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Regime Shifts in U.S. Trend Inflation: Pre-Volcker to Post-Great Moderation*

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Abstract

We revisit U.S. trend inflation dynamics since the 1960s by estimating a nonlinear, nonstationary Markov-switching New Keynesian model in which trend inflation evolves as a latent Markov process. Our estimation (i) confirms the Volcker disinflation as a regime shift from high to mid-level trend inflation between 1980 and 1987; (ii) shows that trend inflation remained stable around 2.8% during the Great Moderation and beyond, despite major disruptions such as the Global Financial Crisis and the COVID-19 pandemic; and (iii) identifies a persistent hawkish monetary policy regime after 1982, with temporary weakening during periods of policy rate reductions at the zero lower bound—while inflation expectations remained well anchored.

JEL classification: E31,E52, C54

Keywords: Trend Inflation, Markov-Switching DSGE, Volcker Disinflation, Great Moderation.

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1. Introduction

U.S. inflation dynamics tend to be associated with movements in trend inflation—agents' infinite-horizon expectation of inflation—which serves as a crucial indicator of long-run nominal stability. As the principal nominal anchor, trend inflation guides private-sector behavior and central bank actions. Its level and persistence shape real interest rates, the credibility of inflation targets, and the transmission of monetary policy. As shown in Figure 1, since the 1960s, shifts in U.S. inflation at major turning points —the Great Inflation, the Volcker disinflation, and the subsequent Great Moderation – align with changes in the inferred trend component, motivating an assessment of the Federal Reserve's nominal anchor.

Recent literature has sought to model time variation in monetary policy and inflation dynamics. For instance, Bhattarai et al. (2012, 2016) and Bianchi et al. (2023) emphasize the importance of accounting for changes in the monetary-fiscal policy mix, while Bjørnland et al. (2018) and Cogley and Sbordone (2008) highlight the role of evolving policy coefficients and volatility regimes in shaping inflation outcomes. However, most studies either impose linear structures on trend inflation or treat it as a smooth drifting process, potentially missing the abrupt and persistent regime changes observed in historical inflation data.

This paper contributes to the literature by revisiting U.S. trend inflation dynamics since the 1960s using a nonlinear, non-stationary Markov-switching New Keynesian model that incorporates a non-zero trend inflation component, following the generalized New Keynesian (GNK) framework (see e.g., Ascari and Sbordone, 2014). A distinctive feature of our approach is the explicit treatment of trend inflation as a latent Markov process, jointly evolving with structural shock volatility and monetary policy stance. This framework captures the possibility of abrupt, persistent shifts in macroeconomic regimes and allows for a richer interpretation of historical episodes such as the Volcker disinflation, the Great Moderation, and the post-2008 low-inflation environment.

Our analysis focuses on two central questions. First, did regime shifts in trend inflation occur at key historical turning points, particularly during the early 1980s? Specifically, does the Volcker disinflation correspond to a persistent regime switch in the underlying trend component? Second, has the Federal Reserve's formal inflation target served as a stable and credible nominal anchor in the aftermath of the Great Moderation? In particular, did trend inflation remain anchored in the face of the sizable disturbances associated with the Global Financial Crisis and the COVID-19 pandemic?

We estimate the model on quarterly U.S. data beginning in 1960Q1, with the sample partitioned into two sub-samples. The first ends in 2008Q2, before the federal funds rate hit the zero lower bound (ZLB). The second extends through the post-crisis period using a shadow

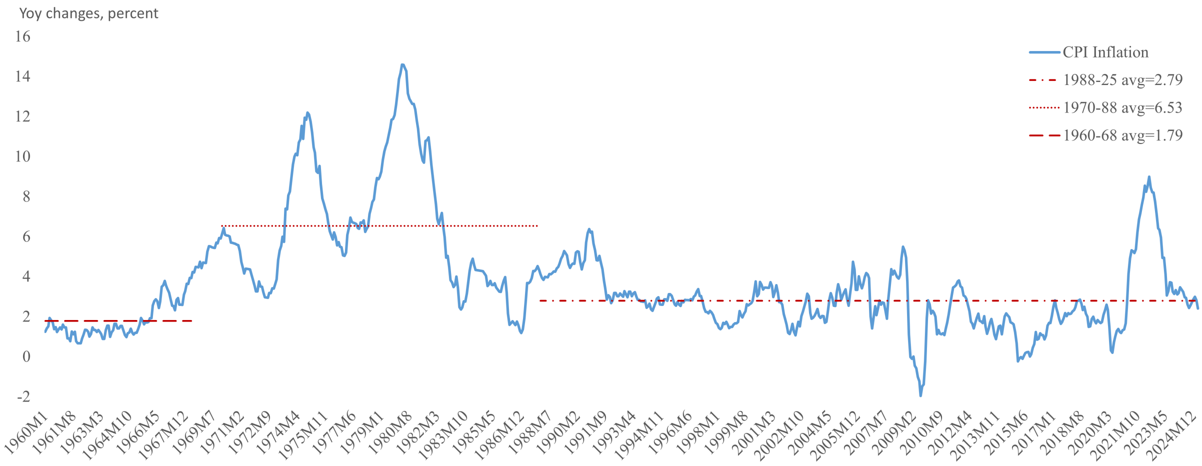

Figure 1: Monthly year-over-year changes in Consumer Price Index. Source: The FRED database.

policy rate instead to account for the Federal Reserve's unconventional monetary policy stance and to assess the credibility of the inflation target in a low-rate environment.[1] The estimation yields three main findings. i) The Volcker disinflation is confirmed as a regime shift in trend inflation from a high to a mid level between 1980 and 1987, and identifies a persistent shift to a more hawkish monetary policy regime after 1982. ii) Trend inflation remained stable around 2.8% throughout the Great Moderation and beyond, even during major disruptions such as the Global Financial Crisis and the pandemic—indicating well-anchored inflation expectations. iii) While the policy response weakened temporarily during ZLB episodes, trend inflation did not revert to high-inflation regimes, suggesting that the credibility of the inflation target remained intact.

By integrating trend inflation, monetary policy stance, and shock volatility into a unified Markov-switching structure, this paper offers a novel framework for analyzing long-run inflation dynamics. Our results highlight the importance of regime-dependent modeling in understanding macroeconomic stability, and provide new empirical evidence on the evolution and anchoring of inflation expectations in the United States.

This study is related to two broad areas of the literature. First, a large body of work studies the evolution of U.S. trend inflation. One line of research estimates trend inflation as a stochastic process—typically a random walk or unobserved component with time-varying volatility—using either reduced-form or structural models (see e.g., Stock and Watson, 2007; Cogley et al., 2010; Del Negro et al., 2015; Gemma et al., 2023). Another line emphasizes the role of monetary and fiscal policy in driving trend inflation. For instance, Ireland (2007) and Cogley and Sbordone (2008) allow inflation targets to respond endogenously to structural

[1] We adopt the shadow policy rate as a simplified alternative to explicitly modeling the central bank's transition to unconventional monetary policy during the ZLB period. While incorporating switching in policy instruments (e.g., Sims and Wu, 2021) may better reflect institutional realities, such extensions entail substantial computational costs without materially enhancing regime identification.

shocks, while Bianchi and Ilut (2017) and Bhattarai et al. (2016) explore how monetary-fiscal policy coordination influences inflation expectations and macroeconomic stability. Unlike these studies, we explicitly model trend inflation as a regime-switching process embedded within a nonlinear DSGE framework.

Second, this paper builds on the literature on Markov-switching DSGE models with exogenous transition probabilities, introduced by Maih (2015) and applied in studies such as Bianchi (2012), Bianchi and Melosi (2017), and Bjørnland et al. (2018), which examine shifts in policy behavior, shock volatility, or structural parameters across regimes. The most closely related work is Kato et al. (2025), who estimate a regime-switching model of trend inflation within a linearized generalized New Keynesian framework using pre-ZLB Japanese data. Our paper takes a step further by employing a nonlinear model and extending the analysis to the post-crisis period using a shadow policy rate, thereby capturing the evolving dynamics of trend inflation under unconventional monetary policy.

The remainder of the paper is organized as follows. Section 2 presents the regime-switching New Keynesian model used in the analysis. Section 3 reports the estimation results, with a focus on the inferred dynamics of trend inflation. Section 4 concludes.

2. A Regime-switching New Keynesian Model

We adopt a standard New Keynesian framework in the spirit of Smets and Wouters (2007), augmented to explicitly incorporate a non-zero trend inflation rate $\bar{\pi}_t$ within a nonlinear and non-stationary setting. Formally, trend inflation is defined as the agents' infinite-horizon expectation of future inflation, which is assumed to converge to the central bank's inflation target according to a sufficiently forward-looking and credible monetary authority (see e.g. Woodford, 2003; Cogley et al., 2010).

Households There is a continuum of infinitely lived households of mass one. The representative household chooses working hours n_t and real consumption c_t. Let $\mathcal{C}_t = c_t - hc_{t-1}$ denote consumption adjusted for internal habit formation, where $h \in [0, 1)$. Instantaneous utility increases with effective consumption $\mathcal{C}_t/a_t$ and and decreases with labor effort n_t. The household's lifetime utility is given by,

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\psi_{p,t} \frac{(\mathcal{C}_t/a_t)^{1-\sigma} - 1}{1-\sigma} - \chi \psi_{n,t} \frac{n_t^{1+\sigma^n}}{1+\sigma^n} \right], \tag{1}$$

where $\chi > 0, \sigma \geq 0$, $\sigma^n \geq 0$, and β denotes the discount factor. The terms $\psi_{p,t}$ and $\psi_{n,t}$ denote preference shocks to consumption and labor, respectively, and evolve according to,

$$\psi_{p,t} = \psi_{p,t-1}^{\rho_p} \exp(\varsigma_p(\mathcal{S}_t^{vol})\varepsilon_t^p), \tag{2}$$

$$\psi_{n,t} = \psi_{n,t-1}^{\rho_n} \exp(\varsigma_n(\mathcal{S}_t^{vol})\varepsilon_t^n), \tag{3}$$

where ε_t^p and ε_t^n are i.i.d. normalized shock, and $\varsigma_p(\mathcal{S}_t^{vol})$ and $\varsigma_n(\mathcal{S}_t^{vol})$ denote regime-dependent standard deviations. Specifically, the variances are governed by a two-state Markov chain $\mathcal{S}_t^{vol} \in \{high, low\}$, which determines whether the economy is in a high- or low-volatility regime. As discussed below, other structural shocks will also be allowed to depend on this macroeconomic volatility regime.

Let $w_t = W_t/P_t$ denote the real wages, τ_t lump-sum taxes, B_t nominal bond holdings, and div_t dividend payments, which is the sum of dividends from intermediate goods firms div_t^F and retailers div_t^R. The household budget constraint is given by

$$P_t c_t + B_t + P_t \tau_t = W_t n_t + R_{t-1} B_{t-1} + P_t div_t \tag{4}$$

The optimal choice for allocations is subject to a budget constraint (4), leading to the first-order conditions for consumption, bond holdings, and working hours.

$$\psi_t^P (\mathcal{C}_t)^{-\sigma} a_t^{\sigma-1} - \beta h \mathbb{E}_t \psi_{t+1}^P (\mathcal{C}_{t+1})^{-\sigma} a_{t+1}^{\sigma-1} = \lambda_t^H, \tag{5}$$

$$\mathbb{E}_t \Lambda_{t,t+1} \pi_{t+1}^{-1} R_t = 1, \tag{6}$$

$$\lambda_t^H w_t = \chi \psi_t^N n_t^{\sigma^n}, \tag{7}$$

where λ_t^H denotes the multiplier on the budget constraint (4) and $\Lambda_{t,t+1} = \beta \lambda_{t+1}^H / \lambda_t^H$ the stochastic discount factor.

Firms Homogeneous intermediate goods firms operate in a perfectly competitive market. Each firm produces intermediate goods using labor n_t as the only input, according to a constant returns to scale technology:

$$y_t = a_t n_t, \tag{8}$$

where a_t denotes a stochastic total factor productivity grow at rate $z_t = a_t/a_{t-1}$. The technology process follows:

$$z_t/z = \exp(\varsigma_z(\mathcal{S}_t^{vol})\varepsilon_t^z), \tag{9}$$

where z denotes the balanced-growth path. The standard deviation ς_z is governed by the same two-state macroeconomic volatility regime $\mathcal{S}_t^{vol}$, as described previously. Let mc_t denote the relative price of each unit of intermediate goods sold to the final goods producers. Profit maximization implies the optimality condition,

$$mc_t y_t / n_t = w_t. \tag{10}$$

Retailer Each retailer, indexed by $j \in [0, 1]$, purchases intermediate goods from the competitive intermediate goods sector at price mc_t, repackages them, and sells the final retail products in a monopolistically competitive market. Final output y_t is a CES aggregate of individual retail outputs $y_{j,t}$ given by,

$$y_t = \left[\int_0^1 y_{j,t}^{\frac{\eta_t - 1}{\eta_t}} dj \right]^{\frac{\eta_t}{\eta_t - 1}}, \tag{11}$$

where η_t denotes the elasticity of substitution across retail varieties. The corresponding demand function for variety j and the aggregate price index are $y_{j,t} = (P_{j,t}/P_t)^{-\eta_t} y_t$ and $P_t = [\int_0^1 P_{j,t}^{1-\eta_t} dj]^{\frac{1}{1-\eta_t}}$, , where $P_{j,t}$ is the price set by retailer and P_t is the aggregate price level. Price setting follows Rotemberg (1982), each period a retailer j chooses an optimal set of $(P_{j,t}; y_{j,t})$ to maximize the expected discounted stream of profits, accounting for quadratic price adjustment costs:

$$\max_{P_{j,t}} \mathbb{E}_t \sum_{i=1}^{\infty} \Lambda_{t,t+i} \left[\left(\frac{P_{j,t}}{P_t} - mc_{t+i} \right) y_{j,t+i} - \frac{\kappa_p}{2} \left(\frac{P_{j,t}}{P_{t-1}} - 1 \right)^2 y_{t+i} \right], \tag{12}$$

where $\Lambda_{t,t+i} = \beta^i \lambda_{t+i}^H / \lambda_t^H$ and κ_p denotes the degree of nominal price rigidity. Under the assumption of a symmetric equilibrium where $P_{j,t} = P_t$, one gets the optimal condition which leads to a hybrid New Keynesian Phillips curve,[2]

$$\eta_t - 1 = \eta_t mc_t - \kappa_p (\pi_t - 1) \pi_t + \kappa_p \mathbb{E}_t \Lambda_{t,t+1} \frac{y_{t+1}}{y_t} (\pi_{t+1} - 1) \pi_{t+1}. \tag{13}$$

We allow for a time-varying cost-push shock via fluctuations in the elasticity of substitution, modeled as,

$$\eta_t = \eta(\psi_{\eta,t})^{-\kappa_p}, \tag{14}$$

$$\psi_{\eta,t} = \psi_{\eta,t-1}^{\rho_\eta} \exp(\varsigma_\eta(\mathcal{S}_t^{vol}) \varepsilon_t^\eta), \tag{15}$$

with volatility governed by the macroeconomic volatility chain $\mathcal{S}_t^{vol}$.

Monetary Policy The central bank sets the nominal interest rate according to a standard Taylor rule,

$$R_t/R = (R_{t-1}/R)^{\rho_r(\mathcal{S}_t^{pol})} \left[(\pi_t/\bar{\pi}_t)^{\phi_{r,\pi}(\mathcal{S}_t^{pol})} (\tilde{y}_t/\tilde{y})^{\phi_{r,y}} \right]^{1-\rho_r(\mathcal{S}_t^{pol})} \exp(\varsigma_r \varepsilon_t^R), \tag{16}$$

where $\varepsilon_t^R \overset{i.i.d.}{\sim} \mathcal{N}(0, 1)$ is a monetary policy shock and ρ_r captures interest rate smoothing. $\phi_{r,\pi}$ and $\phi_{r,y}$ represent the central bank's responsiveness to inflation and output gaps, respectively.[3]

[2] Note that under standard nominal rigidity assumptions, trend inflation does not appear explicitly in the nonlinear Phillips curve; see also Ascari and Sbordone (2014). However, a non-zero trend inflation affects the steady-state marginal cost, thereby influencing the long-run trade-off faced by monetary policy.

[3] Instead of anchoring the Taylor rule to the deviation from flexible-price output, we follow Bjørnland et al. (2018) and define the gap relative to balanced-growth output $\tilde{y} = y/a$. Given that price dispersion has minor

To capture regime shifts in monetary policy behavior, we allow the smoothing parameter $\rho_r(\mathcal{S}_t^{pol})$ and the inflation coefficient $\phi_{r,\pi}$ to switch between two regimes, $\mathcal{S}_t^{pol} \in \{hawkish, dovish\}$. The "hawkish" regime is characterized by a higher value of the coefficient, implying episodes in which monetary authorities place greater emphasis on price stability.

Under rational expectations and the assumption of a credible monetary authority, the central bank's inflation target is defined as trend inflation, $\bar{\pi}_t = \bar{\pi}(\mathcal{S}_t^{\pi})$, which corresponds to the infinite-horizon forecast $\bar{\pi}_t = \lim_{i\to\infty} \mathbb{E}_t \pi_{t+i}$.[4] Unlike earlier studies that treat trend inflation as either constant or evolving with white noise, we allow it to vary over time according to a discrete three-state Markov chain $\mathcal{S}_t^{\pi} \in \{L, M, H\}$, capturing low, medium, and high trend inflation states, respectively. The transition dynamics are governed by the following matrix,

$$\mathbb{Q}_{t,t+1}^{\pi} = \begin{bmatrix} p_{\{L,M\}}^{\pi} & 1 - p_{\{L,M\}}^{\pi} & 0 \\ p_{\{M,L\}}^{\pi} & 1 - p_{\{M,L\}}^{\pi} - p_{\{M,H\}}^{\pi} & p_{\{M,H\}}^{\pi} \\ 0 & p_{\{H,M\}}^{\pi} & p_{\{H,M\}}^{\pi} \end{bmatrix}.$$

To reflect the gradual nature of monetary policy adjustments and the institutional tendency toward policy inertia, we restrict direct transitions between the low and high trend inflation states—specifically, $prob^{L,H} = prob^{H,L} = 0$. That is, regime shifts must proceed through the medium regime. This restriction is consistent with actual practice and improves the identification. Finally, our model comprises twelve regimes denoted by $\mathcal{S}_t = \mathcal{S}_t^{\pi} \times \mathcal{S}_t^{vol} \times \mathcal{S}_t^{pol}$.

To facilitate model solution and ensure a well-defined steady state, we proceed to stationarize all non-stationary variables. In particular, non-stationarity arises due to the presence of balanced growth driven by productivity improvements. Since there is only one source of trend growth in the model,z_t, we remove this trend by expressing all real variables in per-efficiency-unit terms. The stationarized variables are therefore defined as: $\widetilde{\lambda}_t = \lambda_t a_t$, $\widetilde{y}_t = y_t/a_t$, $\widetilde{c}_t = c_t/a_t$, $\widetilde{w}_t = w_t/a_t$, and $\widetilde{\Lambda}_{t,t+1} = \Lambda_{t,t+1} z_{t+1}$. The set of equilibrium conditions is provided in Appendix A1.

3. Estimation

In this section, we present the Bayesian estimation results of the Markov-switching New Keynesian model that allows for regime changes in trend inflation, macroeconomic volatility, and the monetary policy stance. We begin by reporting the estimated parameters and regime probabilities for the pre-crisis sample. In the second part of the analysis, we extend the model to the

effects under a first-order perturbation solution, we prefer the latter for convenience.

[4]Trend inflation is not conceptually equivalent to the central bank's inflation target, while under rational expectations, they may coincide in equilibrium if the target is credible and agents internalize it as the long-run anchor for price dynamics.

post-crisis period by incorporating the shadow rate, examining whether the Federal Reserve's 2% inflation target has remained credible even during the pandemic.

3.1. Data and Bayesian inference

The dataset consists of quarterly U.S. macroeconomic time series and includes three key variables: real per capita GDP growth, denoted by $\Delta \log y_{t,data}$; gross CPI inflation, $\log \pi_{t,data}$; and the nominal interest rate, $\log R_{t,data}$. For the sample period 1960Q1–2008Q2, we use the Federal Funds Rate as the policy rate. For the extended sample covering 1960Q1–2025Q1, we employ the widely used shadow rate constructed by Wu and Xia (2016) to account for the zero lower bound period. All variables are expressed in quarterly terms and are linked to their model counterparts through the following measurement equations,

$$\begin{bmatrix} \log R_{t,data} \\ \log \pi_{t,data} \\ \Delta \log y_{t,data} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \log z_t \end{bmatrix} + \begin{bmatrix} \log R_t \\ \log \pi_t \\ \log \widetilde{y}_t - \log \widetilde{y}_{t-1} \end{bmatrix}. \tag{17}$$

A subset of parameters is calibrated, using empirical means or information from other studies. The discount factor is calibrated to $\beta = 0.995$, corresponding to the average ratio of inflation to the Federal Funds rate over the pre-crisis period (1960Q1–2008Q2). The inverse Frisch elasticity of labor supply is calibrated to $\sigma^n = 0.276$, following Gertler and Karadi (2011). The weight on the disutility of labor, $\chi = 41.46$ is chosen to ensure a steady-state labor supply consistent with an 8-hour workday.

All remaining structural parameters are estimated using weakly informative priors. Following the approach of Bjørnland et al. (2018), we report 90 percent credible intervals, allowing the data to exert primary influence on the shape of the posterior distributions. In particular, for parameters related to trend growth, we apply a transformation of the annualized balanced growth path, $100(z^4-1)$, and specify prior quantiles such that the values of 1 and 2 fall within the 95 percent probability interval. For notational convenience, the estimated trend inflation is expressed in annualized terms, defined as $\bar{\pi}_L^{(A)} = 100(\bar{\pi}^4(\mathcal{S}_t^\pi = L) - 1)$, $\bar{\pi}_M^{(A)} = 100(\bar{\pi}^4(\mathcal{S}_t^\pi = M) - 1)$, and $\bar{\pi}_H^{(A)} = 100(\bar{\pi}^4(\mathcal{S}_t^\pi = H) - 1)$. As the primary parameters of interest, the regime-dependent trend inflation rates—$\bar{\pi}_L^{(A)}$, $\bar{\pi}_M^{(A)}$, and $\bar{\pi}_H^{(A)}$—are assigned prior means of 1.0, 3.0, and 7.0 percent, respectively. Each is assumed to follow a normal distribution, which permits the possibility of negative trend inflation should the data support such an outcome. The transformed price stickiness parameter $(0.02\kappa_p)$,and the smoothing parameters of structural shocks are assumed to follow beta distributions, with their 95 percent probability intervals spanning the range from 0.2 to 0.8. For the standard deviations of shocks, we apply a gamma prior to their transformed

Table 1: Priors and Posterior Distributions (1960Q1–2008Q2)

	Prior			Posterior				
Parameter	Distr.	5%	95%	Mode	Mean	Median	5%	95%
$100(z^4-1)$	G	1	2	1.180	1.256	1.207	0.922	1.478
h	B	0.2	0.8	0.742	0.679	0.679	0.565	0.810
σ	G	0.5	3.5	1.656	1.787	1.767	1.004	2.516
$0.02\kappa_p$	B	0.2	0.8	0.086	0.098	0.097	0.017	0.154
η	G	2	10	8.330	8.574	8.342	5.310	12.12
ρ_η	B	0.2	0.8	0.906	0.885	0.885	0.838	0.934
ρ_p	B	0.2	0.8	0.213	0.235	0.233	0.105	0.365
ρ_n	B	0.2	0.8	0.791	0.659	0.642	0.480	0.525
$p^{\pi}_{\{L,M\}}$	B	0.025	0.075	0.051	0.048	0.047	0.028	0.066
$p^{\pi}_{\{M,L\}}$	B	0.025	0.075	0.038	0.044	0.043	0.025	0.062
$p^{\pi}_{\{H,M\}}$	B	0.025	0.075	0.042	0.049	0.048	0.030	0.066
$p^{\pi}_{\{M,H\}}$	B	0.025	0.075	0.029	0.039	0.038	0.021	0.055
$p^{vol}_{\{low,high\}}$	B	0.025	0.075	0.043	0.047	0.047	0.027	0.065
$p^{vol}_{\{high,low\}}$	B	0.050	0.250	0.079	0.122	0.117	0.052	0.193
$p^{pol}_{\{dovish,hawkish\}}$	B	0.010	0.250	0.064	0.082	0.079	0.014	0.143
$p^{pol}_{\{hawkish,dovish\}}$	B	0.010	0.250	0.027	0.046	0.039	0.009	0.090
$\bar{\pi}^{(A)}_L$	N	0	2	0.804	1.131	1.240	0.202	1.920
$\bar{\pi}^{(A)}_M$	G	2	4	3.231	3.209	3.194	2.771	3.636
$\bar{\pi}^{(A)}_H$	G	4	10	9.197	7.004	6.932	4.307	9.644
$100\varsigma_\eta(low)$	G	0.1	5	0.462	0.762	0.769	0.193	1.233
$100\varsigma_\eta(high)$	G	0.1	5	3.107	2.676	2.571	1.279	4.233
$100\varsigma_z(low)$	G	0.1	5	0.866	0.920	0.918	0.669	1.187
$100\varsigma_z(high)$	G	0.1	5	1.614	1.893	1.882	1.240	2.500
$100\varsigma_p(low)$	G	0.1	5	2.532	2.268	2.216	1.440	3.138
$100\varsigma_p(high)$	G	0.1	5	5.649	5.058	5.047	3.341	6.682
$100\varsigma_n(low)$	G	0.1	5	0.547	0.280	0.259	0.006	0.528
$100\varsigma_n(high)$	G	0.1	5	0.548	0.608	0.530	0.119	1.143
$100\varsigma_r$	IG	0.01	5	0.472	0.457	0.454	0.380	0.525
$\rho_r(dovish)$	B	0.6	0.9	0.609	0.571	0.585	0.429	0.679
$\rho_r(hawkish)$	B	0.6	0.9	0.592	0.625	0.617	0.525	0.741
$\phi_{r,\pi}(dovish)$	G	0.5	1.5	1.212	1.207	1.193	1.027	1.381
$\phi_{r,\pi}(hawkish)$	G	1.5	2.5	2.497	2.499	2.496	2.090	2.842
$\phi_{r,y}$	G	0.2	0.8	0.091	0.150	0.130	0.048	0.269

Note: Abbreviations for prior distributions include B (Beta), N (Normal), G (Gamma), and IG (Inverse Gamma). Values in parentheses indicate the lower and upper bounds of the 95% confidence interval for the quantile prior. The log marginal data density is computed using the Laplace approximation: 2090.54.

values, such that the 0.1 and 5 quantiles cover 95 percent of the prior probability mass.[5]

3.2. Estimation Results for the Pre-Crisis Sample

The first-order perturbation solution of the model is computed using the Newton-based algorithm with all computational procedures implemented through the RISE toolbox (see Chang et al., 2021).[6] Posterior mode estimation is conducted via a derivative-based optimization routine that maximizes the joint posterior—combining the likelihood function with the specified priors. Given the mode, the posterior distribution is simulated using a random-walk Metropolis-Hastings algorithm with three parallel chains. Each chain is run for 36,000 iterations, with the

[5] For identification purposes, we impose a restriction $\varsigma_i(low) < \varsigma_i(high)$, $i \in \{\eta, z, n, p\}$, requiring that the standard deviation of each shock in the low-volatility regime is strictly less than that in the high-volatility regime.

[6] While higher-order perturbation is feasible in RISE, we use a first-order solution given our focus on the first moment of trend inflation and the limited accuracy gain.

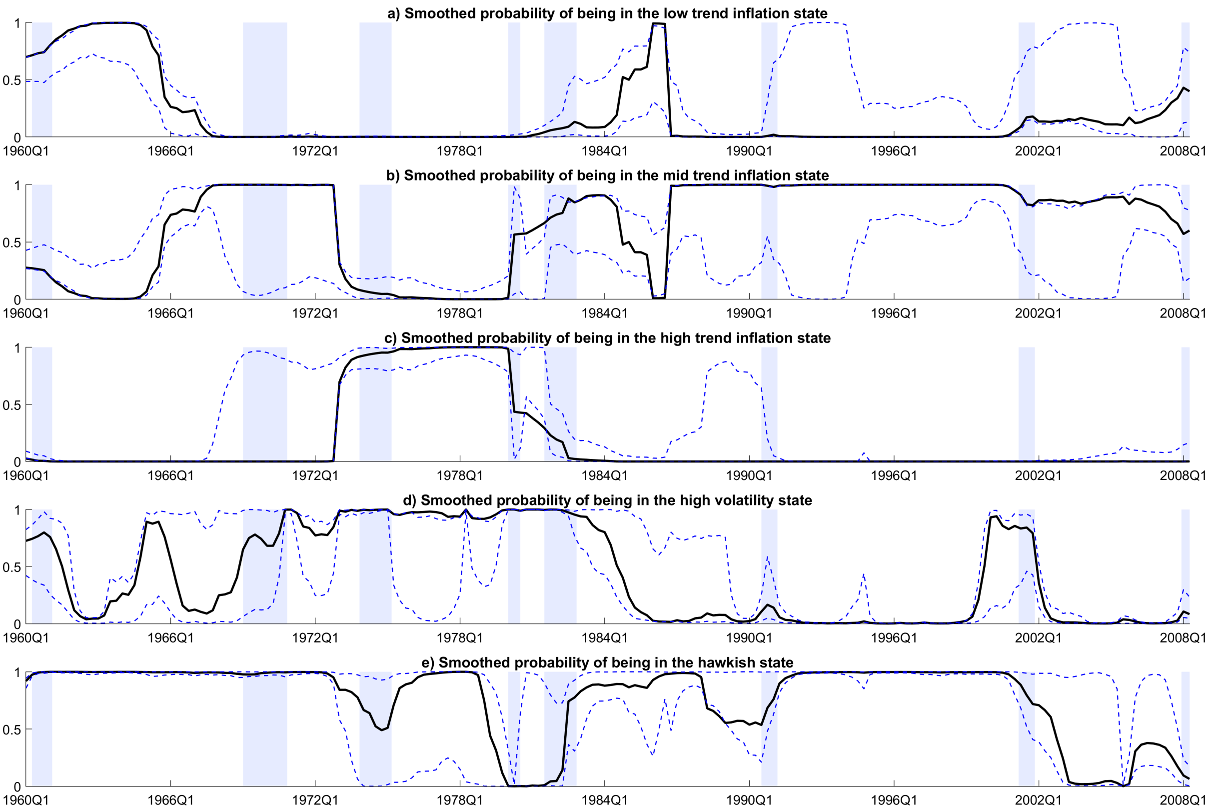

Figure 2: Smoothed state probabilities over the sample period from 1960Q1 to 2008Q2. The top three panels display the smoothed probabilities of being in the low, medium, and high trend inflation regimes, respectively. The fourth row presents the smoothed probabilities of being in the high volatility state. The bottom row presents the smoothed probabilities of being in the hawkish state. Shaded areas correspond to officially dated NBER recessions.

initial 6,000 draws discarded as burn-in. The scale parameter is tuned to achieve an acceptance rate of approximately 0.3.

Table 1 summarizes the prior distributions and posterior estimates of the structural parameters for the sample period 1960Q1–2008Q2. Our primary focus is on the regime-dependent trend inflation parameters $\bar{\pi}_L^{(A)}$, $\bar{\pi}_M^{(A)}$, $\bar{\pi}_H^{(A)}$. The posterior means for the low-, medium-, and high-inflation regimes are 0.804, 3.231, and 9.197 percent (annualized), respectively, indicating well-identified and empirically distinct inflation regimes over the sample. Another set of important regime-dependent parameters concerns the Taylor rule coefficient on the inflation gap, which captures the central bank's responsiveness to inflation stabilization. In the "hawkish" regime, the estimated posterior mode of this coefficient is 2.497, indicating a strong reaction to inflation deviations. In contrast, under the "dovish" regime, the coefficient is significantly lower, at 1.212, reflecting a more accommodative policy stance. The estimated transition probability from the hawkish to the dovish regime is 2.7 percent per quarter, suggesting that shifts to a dovish regime are relatively rare—consistent with actual policy practice.

The remaining parameters are regime-invariant. Although a direct comparison with earlier studies is not fully appropriate due to differences in sample periods and model specifications,

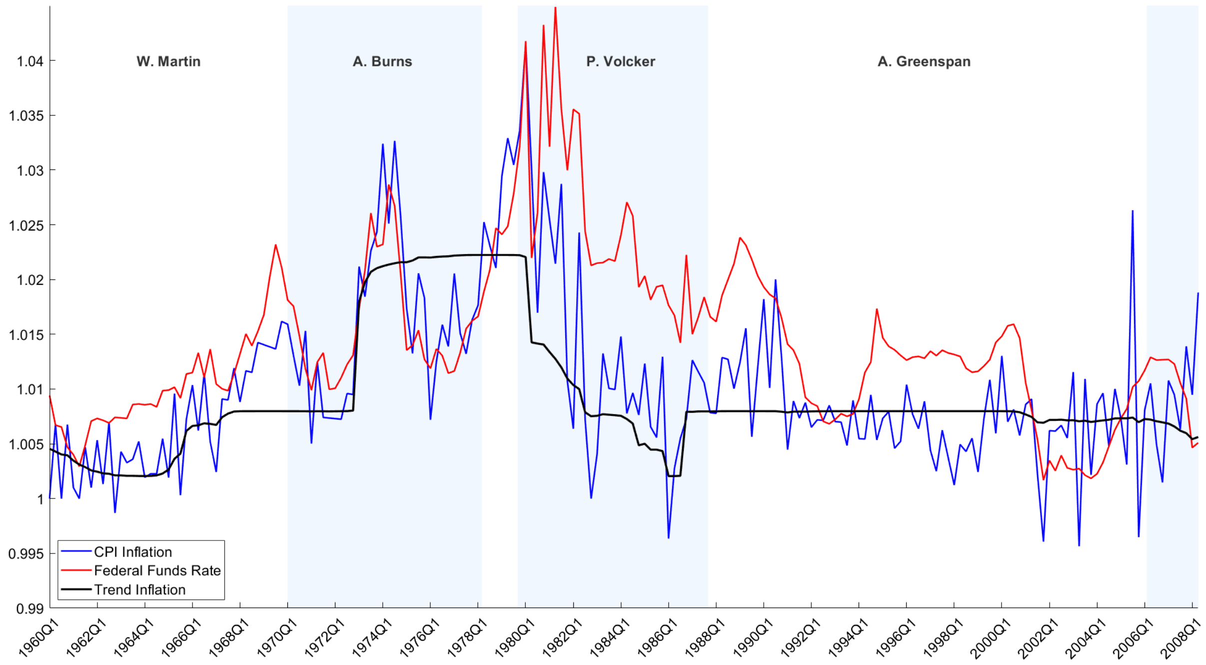

Figure 3: The black line represents the point estimates of expected trend inflation (expressed in gross quarterly terms) over the sample period from 1960Q1 to 2008Q2. The blue line depicts the observed CPI inflation, while the red line shows the nominal Federal Funds rate. The shaded areas correspond to the tenures of successive Federal Reserve Chairs.

the posterior modes and means are broadly in line with estimates from previous U.S. studies. Relatively, the estimated price stickiness parameter, κ_p is lower than in many earlier works, suggesting a higher degree of price flexibility.[7] This result is consistent with the elevated average level and volatility of inflation during the oil price shock era, as well as with the use of a standard Rotemberg pricing framework that does not account for indexation to trend inflation.

Another important outcome of our estimation is the smoothed state probabilities. The shaded areas in Figure 2 correspond to U.S. recessions as dated by the NBER. The first panel displays the probability of being in the low trend inflation regime, which aligns with two distinct periods: 1960–1965 and 1985–1988. The former reflects a period of low and stable inflation under the Fed's cautious policy stance.[8] The latter captures the hard landing following the Volcker disinflation, driven by aggressive tightening to restore price stability. In 1973, the onset of the first oil shock and the collapse of the Bretton Woods system marked a turning point in the U.S. inflation dynamics.[9] This is reflected not only in the sharp rise in headline CPI inflation but also in the elevation of underlying trend inflation, suggesting a de-anchoring of long-term inflation expectations. The elevated level of trend inflation persisted through the second oil shock and remained until Paul Volcker assumed the chairmanship of the Federal Reserve in 1979. This

[7]This finding is related to the results of Nakamura and Steinsson (2008), who document that prices adjust more rapidly during periods of high inflation and remain more stable during low-inflation regimes.

[8]See Hetzel (2008).

[9]As emphasized by Friedman, the delayed effects of prior monetary expansion further amplified inflationary pressures.

Table 2: Priors and Posterior Distributions (1960Q1–2025Q1)

	Prior			Posterior				
Parameter	Distr.	5%	95%	Mode	Mean	Median	5%	95%
$100(z^4-1)$	G	1	2	0.893	0.908	0.907	0.676	1.128
h	B	0.2	0.8	0.328	0.324	0.325	0.243	0.406
σ	G	0.5	3.5	5.615	5.497	5.454	4.348	6.623
$0.02\kappa_p$	B	0.2	0.8	0.111	0.132	0.127	0.052	0.226
η	G	2	10	8.307	8.966	8.770	4.918	12.97
ρ_η	B	0.2	0.8	0.899	0.899	0.900	0.880	0.918
ρ_p	B	0.2	0.8	0.483	0.487	0.487	0.283	0.679
ρ_n	B	0.2	0.8	0.514	0.458	0.481	0.152	0.712
$p^\pi_{\{L,M\}}$	B	0.025	0.075	0.049	0.053	0.053	0.029	0.074
$p^\pi_{\{M,L\}}$	B	0.025	0.075	0.035	0.034	0.033	0.019	0.049
$p^\pi_{\{H,M\}}$	B	0.025	0.075	0.044	0.047	0.046	0.028	0.063
$p^\pi_{\{M,H\}}$	B	0.025	0.075	0.031	0.031	0.030	0.017	0.045
$p^{vol}_{\{low,high\}}$	B	0.025	0.075	0.036	0.039	0.039	0.026	0.052
$p^{vol}_{\{high,low\}}$	B	0.050	0.250	0.183	0.192	0.187	0.110	0.273
$p^{pol}_{\{dovish,hawkish\}}$	B	0.010	0.250	0.135	0.147	0.138	0.059	0.237
$p^{pol}_{\{hawkish,dovish\}}$	B	0.010	0.250	0.038	0.036	0.035	0.013	0.057
$\bar{\pi}^{(A)}_L$	N	0	2	1.753	1.221	1.200	0.620	1.848
$\bar{\pi}^{(A)}_M$	G	2	4	3.239	3.462	3.475	3.039	3.874
$\bar{\pi}^{(A)}_H$	G	4	10	6.244	7.288	7.503	5.517	8.611
$100\varsigma^\eta(low)$	G	0.1	5	1.884	1.886	1.891	1.225	2.527
$100\varsigma^\eta(high)$	G	0.1	5	4.352	4.698	4.510	2.900	6.617
$100\varsigma^z(low)$	G	0.1	5	1.029	1.011	1.005	0.864	1.161
$100\varsigma^z(high)$	G	0.1	5	4.686	4.966	5.038	3.507	6.093
$100\varsigma^p(low)$	G	0.1	5	0.554	0.274	0.242	0.018	0.549
$100\varsigma^p(high)$	G	0.1	5	0.555	0.570	0.590	0.254	0.845
$100\varsigma^n(low)$	G	0.1	5	0.077	0.105	0.097	0.002	0.189
$100\varsigma^n(high)$	G	0.1	5	0.454	0.426	0.410	0.126	0.731
$100\varsigma_r$	IG	0.01	5	0.442	0.448	0.446	0.388	0.515
$\rho_r(dovish)$	B	0.6	0.9	0.732	0.762	0.765	0.695	0.830
$\rho_r(hawkish)$	B	0.6	0.9	0.689	0.670	0.671	0.604	0.730
$\phi_{r,\pi}(dovish)$	G	0.5	1.5	1.254	1.263	1.260	1.067	1.448
$\phi_{r,\pi}(hawkish)$	G	1.5	2.5	2.986	2.918	2.929	2.535	3.271
$\phi_{r,y}$	G	0.2	0.8	0.182	0.186	0.181	0.094	0.281

Note: Abbreviations for prior distributions include B (Beta), N (Normal), G (Gamma), and IG (Inverse Gamma). Values in parentheses indicate the lower and upper bounds of the 95% confidence interval for the quantile prior. The log marginal data density is computed using the Laplace approximation: 2836.00.

prolonged episode of high long-run inflation is related to the Fed's failure to consistently tighten monetary policy,[10] reflecting a tendency toward a dovish stance, as illustrated in the fifth panel of Figure 2. In the following subsection, we show that during 1974–1975, the dovish regime is identified with near certainty under the full-sample estimation.

As one of the central findings of this paper, the Volcker disinflation and the subsequent Great Moderation period are reaffirmed in our estimation. This is reflected in a regime switch of trend inflation back to the middle state, which then persists throughout the moderation era, as shown in Figure 3. To better visualize the point estimate of trend inflation, we combine the posterior mode of the regime-specific inflation means ($\bar{\pi}^{(A)}_L$, $\bar{\pi}^{(A)}_M$, and $\bar{\pi}^{(A)}_H$) with the smoothed probabilities of each state, which allows us to compute the expected path of trend inflation

[10] Romer and Romer (2004) document that the monetary stance during much of the 1970s lacked the commitment necessary to anchor inflation expectations.

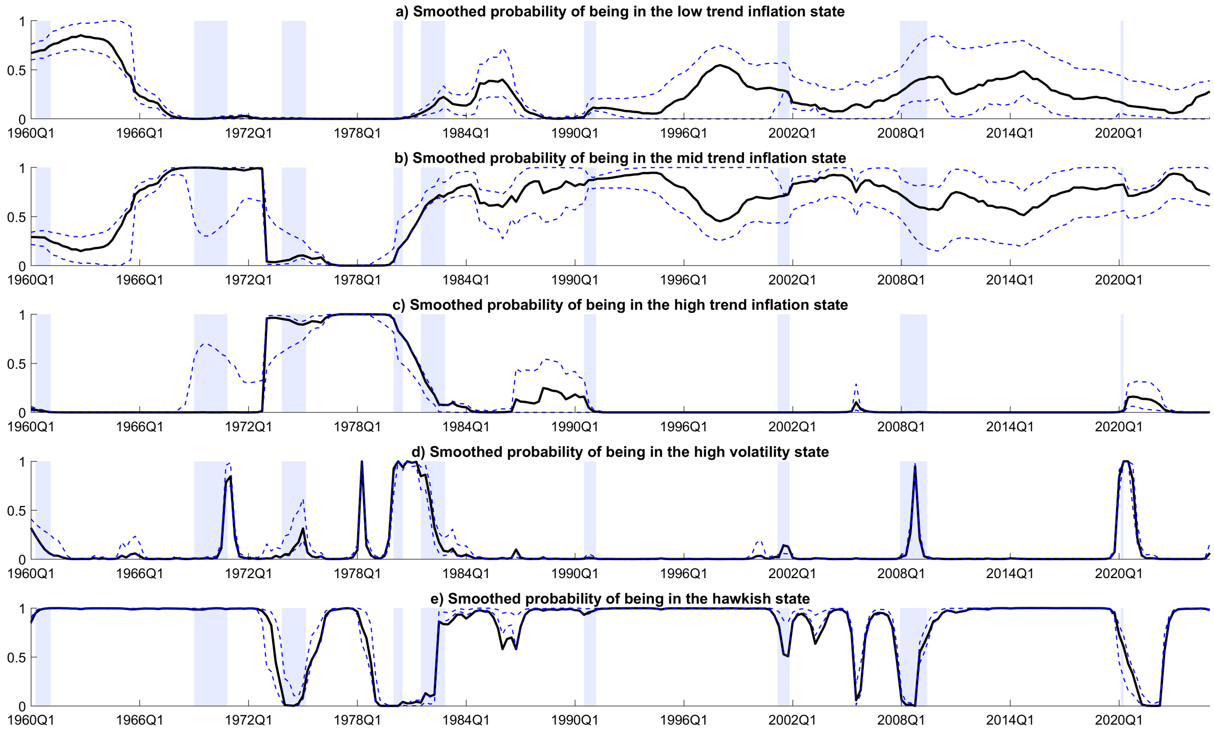

Figure 4: The black solid line represents the smoothed state probabilities over the sample period from 1960Q1 to 2025Q1 at posterior mode with blue dashed lines represent the 68% probability band derived from retained parameter draws.

over time. Specifically, trend inflation declined from 9.197% in 1980Q1 to 0.804% in 1986, before gradually returning to the mid-level of 3.231% toward the end of Volcker's tenure. This model-implied regime shift closely aligns with the period of his chairmanship. During the Great Moderation, not only did trend inflation remain stable at this intermediate level, but macroeconomic volatility also declined, with the economy predominantly residing in the low-volatility regime—except for a temporary deviation during the early 2000s dot-com bubble.

3.3. Estimation Results for the full Sample

In this section, we extend the sample to 1960Q1–2025Q1 to examine the dynamics of trend inflation in the post-crisis era and to further validate our earlier findings. For simplicity, we use the shadow rate proposed by Wu and Xia (2016) as a proxy for the potential shift in the monetary policy stance around the 2008 crisis.[11]

As shown in Figure 4, the high trend inflation regime is identified during the two oil shock periods, consistent with the findings from the shorter-sample estimation. The sharp decline in long-run inflation expectations following Volcker's appointment—i.e., the Volcker disinflation—is also robustly well-captured by the model. However, relative to the posterior estimates

[11] A comprehensive analysis would require modeling large-scale asset purchases and explicitly specifying a shift in the monetary policy instrument—from the policy rate to reserve supply—along with other concurrent structural changes (see Hu and Schabert, 2025). Such an extension is beyond the scope of this paper and is left for future research.

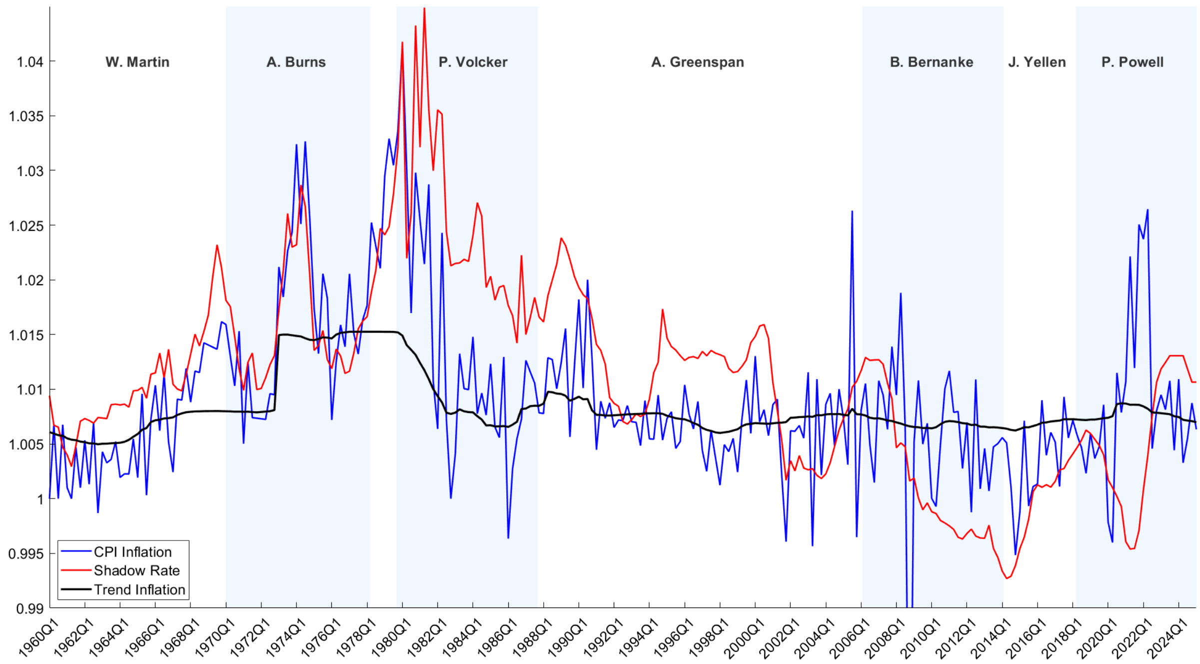

Figure 5: Trend inflation over the sample period from 1960Q1 to 2025Q1.

in the shorter sample, the longer sample leads to a downward revision of the posterior mode for the high trend inflation regime to 6.244% and an upward revision of the low trend inflation regime to 1.753%, as reported in Table 2. This can be attributed to the informational content of the longer sample. With priors held constant, the inclusion of additional post-2008 data—characterized by persistently low and stable inflation—places more weight on low- or mid-inflation observations. As a result, the posterior estimates become more balanced across regimes, pulling the extreme regime-specific values closer to the ergodic mean. This effect may also be interpreted through the lens of trend inflation's definition as the infinite-horizon forecast of inflation, which naturally places greater weight on prolonged periods of price stability in shaping the long-run inflation trend.

We next assess whether the stability associated with the Great Moderation has persisted into the present day. In particular, we examine whether trend inflation remained anchored despite major disruptions such as the Global Financial Crisis (GFC) and the COVID-19 pandemic. As shown in Figure 5, trend inflation exhibits moderate fluctuations following Greenspan's appointment but remains centered around a mean of approximately 2.8%. This relative stability likely reflects enhanced policy credibility and a strengthened commitment to low inflation during the Greenspan era. Although headline CPI inflation surged in early 2021—peaking near 9% in mid-2022 and approaching levels last seen during the oil shocks—long-run trend inflation did not revert to the extreme values observed in the 1970s. Since the formal adoption of the 2% inflation target in 2012, our estimates suggest that trend inflation has hovered around 2.8%. While slightly above target, the persistence of this estimate over an extended period supports

Table 3: Variance Decomposition of Inflation across Regimes (percent)

Shock	Horizon (quarters)					
	1	4	8	12	20	40
Panel A: Pre-Volcker						
Cost-push shock	86.30	88.55	89.37	89.69	89.87	89.91
Monetary-policy shock	12.29	10.13	9.40	9.12	8.96	8.93
Panel B: Volcker						
Cost-push shock	68.19	72.84	74.97	75.79	76.26	76.36
Monetary-policy shock	25.52	21.24	19.56	18.92	18.57	18.48
Panel C: Great Moderation						
Cost-push shock	35.47	41.30	44.02	45.11	45.74	45.88
Monetary-policy shock	63.86	57.97	55.28	54.21	53.58	53.45

Notes: Panel A (Pre-Volcker): High trend inflation & Dovish & High volatility state; *Panel B (Volcker):* High trend inflation & Hawkish & High volatility state; *Panel C (Great Moderation):* Mid trend inflation & Hawkish & Low volatility state.

the interpretation that the Federal Reserve's inflation objective has served as a credible nominal anchor.

Further insight is provided by the bottom panel of Figure 4, which shows the smoothed probability of being in the high monetary policy response regime—characterized by a stronger reaction to inflation deviations. It is widely acknowledged that the more hawkish stance adopted by Chair Paul Volcker played a pivotal role in ending the high inflation of the 1970s. Our results are consistent with this narrative, revealing that the Fed's response to inflation intensified following Volcker's appointment. However, in line with Bjørnland et al. (2018), we do not observe a regime switch to the hawkish state until after 1982. Thereafter, the economy remains in this regime for most of the sample, with the exception of two notable episodes: the GFC and the COVID-19 crisis. Despite policy rates being lowered to the zero lower bound under Chairs Bernanke and Powell—and the model indicating a reduction in the structural policy response coefficient—trend inflation remained relatively stable throughout both episodes. This again suggests that inflation expectations were well anchored, likely reflecting the credibility of the Federal Reserve's commitment to price stability, even in the presence of unconventional monetary policy measures.

3.4. Variance Decomposition

Table 3 reports the variance decomposition of inflation across three historical episodes—pre-Volcker, the Volcker chairmanship, and the Great Moderation sampled from 1960Q1 to 2025Q1. In the pre-Volcker period, under a relatively dovish policy stance and elevated supply-side volatility, inflation variability is predominantly supply-driven: cost-push shocks account for 86.30% of the variance, while monetary-policy shocks contribute only 12.29% in the short run.

During this phase, cost-push shocks account for a large share of inflation variability; although the model omits an explicit oil-price process, oil-related disturbances are effectively captured by the reduced-form cost-push component. Under Volcker—characterized by a hawkish policy stance, high macroeconomic volatility, and high trend inflation—the decomposition shifts: the cost-push share recedes, and policy shocks account for a larger short-run fraction, a pattern that suggests stronger nominal anchoring and firmer policy credibility. During the Great Moderation—marked by a hawkish stance, low macroeconomic volatility, and mid-level trend inflation—the decomposition stabilizes further: cost-push influence is dampened and policy shocks become the dominant source of variation (63.86%), suggesting that, with a well-anchored trend and muted supply disturbances, monetary policy has greater scope to stabilize inflation, as short-run variation is largely policy-driven.

4. Conclusion

In this paper, we revisit the post-1960 dynamics of U.S. trend inflation by estimating a nonlinear, non-stationary regime-switching New Keynesian model. The framework allows for regime changes in three dimensions: trend inflation, structural shock volatility, and the monetary policy stance. This flexible structure enables the model to capture key historical transitions in macroeconomic policy and outcomes while remaining grounded in theory. By extending the sample through 2025Q1, the analysis offers a unified account of how long-run inflation expectations evolved across different monetary regimes and crisis episodes.

Our estimation yields three key findings. First, the model confirms two cornerstone episodes in modern U.S. monetary history: the Volcker disinflation and the Great Moderation. These are captured as a sharp and persistent regime switch in trend inflation—from high to mid-level—starting in the early 1980s and lasting through the early 2000s. Second, despite major disruptions such as the Global Financial Crisis and the COVID-19 pandemic, trend inflation remained relatively stable, suggesting that long-run inflation expectations were well anchored—likely due to the Federal Reserve's strengthened credibility following the formal adoption of a 2% inflation target in 2012. Third, we identify a structural shift to a more hawkish monetary policy regime beginning after 1982, aligned with Paul Volcker's aggressive stance. While this hawkish stance was temporarily interrupted under the leadership of Chairs Bernanke and Powell—during which policy rates reached the zero lower bound—the model finds that trend inflation remained stable, reflecting the continued anchoring of expectations despite a reduced policy response coefficient on inflation.

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A Rational Expectations Equilibrium

The REE of the stationary model is a set of sequences of quantities $\{\widetilde{y}_t, \widetilde{c}_t, mc_t, n_t\}$ and prices $\{\widetilde{w}_t, \eta_t, R_t, \pi_t, \widetilde{\lambda}_t, \widetilde{\Lambda}_t\}$ satisfying the following conditions,

$$\tilde{\lambda}_t = \psi_t^P(\widetilde{c}_t - h\widetilde{c}_{t-1}/z_t)^{-\sigma} - \beta h \mathbb{E}_t \psi_{t+1}^P(\widetilde{c}_{t+1} - h\widetilde{c}_t/z_{t+1})^{-\sigma}, \tag{18}$$

$$\mathbb{E}_t \widetilde{\Lambda}_{t,t+1} \pi_{t+1}^{-1} z_{t+1}^{-1} R_t = 1, \tag{19}$$

$$\widetilde{\lambda}_t \widetilde{w}_t = \chi \psi_t^N n_t^{\sigma^n}, \tag{20}$$

$$\widetilde{\Lambda}_{t,t+1} = \beta \widetilde{\lambda}_{t+1}/\widetilde{\lambda}_t, \tag{21}$$

$$mc_t \widetilde{y}_t = \widetilde{w}_t n_t, \tag{22}$$

$$\widetilde{y}_t = n_t^{1-\alpha}, \tag{23}$$

$$\eta_t - 1 = \eta_t mc_t - \kappa_p (\pi_t - 1) \pi_t + \kappa_p \mathbb{E}_t \Lambda_{t,t+1} \frac{y_{t+1}}{y_t} (\pi_{t+1} - 1) \pi_{t+1}, \tag{24}$$

$$\eta_t = \eta(\psi_t^\eta)^{-\kappa_p}, \tag{25}$$

$$\widetilde{y}_t = \widetilde{c}_t + \frac{\kappa_p}{2} (\pi_t - 1)^2 \widetilde{y}_t, \tag{26}$$

$$R_t/R = (R_{t-1}/R)^{\rho_r(\mathcal{S}_t^{pol})} \left[(\pi_t/\bar{\pi}(\mathcal{S}_t^\pi))^{\phi_{r,\pi}(\mathcal{S}_t^{pol})} (\tilde{y}_t/\tilde{y})^{\phi_{r,y}} \right]^{1-\rho_r(\mathcal{S}_t^{pol})} \exp(\varsigma_r \varepsilon_t^R), \tag{27}$$

the transerversality conditions, given the exogenous sequences $\{\psi_t^\eta, \psi_t^P, \psi_t^N\}$. Suppose the steady-state/balanced growth path of the productivity growth is z, a TFP growth shock is given as

$$z_t/z = \exp(\varsigma^z \varepsilon_t^z). \tag{28}$$

B Appendix to Section 3

This section presents two alternative estimates based on different starting periods—1955Q2–2025Q1 and 1965Q1–2025Q1—to examine the robustness of the results.

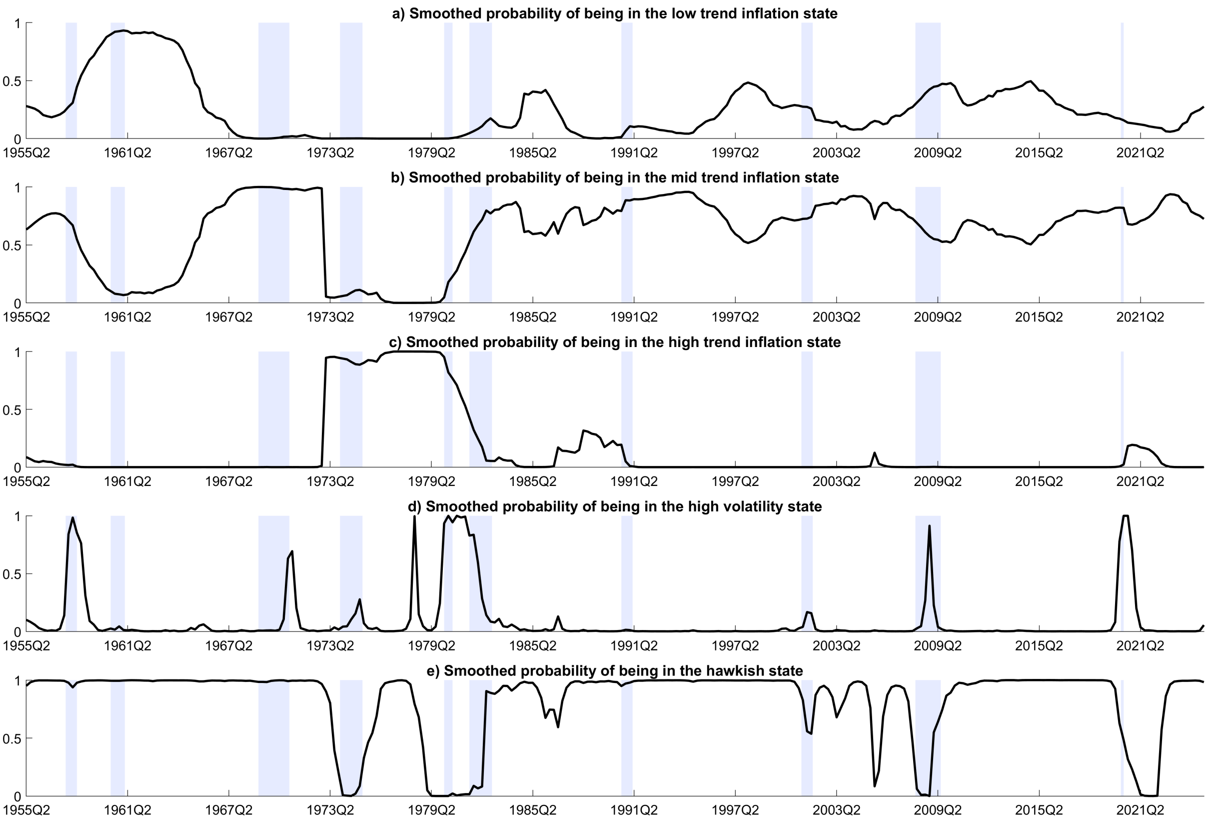

Figure 6: Smoothed state probabilities starting in 1955Q2 at posterior mode. The top three panels display the smoothed probabilities of being in the low, medium, and high trend inflation regimes, respectively. The fourth row presents the smoothed probabilities of being in the high volatility state. The bottom row presents the smoothed probabilities of being in the hawkish state. Shaded areas correspond to officially dated NBER recessions.

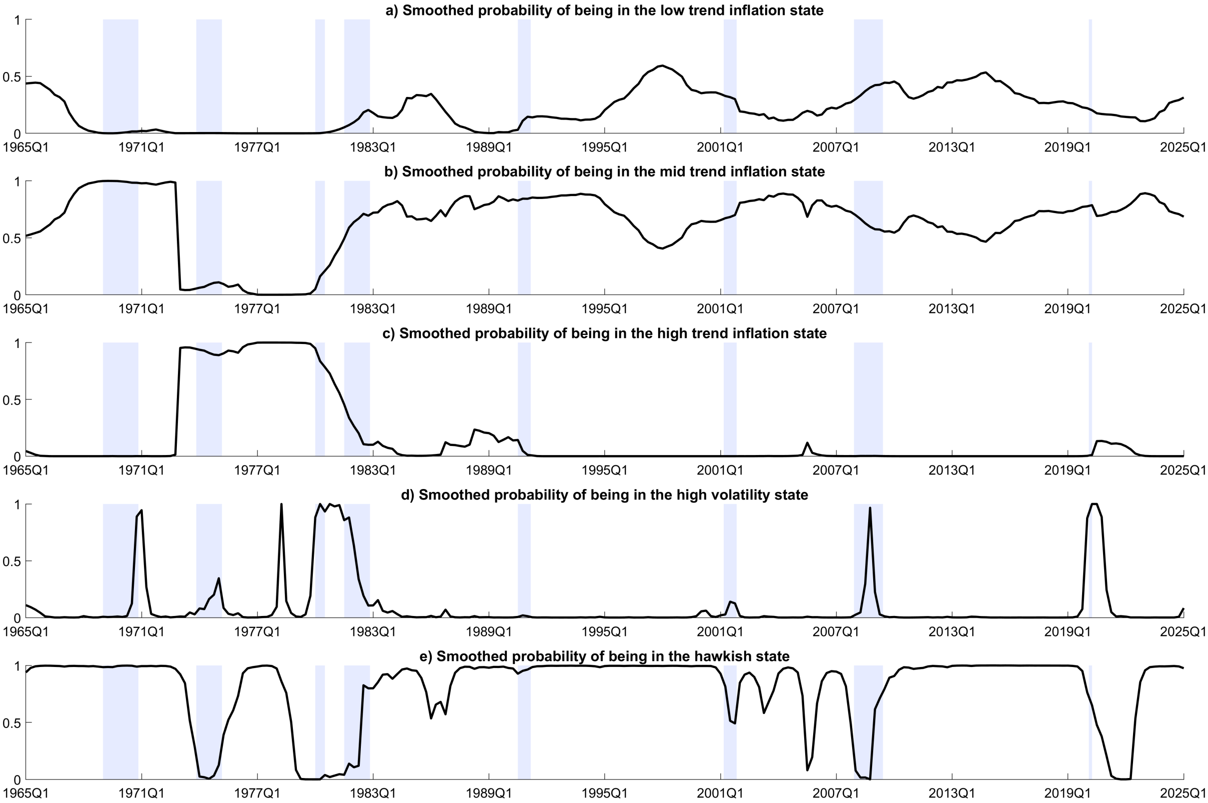

Figure 7: Smoothed state probabilities starting in 1960Q2 at posterior mode. The top three panels display the smoothed probabilities of being in the low, medium, and high trend inflation regimes, respectively. The fourth row presents the smoothed probabilities of being in the high volatility state. The bottom row presents the smoothed probabilities of being in the hawkish state. Shaded areas correspond to officially dated NBER recessions.