+1} - \hat{q}_t = 0 \tag{37}$$

• FOC for investment:

$$\beta E_t\hat{i}_{t+1} - \left(1+\beta\right)\hat{i}_t + \frac{1}{\kappa}\hat{q}_t = -\hat{i}_{t-1} \tag{38}$$

• Law of motion for capital:

$$\hat{k}_t - \delta\hat{i}_t = \left(1-\delta\right)\hat{k}_{t-1} \tag{39}$$

- Frictionless real wage and total labor:

$$\left[\left(\theta_w - 1\right) n^p - n^g\right] \left(\hat{\lambda}_t + \hat{w}_t^{\text{flex}} - \frac{\tau^n}{1-\tau^n} \hat{\tau}_t^n - \eta \hat{n}_t \right) + n^g \left(\hat{n}_t^p - \hat{n}_t^g \right) = 0$$

$$n \hat{n}_t - n^p \hat{n}_t^p - \alpha_{n^g} n^g \hat{n}_t^g = 0 \tag{40}$$

- Real wage target:

$$\hat{w}_t^{\text{tgt}} = \phi_{bg} \hat{w}_{t-1}^{\text{tgt}} + \phi_{bg}^f E_t \hat{w}_{t+1}^{\text{tgt}} + \lambda_{bg} \hat{w}_t^{\text{flex}} \tag{41}$$

- Wage Phillips curve and wage inflation:

$$\hat{\pi}_t^w = \beta E_t \hat{\pi}_{t+1}^w + \frac{\theta_w - 1}{\phi_w} \left(\hat{w}_t^{\text{tgt}} - \hat{w}_t \right) \tag{42}$$

$$\hat{\pi}_t^w = \hat{w}_t - \hat{w}_{t-1} + \hat{\pi}_t \tag{43}$$

where $\frac{\theta_w - 1}{\phi_w} = \frac{(1-\omega_w)(1-\omega_w \beta)}{\omega_w}$.

- Production function:

$$\hat{y}_t - \left(1 - \alpha\right) \hat{n}_t^p - \alpha \hat{u}_t = \alpha \hat{k}_{t-1} \tag{44}$$

- Capital-labor ratio:

$$\hat{w}_t - \hat{r}_t^k - \hat{u}_t + \hat{n}_t^p = \hat{k}_{t-1} \tag{45}$$

- Real marginal cost:

$$\hat{mc}_t - \left(1 - \alpha\right) \hat{w}_t - \alpha \hat{r}_t^k = 0 \tag{46}$$

- Deep habits (absorption, habit stock and price-elastic demand):

$$y \widehat{abs}_t - c \hat{c}_t - i \hat{i}_t - g \hat{g}_t = 0 \tag{47}$$

$$\hat{s}_t - \left(1 - \rho_{dh}\right) \widehat{abs}_t = \rho_{dh} \hat{s}_{t-1} \tag{48}$$

$$\left(1 - \theta_{dh}\right) \hat{x}_t - \widehat{abs}_t = -\theta_{dh} \hat{s}_{t-1} \tag{49}$$

- Envelope condition for the shadow value of the customer base:

$$\hat{v}_t^{dh} = E_t \hat{\lambda}_{t+1} - \hat{\lambda}_t + \beta \chi_{dh} E_t \hat{v}_{t+1}^{dh} - \left(\theta_p - 1\right) \left(1 - \beta \chi_{dh}\right) E_t \hat{mc}_{t+1} \tag{50}$$

where $\chi_{dh} \equiv \rho_{dh} + \left(1 - \rho_{dh}\right) \theta_{dh}$.

• Pricing condition under deep habits:

$$\Omega_{dh}\left(\widehat{abs}_t - \hat{x}_t\right) + \left(\theta_p - 1\right)\hat{mc}_t^* - \left(\Omega_{dh} - 1\right)\hat{v}_t^{dh} = 0 \tag{51}$$

• Intermediate firm's FOC for price:

$$\phi_p \bar{\pi}^2 \left(\hat{\pi}_t - \beta E_t \hat{\pi}_{t+1}\right) - \left(\theta_p - 1\right)\left(\hat{mc}_t - \hat{mc}_t^*\right) = 0 \tag{52}$$

A fall in demand relative to the inherited habit stock lowers $\hat{x}_t$ relative to $\widehat{abs}_t$, which lowers $\hat{mc}_t^*$ and thus raises the desired markup. Without deep habits ($\theta_{dh} = 0$), $\hat{mc}_t^* = 0$ and the standard Rotemberg Phillips curve obtains.

• Government budget constraint:

$$\begin{aligned} &b\hat{b}_t + \tau^k r^k k\left(\hat{\tau}_t^k + \hat{r}_t^k + \hat{u}_t + \hat{k}_{t-1}\right) + \tau^c c\left(\hat{\tau}_t^c + \hat{c}_t\right) \\ &+\tau^n w\left[\left(n^p + n^g\right)\hat{\tau}_t^n + n^p \hat{n}_t^p + n^g \hat{n}_t^g\right] + \left[\tau^n\left(n^p + n^g\right) - n^g\right] w\hat{w}_t \\ &-\frac{(1+\rho P^m)b}{\pi P^m}\left(\hat{b}_{t-1} - \hat{P}_{t-1}^m - \hat{\pi}_t\right) - \rho\frac{b}{\pi}\hat{P}_t^m - wn^g\hat{n}_t^g - g\hat{g}_t - z\hat{z}_t = 0 \end{aligned} \tag{53}$$

where

$$\hat{n}_t^g = \psi_{n^g}\hat{n}_{t-1}^g - \left(1 - \psi_{n^g}\right)\gamma_{n^g}\hat{s}_{t-1}^b + \hat{v}_t^{n^g} \tag{54}$$

• Monetary policy rule:

$$\hat{R}_t - \left(1 - \psi_r\right)\left(\phi_\pi \hat{\pi}_t + \phi_y \hat{y}_t\right) = \psi_r \hat{R}_{t-1} \tag{55}$$

• Aggregate resource constraint:

$$y\hat{y}_t - c\hat{c}_t - i\hat{i}_t - g\hat{g}_t - \left(1 - \tau^k\right) r^k k\hat{u}_t = 0 \tag{56}$$

• Substituting the consumption Euler equation (34) in the term structure equation (13) in the main text, we obtain

$$\hat{P}_t^m = \sum_{j=0}^{\infty}(\rho\beta)^j E_t\left(\hat{\lambda}_{t+j+1} - \hat{\lambda}_{t+j} - \hat{\pi}_{t+j+1}\right) \tag{57}$$

The long-run real interest rate is

$$\hat{r}_t^L = -\sum_{j=0}^{\infty}(\rho\beta)^j E_t\left(\hat{\lambda}_{t+j+1} - \hat{\lambda}_{t+j}\right) \tag{58}$$

Using equations (57) and (58), we have

$$\begin{aligned} \hat{r}_t^L &= -\hat{P}_t^m - \sum_{j=0}^{\infty} (\rho\beta)^j E_t \hat{\pi}_{t+j+1} \\ &= -\hat{P}_t^m - E_t \hat{\pi}_{t+1} - (\rho\beta) \sum_{j=0}^{\infty} (\rho\beta)^j E_t \hat{\pi}_{t+j+2} \end{aligned} \tag{59}$$

Then the long-run expected inflation rate is defined as

$$\hat{\pi}_t^L = \sum_{j=0}^{\infty} (\rho\beta)^j E_t \hat{\pi}_{t+j+1} = -\hat{r}_t^L - \hat{P}_t^m$$

Moving equation (58) one period forward and taking expectations give

$$E_t \hat{r}_{t+1}^L = -E_t \hat{P}_{t+1}^m - \sum_{j=0}^{\infty} (\rho\beta)^j E_t \hat{\pi}_{t+j+2} \tag{60}$$

Combining equations (59) and (60), we can rewrite the long-run real interest rate recursively:

$$\hat{r}_t^L = -\hat{P}_t^m - E_t \hat{\pi}_{t+1} + \rho\beta \left(E_t \hat{r}_{t+1}^L + E_t \hat{P}_{t+1}^m \right)$$

5.4 Derivation of the Log-Linearized Government Budget Constraint

The primary surplus, $\widehat{PS}_t$, is defined as

$$\begin{aligned}\widehat{PS}_t \equiv & \frac{\tau^k r^k k}{PS}\left(\hat{\tau}_t^k + \hat{r}_t^k + \hat{u}_t + \hat{k}_{t-1}\right) + \frac{\tau^c c}{PS}\left(\hat{\tau}_t^c + \hat{c}_t\right) \\ & + \frac{\tau^n w}{PS}\left[\left(n^p + n^g\right)\left(\hat{\tau}_t^n + \hat{w}_t\right) + n^p \hat{n}_t^p + n^g \hat{n}_t^g\right] \\ & - \frac{w n^g}{PS}\left(\hat{w}_t + \hat{n}_t^g\right) - \frac{g}{PS}\hat{g}_t - \frac{z}{PS}\hat{z}_t.\end{aligned}$$

All the non-debt fiscal terms in equation (53) can be collected as $PS\,\widehat{PS}_t$. Then equation (53) becomes

$$\frac{(1+\rho P^m)b}{\pi P^m}\left(\hat{b}_{t-1} - \hat{P}_{t-1}^m - \hat{\pi}_t\right) = b\,\hat{b}_t - \rho\frac{b}{\pi}\hat{P}_t^m + PS\,\widehat{PS}_t.$$

In the steady state, $\frac{(1+\rho P^m)b}{\pi P^m} = \frac{b}{\pi\beta}$. So the above equation can be written in the recursive form:

$$\hat{b}_{t-1} = -\rho\beta\,\hat{P}_t^m + \hat{P}_{t-1}^m + \hat{\pi}_t + (1-\beta)\,\widehat{PS}_t + \beta\hat{b}_t. \tag{61}$$

Define the *ex post* real return on government bonds as

$$\hat{r}_t^m \equiv \rho\beta\,\hat{P}_t^m - \hat{P}_{t-1}^m - \hat{\pi}_t.$$

Substituting this into (61) yields

$$\hat{b}_{t-1} = (1-\beta)\,\widehat{PS}_t - \hat{r}_t^m + \beta\hat{b}_t. \tag{62}$$

Iterating equation (62) forward gives

$$\hat{b}_t = (1-\beta)\,\widehat{PS}_{t+1} - \hat{r}_{t+1}^m + \beta E_t\hat{b}_{t+1}.$$

Substituting this into (62) gives

$$\begin{aligned}\hat{b}_{t-1} &= (1-\beta)\,\widehat{PS}_t - \hat{r}_t^m + \beta E_t\left[(1-\beta)\,\widehat{PS}_{t+1} - \hat{r}_{t+1}^m + \beta\hat{b}_{t+1}\right] \\ &= (1-\beta)\,\widehat{PS}_t + \beta(1-\beta)E_t\widehat{PS}_{t+1} - \hat{r}_t^m - \beta E_t\hat{r}_{t+1}^m + \beta^2 E_t\hat{b}_{t+1}.\end{aligned}$$

Repeating this argument J times gives

$$\hat{b}_{t-1} = (1-\beta)E_t \sum_{j=0}^{J} \beta^j \widehat{PS}_{t+j} - E_t \sum_{j=0}^{J} \beta^j \hat{r}^m_{t+j} + \beta^{J+1} E_t \hat{b}_{t+J}. \tag{63}$$

Imposing the transversality condition

$$\lim_{J\to\infty} \beta^{J+1} E_t \hat{b}_{t+J} = 0$$

and taking the limit of (63) as $J \to \infty$ yields

$$\hat{b}_{t-1} = (1-\beta)E_t \sum_{j=0}^{\infty} \beta^j \widehat{PS}_{t+j} - E_t \sum_{j=0}^{\infty} \beta^j \hat{r}^m_{t+j}. \tag{64}$$

Separating out the $j = 0$ terms in (64), we obtain equation (29) in the main text

$$\hat{b}_{t-1} = -\rho\beta \hat{P}^m_t + \hat{P}^m_{t-1} + \hat{\pi}_t + (1-\beta)E_t \sum_{j=0}^{\infty} \beta^j \widehat{PS}_{t+j} - E_t \sum_{j=1}^{\infty} \beta^j \hat{r}^m_{t+j}.$$

6 Calibration of the Monetary Policy Rule

Following the *impulse-response-matching* approach of Christiano et al. (2005), we choose the monetary policy coefficients by minimizing a measure of the distance between the model and empirical impulse response functions for private employment and the real wage. Policy rule estimates and equilibrium determinacy restrict the parameter search. For each subsample, we estimate

$$i_t = c + \psi_r i_{t-1} + (1 - \psi_r)(\phi_\pi \pi_t + 4\phi_y x_t) + u_t,$$

where i_t is the annualized policy rate. For the pre-Volcker and Great Moderation samples, we use the federal funds rate (FFR; FRED `FEDFUNDS`). For the post-GFC sample, we replace the FFR with the shadow short rate of Krippner (2013) over 2008Q4–2015Q4 and 2020Q1–2022Q1, and use the FFR otherwise. π_t is the annualized GDP-deflator inflation (FRED `GDPDEF`). The output gap, x_t, is the difference between real GDP and CBO potential GDP (FRED `GDPC1` and `GDPPOT`). The factor of four converts the model's quarterly output response coefficient to annualized units. The estimation samples are 1960Q1–1979Q3 (pre-Volcker), 1984Q1–2007Q2 (GM), and 2008Q4–2025Q1 (post-GFC).

We estimate the policy rule by OLS and two-step GMM with Newey–West covariance matrices. The GMM instruments are a constant and four lags each of inflation, the output gap, and the policy rate. Following Mavroeidis (2010), we construct a 90% identification-robust confidence set for $(\psi_r, \phi_\pi, \phi_y)$ by inverting the combined K-LM/JKLM test. This set contains the parameter values rejected by neither the K-LM test at the 9% level nor the JKLM test at the 1% level, so that the combined test has size 10%, following the split recommended by Kleibergen (2005). We further require admissible coefficients to lie in both the nominal 90% joint OLS and GMM Wald regions. The intersection serves as a calibration restriction; it does not itself have guaranteed 90% coverage.

We impose $\phi_\pi, \phi_y \geq 0$ and $0.30 \leq \psi_r \leq 0.90$. Each rule must deliver a unique stable equilibrium at the benchmark and at all 10,000 fixed structural parameter draws used in the prior predictive analysis. We maintain Regime F (i.e., $\phi_\pi < 1$) for the pre-Volcker and post-GFC samples and Regime M (i.e., $\phi_\pi > 1$) for the Great Moderation. The calibration is conditional on these regime assignments.

We solve the matching problem by first searching over a parameter grid and then refining the best admissible candidates by constrained numerical optimization. All other model parameters are held fixed. Let v_e stack the VAR median responses of private employment and the real wage over the first 20 quarters in era e. Let $m_{ej}(\theta)$ contain the corresponding model responses under debt maturity $AD = j$, where $\theta = (\psi_r, \phi_\pi, \phi_y)$. The maturity sets are $\mathcal{J}_e = \{1\}$ for the pre-Volcker era, $\{1, 20\}$ for the Great Moderation,

and $\{20\}$ for the post-GFC era. For each admissible θ, we compute

$$Q_e(\theta) = \sum_{j \in \mathcal{J}_e} \|s_e(\theta) m_{ej}(\theta) - v_e\|^2,$$
$$s_e(\theta) = \frac{m_{e0}(\theta)' v_e}{m_{e0}(\theta)' m_{e0}(\theta)} > 0,$$

where the reference vector m_{e0} determines the shock scale s_e by least squares and contains the $AD = 1$ responses for the pre-Volcker era and the Great Moderation, and the $AD = 20$ responses for the post-GFC era. For the Great Moderation, we apply this scale to both maturity specifications and include both sets of scaled responses in Q_e.

Table 2 reports the calibrated coefficients employed in our DSGE model, together with the range of each coefficient over the admissible set, which contains all rules that satisfy the restrictions above. Each calibrated rule lies in the admissible set of its era.

Table 2: Monetary Policy Coefficients and Admissible Set

	Pre-Volcker 1960Q1–1979Q3	Great Moderation 1984Q1–2007Q2	Post-GFC 2008Q4–2025Q1
ψ_r	0.69 [0.64, 0.83]	0.90 [0.85, 0.90]	0.89 [0.83, 0.90]
ϕ_π	0.70 [0.65, 0.95]	2.14 [1.01, 2.94]	0.54 [0.00, 0.80]
ϕ_y	0.10 [0.08, 0.26]	0.33 [0.27, 0.68]	0.50 [0.25, 0.55]

Notes: Brackets report the smallest and largest values of each coefficient over the admissible set of the era.

7 Robustness of the DSGE Model

7.1 Fixed Debt Ratios Across Regime F_{SD} & Regime F_{LD}

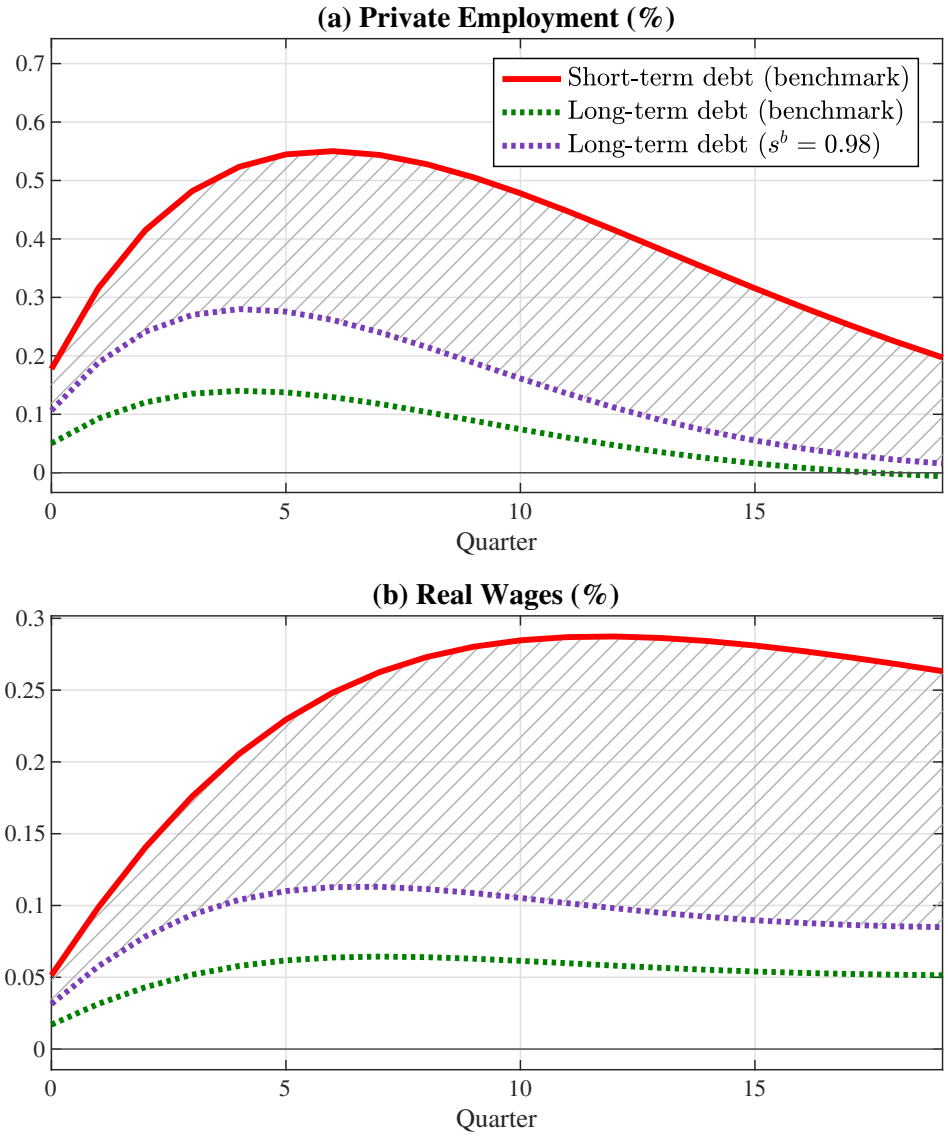


Figure 10: Simulated IRFs Under Regime F_{SD} & Regime F_{LD} with Fixed Debt Ratios

7.2 Post-GFC Policy Specifications

7.2.1 Specification 1: Regime $\mathbf{F_{LD}}$

The monetary authority follows the standard Taylor rule

$$R_t = R_{t-1}^{\psi_r} \left[\bar{R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{\phi_\pi} \left(\frac{y_t}{\bar{y}} \right)^{\phi_y} \right]^{1-\psi_r}, \tag{65}$$

and the long bond is priced by the no-arbitrage condition, whose level form is

$$P_t^m = \frac{1 + \rho \, \mathbb{E}_t P_{t+1}^m}{R_t}. \tag{66}$$

7.2.2 Specification 2: Regime $\mathbf{F_{LD}}$ + ELB

The ELB episode is represented as a K-quarter peg of the nominal policy rate, $R_t = \bar{R}$ for $t = 1, \ldots, K$ with $K = 8$, implemented as a Laséen and Svensson (2011) sequence of anticipated policy shocks. This is the standard linear representation of a fixed-rate episode (e.g., Carlstrom et al., 2017): it delivers the peg exactly over the announced window while leaving the rule (65) in force thereafter. As a result, equation (65) is replaced by the following (67), and K wedge processes are added:

$$R_t = R_{t-1}^{\psi_r} \left[\bar{R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{\phi_\pi} \left(\frac{y_t}{\bar{y}} \right)^{\phi_y} \right]^{1-\psi_r} \exp(m_t), \tag{67}$$

$$m_t = \varepsilon_t^{m,0} + \xi_{1,t-1}^m, \tag{68}$$

$$\xi_{j,t}^m = \xi_{j+1,t-1}^m + \varepsilon_t^{m,j}, \qquad j = 1, \ldots, K-2, \tag{69}$$

$$\xi_{K-1,t}^m = \varepsilon_t^{m,K-1}. \tag{70}$$

Here $\varepsilon_t^{m,0}$ is an unanticipated wedge and $\varepsilon_t^{m,j}$ is a wedge *announced* at t and *implemented* j quarters later: (69)–(70) are a news pipeline that carries each announcement forward to its implementation date. All wedges are zero in the steady state, so $m = 0$ and the entire steady state—including $\bar{R}$, $\bar{P}^m$ and every real quantity—is identical to that in Specification 1 at every parameter value.

The K announcements are chosen so that the policy-rate response is exactly zero over the peg window. Let a_h be the $\hat{R}$ response at horizon h to $\varepsilon_1^{n^g}$ and let A_{hj} be the response at horizon h to a unit $\varepsilon_1^{m,j}$, both from the first-order solution. The peg vector $u = (u_0, \ldots, u_{K-1})'$ solves the $K \times K$ linear system

$$A\,u = -a \qquad \text{over } h = 1, \ldots, K,$$

and, because the solution is first order, the pegged response of any variable x is the corresponding linear combination,

$$x_{\text{peg}}(h) = x_{n^g}(h) + \sum_{j=0}^{K-1} u_j \, x_{m_j}(h).$$

The realized $\max_{h \le K} |\hat{R}_h|$ is of order 10^{-19}, so the peg binds to machine precision.

7.2.3 Specification 3: Regime $\mathbf{F_{LD}}$ + ELB + QE

This specification combines the $K = 8$ peg of Specification 2 with a maturity premium on the long bond, so that quantitative easing operates on the term premium. Both modifications are active simultaneously: equations (67)–(70) and the peg system are in force, and the bond-pricing equation (66) is replaced as follows:

$$P_t^m = \frac{1 + \rho \, \mathbb{E}_t P_{t+1}^m}{R_t \, e^{\zeta_t}}, \tag{71}$$

where the consol carries a maturity premium ζ_t, with the premium determined by the quantity of privately held duration and by the central bank's long-bond position

$$\zeta_t = \zeta_b \Big(\frac{AD}{20} \Big) \ln \Big(\frac{s_{t-1}^b}{\bar{s}^b} \Big) - \zeta_q \, qe_t, \tag{72}$$

$$qe_t = \rho_{qe} \, qe_{t-1} + \varepsilon_t^{qe}, \tag{73}$$

where $s_t^b = b_t / y_t$ is the market value of debt relative to GDP and qe_t is the central bank's long-bond holding as a share of that market value, zero in the steady state. $\zeta = 0$ in the steady state.

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