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Double Inertia, Taylor Rules, and Monetary Policy Gradualism*

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Abstract

In recent decades, an empirically estimated double-inertial rule fits the path of changes in the federal funds rate better than a standard inertial Taylor rule. Inertial Taylor rules aim to capture monetary policy gradualism via slow adjustments in the *level* of the policy rate. Double-inertial rules build on this specification by also gradually adjusting the *pace* of change in the policy rate. Because a double-inertial rule explains more than twice the variation of changes in the policy rate than its standard inertial counterpart, we argue that practitioners should consider a double-inertial rule when characterizing U.S. monetary policy.

Keywords: Monetary policy, Taylor rules, gradualism, interest rate smoothing, inertia, federal funds rate, effective lower bound.
JEL Codes: E52, E58, E43.

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1 Introduction

"Indeed, FOMC participants have built [...] a gradual path of rate hikes into their projections for the next couple of years."

— Janet Yellen, October 15, 2017, Speech as Fed Chair at the Group of 30 International Banking Seminar in Washington, DC.[1]

"At some point, as the stance of monetary policy tightens further, it likely will become appropriate to slow the pace of increases."

— Jerome Powell, August 26, 2022, Speech as Fed Chair at an economic symposium in Jackson Hole, Wyoming.[2]

The last two decades provide an especially useful setting for studying the behavior of U.S. monetary policy. In the wake of the 2008 financial crisis, the federal funds rate was held at the effective lower bound (ELB) for an extended period. After a brief normalization, the COVID-19 pandemic brought about a return to the ELB, followed by a bout of high inflation, a rapid hiking cycle from 2022 to 2024, and a subsequent easing towards more moderate levels. Understanding the factors that explain this variation in the federal funds rate, its departures from the ELB, and its relationship with economic fundamentals is an ongoing challenge in monetary economics.

Since their inception in the early 1990s , Taylor rules (Taylor, 1993) have been widely employed as a framework for describing the movements of the policy rate through a small set of macroeconomic aggregates. Despite their simplicity, these rules perform remarkably well and remain among the most influential frameworks for describing monetary policy. A large subsequent literature has established that adding the lagged policy rate to these rules substantially improves fit, particularly in the post-Volcker era (Clarida et al., 2000; Sack and Wieland, 2000). This success is commonly interpreted as evidence of monetary policy "gradualism"—the practice of avoiding large, abrupt adjustments of the *level* of the policy rate and instead adjust the policy rate gradually in response to economic fundamentals.

However, large, abrupt adjustments of the *pace* of policy rate changes are also rare and policymakers often communicate their policy decisions in terms of the pace of changes, as our opening quotes make clear. Carlstrom and Fuerst (2014) argue that such a view of gradualism cannot be captured with a single lag in a policy rule and introduced the term "double inertia" to capture the smooth path of policy rate *changes*. Using data up to 2008, Carlstrom and Fuerst (2014) and Coibion and Gorodnichenko (2012) document that a double-inertial Taylor rule fits the path of the federal funds rate better than a single-inertial rule.

This paper provides a systematic empirical evaluation of the double-inertial Taylor rule through 2025, thereby doubling the sample length of previous work. The sample includes two episodes during which the policy rate hit its effective lower bound (ELB), which may be particularly important for understanding gradualism. That is, gradual

[1] https://www.federalreserve.gov/newsevents/speech/yellen20171015a.htm.

[2] https://www.federalreserve.gov/newsevents/speech/powell20220826a.htm.

post-liftoff increases in the policy rate can act as a partial commitment device, helping policymakers keep rates lower for longer when the risk of returning to the ELB remains elevated (Evans et al., 2015; Nakata, 2017; Nakov, 2008). The December 2015 ELB departure was followed by small increases of 0.25 percentage points, but the 2022 exit was one of the most rapid tightening cycles in 40 years. Taking into account the pace of policy rate increases featured in the double-inertial rule helps explain the behavior of the federal funds rate in both episodes.

We find strong evidence that the double-inertial rule can explain the path of the federal funds rate. At an R^2 of 0.57, the double-inertial rule is able to explain more than twice the variation in quarterly changes to the federal funds rate across the relevant sample than the best single-inertial rule. Furthermore, this result is robust to alternative data subsets, the use of shadow rate estimates during effective lower bound periods, substitution of an output gap measure for the unemployment gap, and the use of real-time rather than realized data in the spirit of Orphanides (2001). Because a single-inertial rule captures only part of the gradualism evident in the data, its use in estimated New-Keynesian models risks misspecification. A double-inertial specification offers a sharper benchmark for the policy analysis and forecasting carried out in central banks and the private sector.

The success of inertial rules may simply reflect the fact that first-order autoregressive models are often the best predictor of macroeconomic time series, including interest rates. Indeed, simple autoregressive models do virtually just as well in predicting one-quarter-ahead changes in the federal funds rate as single-inertial Taylor rules, as noted by Nakamura et al. (2025). However, when predicting the policy rate at longer horizons, rules relying on economic fundamentals outperform simple autoregressive benchmarks. Economic fundamentals thus contribute little to short-run predictions of the policy rate but are essential for predicting the path of the policy rate over longer horizons.

We also evaluate the empirical performance of the inertial rules during the historical period starting in 1960 and ending with Volcker's resignation. A large literature indicates that monetary policy was structurally different before the 1980s, exhibiting weaker responses to inflation expectations, more focus on monetary aggregates, less reliance on policy rules, and lower inertia (e.g. Taylor, 1999; Clarida et al., 2000; Duffee, 2026). In line with this literature, we cannot reject the null that a single-inertial rule is sufficient to describe the behavior of the federal funds rate prior to 1987.

While we show that the smoothing of the pace of rate changes is a good empirical description of monetary policy, an analysis of why policymakers behave in this way is beyond the scope of our paper. Rudebusch (2006) has contended that interest-rate smoothing may just be an artifact of persistent policy shocks, but Coibion and Gorodnichenko (2012) provide several pieces of evidence refuting this interpretation. There is theoretical work that justifies interest rate smoothing as optimal. Most prominently, Woodford (1999) derives the interest rate rule that implements optimal monetary policy in a standard New-Keynesian model and shows that it is inertial. In fact, it features exactly two lags in the policy rate, just like the double-inertial rule. Other normative arguments explain that inertia could be an optimal response to economic uncertainty and financial market volatility (Bernanke, 2004; Woodford, 1999; Sack and Wieland, 2000; Stein and Sunderam, 2018; Levin et al., 1999; Caballero and Simsek, 2022).

Our paper contributes to recent work that assesses how well Taylor rules fit the path of the federal funds rate. Aastveit et al. (2024) document a higher degree of interest rate smoothing in economic expansions than in contractions. Kakhbod et al. (2026) and Hofmann et al. (2025) find higher Taylor rule coefficients on demand-driven inflation than supply-driven inflation. Nakamura et al. (2025) compare Taylor rule predictions across countries and find the strongest fit for the United States, but with the caveat that the quality of the fit varies across the sample. Carlstrom and Jacobson (2015), Bauer et al. (2024a,b), González-Astudillo and Tanvir (2026), and Herbst and Page (2026) study professional forecasts of interest rates through the lens of Taylor rules. Tatar and Wieland (2024) interpret the Taylor rules published in the Federal Reserve's Monetary Policy Report to Congress.

The structure of the rest of the paper is as follows. Section 2 presents our Taylor rules and benchmark models used in estimation. Section 3 describes our data and methodological approach. Section 4 evaluates our primary results and goodness of fit metrics. Section 5 details our additional robustness exercises. Section 6 concludes.

2 Monetary policy rules

We first review Taylor rule specifications with and without inertia, including the double-inertial rule of Carlstrom and Fuerst (2014).

Let i_t be the nominal policy rate at time t. A non-inertial Taylor rule TR_t relates the nominal policy rate i_t to inflation and a measure of resource utilization in the economy. When the policy rate is not constrained by the effective lower bound (ELB), the policy rate is set according to:

$$i_t = \underbrace{r^* + \pi^* + \beta_\pi(\pi_t - \pi^*) + \beta_u(u_t - u_t^*)}_{=:TR_t}, \tag{1}$$

where r^* is the longer-run neutral real rate (assumed to be constant over a given data window), π_t is the inflation rate, u_t is the unemployment rate, π^* is the target rate of inflation, and u_t^* is the natural rate of unemployment. In estimation, we account for the effective lower bound by specifying the shadow policy rate as:

$$\tilde{i}_t = \theta_0 + \theta_1\pi_t + \theta_2(u_t - u_t^*) + \varepsilon_t, \tag{2}$$

and we then observe

$$i_t = \max\{\underline{i}, \tilde{i}_t\}, \tag{3}$$

where the max operator captures the constraint that the interest rate cannot fall below the ELB, $\underline{i}$.

The standard way of adding gradualism to this rule is to assume that the interest rate is set as a weighted average of the Taylor rule prescription, TR_t, and the previous period's interest rate. We thus introduce a parameter ρ that captures gradualism on the *level* of the policy rate. The resulting specification is the "single-inertial" Taylor rule. Away from the ELB, this rule prescribes:

$$i_t = \rho i_{t-1} + (1-\rho)TR_t. \tag{4}$$

By subtracting i_{t-1} from both sides, this rule can be rewritten into a partial-adjustment specification that relates the pace of change in interest rates to the difference between the prescribed and the previous level of the policy rate:

$$\Delta i_t = (1-\rho)(TR_t - i_{t-1}),$$

where $(1-\rho)$ is the proportion of movement from the current level of the policy rate towards the intermediate rate target given by the non-inertial Taylor rule.

Expanding the levels specification of the single-inertial rule yields the following:

$$i_t = \rho\, i_{t-1} + (1-\rho)\left[r^* + \pi^* + \beta_\pi(\pi_t - \pi^*) + \beta_u(u_t - u_t^*)\right]. \tag{5}$$

We recover the parameters of this rule from the estimation of the corresponding latent policy rate specification:

$$i_t = \max\{\underline{i}, \theta_0 + \theta_1\pi_t + \theta_2(u_t - u_t^*) + \theta_3 i_{t-1} + \varepsilon_t\}. \tag{6}$$

Carlstrom and Fuerst (2014) advocated for a Taylor rule with "double inertia", which smooths not only the level of the policy rate, but also its pace of change. The motivating idea is that it is uncommon for central banks to abruptly go from a hike to a cut even when the cut is small, and central banks commonly adjust the policy rate in a series of equal-size increments. These empirical regularities are captured with the addition of a parameter γ in the partial-adjustment specification:

$$\Delta i_t = \gamma\Delta i_{t-1} + (1-\rho)(TR_t - i_{t-1}).$$

Expanding and converting into levels, the double-inertial Taylor rule away from the ELB takes the form:

$$i_t = -\gamma i_{t-2} + (\rho+\gamma)i_{t-1} + (1-\rho)\left[r^* + \pi^* + \beta_\pi(\pi_t - \pi^*) + \beta_u(u_t - u_t^*)\right]. \tag{7}$$

We recover the parameters of this rule by estimating the corresponding latent policy rate specification:

$$i_t = \max\{\underline{i}, \theta_0 + \theta_1\pi_t + \theta_2(u_t - u_t^*) + \theta_3 i_{t-1} + \theta_4 i_{t-2} + \varepsilon_t\}. \tag{8}$$

To understand the extent to which the strong empirical performance of inertial Taylor rules comes simply from anchoring predictions for the current interest rate to their previous level, we also evaluate AR(1) and AR(2) benchmark models of the policy rate, where we set θ_1 and θ_2 to zero in (6) and (8).

3 Data

All of the data used in our primary estimation procedure is sourced from the Federal Reserve Bank of St. Louis's FRED database. We focus on the 2026:Q2 data vintage, which allows us to estimate a longer sample than would be possible using real-time data, as in Orphanides (2001).[3] We use data for the federal funds effective rate (FEDFUNDS), the personal consumption expenditures price index (PCEPILFE), the unemployment rate (UNRATE), and the Congressional Budget Office estimate of the noncyclical rate of unemployment (NROU) at a quarterly frequency. We then construct an unemployment gap proxy by computing the difference between the unemployment rate and the noncyclical rate of unemployment in every quarter. The inflation target π^* is not estimated but instead set to the Federal Reserve's 2 percent goal. While this target was not formally announced until 2012, we treat it as a reasonable proxy for the low and stable inflation mandate that guided policy in earlier decades.

We focus our analysis on three data samples. The first sample runs from 1987:Q4 to 2006:Q4, which covers the period following Paul Volcker's resignation as Chair of the Federal Reserve Board but prior to the events associated with the 2008 recession. This window corresponds fairly closely to the data used in previous analysis of Taylor rules with double inertia, which also ends before the 2008 crisis. We estimate the parameters of our policy rules over this period using OLS regression in line with Carvalho et al. (2021), who show that the endogeneity bias is small.

The second sample additionally includes the period between 2007:Q1 and 2025:Q3. This extension doubles the sample size used in previous work, allowing us to reassess the prevalence of double inertia in recent decades with greater precision. During this period, the Federal Reserve held the policy rate at the effective lower bound (ELB) from December 16, 2008 to December 15, 2015, and again from March 15, 2020 through March 16, 2022. As a result, our extended sample includes "liftoff" episodes, which may be especially important for understanding gradualism given that policymakers may want to increase the policy rate slowly to mitigate the risk of returning to the ELB. Because changes in the stance of monetary policy are not reflected in the federal funds rate during ELB periods, we employ Tobit regressions to estimate the rule parameters in our model of the latent policy rate.

Our third data subset covers an earlier period from 1960:Q1 to 1987:Q3. This window provides a valuable comparison that both highlights the importance of double inertia in prediction and helps to support its interpretation in the context of monetary policy gradualism. The literature has long recognized that Taylor rules—particularly those with single inertia—describe monetary policy far more accurately in the post-Volcker era (e.g. Clarida et al., 2000, Taylor, 1999). This observation is generally understood as reflecting substantial shifts in the Federal Reserve's approach to monetary policy in the late eighties and early nineties, including stronger adherence to the Taylor principle, greater concern with market expectations, and a more gradual policy rate adjustment process. To the extent that our estimates suggest double inertia is more pronounced in recent decades

[3] Section 5 shows that our conclusions hold with real-time data.

than it was in the historical sample, this provides evidence that it may be a characteristic feature of gradualist policy regimes.

4 Results

4.1 Rule parameters

Table 1 reports the estimated parameters of each Taylor rule variant.

The inflation gap coefficient $\hat{\beta}_\pi$ is positive and the unemployment gap coefficient $\hat{\beta}_u$ is negative in all models, as expected. The inflation gap coefficient is also larger than one in all models except in the full post-1987 sample, where the inflation coefficient for the non-inertial Taylor rule is small with a large standard error. At 0.92, the implied policy response to inflation is less than one-for-one over the period, implying a violation of the Taylor principle. We think this reflects misspecification from the missing inertia in this rule: The Federal Reserve did adjust *target* interest rates more than one-for-one in response to inflation.

The r^* estimates generated by the Taylor rule variants are very stable across models within the pre-2007 sample, clustering between 2.30 and 2.40. The estimates are considerably lower in the full sample, ranging from 0.32 for the double-inertial model to 1.27 for the non-inertial rule. These levels are broadly consistent with r^* estimates over recent decades, and the differences across the samples are consistent with a secular decline in the natural real rate.

The single-inertia parameter ρ is estimated to be large and highly significant in the pre-2007 sample. In the absence of double inertia, these estimates imply partial adjustments of 13 and 20 percent toward the implied intermediate rate target per quarter. In the full sample, the estimated inertia is slightly higher, implying partial adjustments of less than 10 percent. That is, more than 90 percent of the level of the current federal funds rate in a given quarter can be attributed to its level in the previous quarter.

Most notably, the double-inertia coefficient γ is estimated fairly precisely at 0.61 and 0.63 in the pre-2007 and full samples, respectively. This implies that about 60 percent of the previous change in the federal funds rate passes through to the adjustment in the current quarter. Both parameter estimates are highly significant, easily rejecting the null that single inertia alone is sufficient to describe the dynamics of the policy rate.

We also estimated a "triple-inertial" Taylor rule that adds a third lag of the policy rate to the rule (not reported in Table 1). The estimated coefficient on this third lag is small and statistically insignificant across all samples, suggesting that two lags offer the best empirical description of the behavior of the federal funds rate in recent decades.[4]

These results together corroborate previous findings that inertia, and hence gradualism, play a significant role in monetary policy through the 1990s and into the 2000s. In addition, they are evidence that gradualism encompasses persistence in the pace of

[4] We also use information criteria to evaluate the fit of our triple-inertial Taylor rule, and find that it has higher BIC values than the double-inertial rule over both the full 'Post-1987' and 'Pre-2007' samples.

Table 1: Recovered Rule Parameters by Sample

Parameter	Pre-2007			Post-1987		
	(1) Non-inertial	(2) Single-inertial	(3) Double-inertial	(4) Non-inertial	(5) Single-inertial	(6) Double-inertial
$\hat{r}^*$	2.37	2.34	2.37	1.27	0.39	0.32
	(0.29)	(0.46)	(0.38)	(0.37)	(1.17)	(0.95)
$\hat{\beta}_\pi$	1.68	1.74	1.51	0.92	2.38	1.88
	(0.20)	(0.32)	(0.29)	(0.65)	(0.98)	(0.75)
$\hat{\beta}_u$	-1.73	-2.30	-1.66	-1.62	-4.34	-3.09
	(0.20)	(0.34)	(0.46)	(0.33)	(1.67)	(1.12)
$\hat{\rho}$		0.80	0.87		0.94	0.96
		(0.05)	(0.03)		(0.03)	(0.01)
$\hat{\gamma}$			0.61			0.63
			(0.12)			(0.08)
N	77	77	77	152	152	152

Note: This table presents estimates for the specifications detailed in Section 2. The rules are estimated using quarterly data from FRED, as detailed in Section 3. Parameters $\hat{r}^*$, $\hat{\beta}_\pi$, $\hat{\beta}_u$, $\hat{\rho}$, and $\hat{\gamma}$ are recovered from the regression coefficients, and Newey–West standard errors with a lag length of 4 are computed via the delta method. OLS estimation was used for the 'Pre-2007' sample, running from 1987:Q4 to 2006:Q4. Tobit regression with censorship at 0 was used for the full 'Post-1987' sample, running from 1987:Q4 to 2025:Q3.

change of the policy rate: policymakers tend to pursue interest rate adjustments of similar size and in the same direction across periods. The strong evidence in favor of the double-inertial rule in the full sample underscores the relevance of the pace of changes in modern U.S. monetary policy.

4.2 Goodness of fit

To better quantify and evaluate the performance of each policy rule across subsets, we construct three R^2 statistic variants.

The first measure is standard, describing the explanatory power of each estimated rule with respect to the *level* of the policy rate, given realized values of the inflation and unemployment gaps in the next quarter. We can express this measure formally as follows:

$$R^2 = 1 - \frac{\sum_t \left(i_t - \hat{i}_t\right)^2}{\sum_t \left(i_t - \bar{i}\right)^2}, \tag{9}$$

where $\bar{i}$ is the average federal funds rate over the sample and $\hat{i}_t$ denotes the policy rate predicted by the estimated rule r in period t. Note that these policy rate predictions are truncated below at 0 to account for the ELB, as described in Section 2. Because the prediction of the policy rate $\hat{i}_t$ makes use of the realized values of the policy rate up to time $t-1$, we refer to this measure as "one-quarter levels" R^2.

Across both samples, the results for this measure, as reported in the R^2 columns of Table 2, are broadly similar. In the pre-2007 sample, the non-inertial rule achieves a moderate R^2 of 0.78, while the single- and double-inertial rules are able to explain almost all of the variation in the policy rate, achieving R^2 values of 0.97 and 0.98, respectively. In the full post-1987 sample, this disparity is even more drastic: the non-inertial rule

Table 2: Model Fit Statistics by Sample

	Pre-2007					Post-1987				
Policy Rule	R^2	$R^2{}_\Delta$	$R^2{}_4$	AIC	BIC	R^2	$R^2{}_\Delta$	$R^2{}_4$	AIC	BIC
Non-inertial	0.78	-3.62	0.78	182.31	177.62	0.44	-17.44	0.44	458.60	452.55
Single-inertial	0.97	0.30	0.80	38.62	36.28	0.98	0.27	0.82	59.98	56.95
Double-inertial	0.98	0.59	0.81	0.00	0.00	0.99	0.57	0.83	0.00	0.00
AR(1)	0.95	0.02	0.54	61.17	54.14	0.97	-0.07	0.65	115.34	106.27
AR(2)	0.98	0.53	0.70	5.77	1.08	0.98	0.50	0.76	26.05	20.00

Note: The reported statistics are for the estimated models as in Table 1. Predictions below 0 are truncated for the calculation of the goodness of fit measures. R^2 measures fit for one-quarter-ahead levels of the FFR, $R^2{}_\Delta$ measures fit for one-quarter-ahead changes, and $R^2{}_4$ measures fit for year-ahead levels. The computation procedures are detailed in Section 4.2. AIC and BIC are computed from the model log-likelihoods and normalized to zero for the double-inertial model. The 'Pre-2007' sample runs from 1987:Q4 to 2006:Q4, and is estimated with OLS. The full 'Post-1987' sample runs from 1987:Q4 to 2025:Q3, and is estimated with Tobit regression.

performs rather poorly with an R^2 of merely 0.44, while the single- and double-inertial rules achieve R^2 values of 0.98 and 0.99. Clearly, the single- and double-inertial rules are able to substantially improve explanatory power relative to the non-inertial specification.

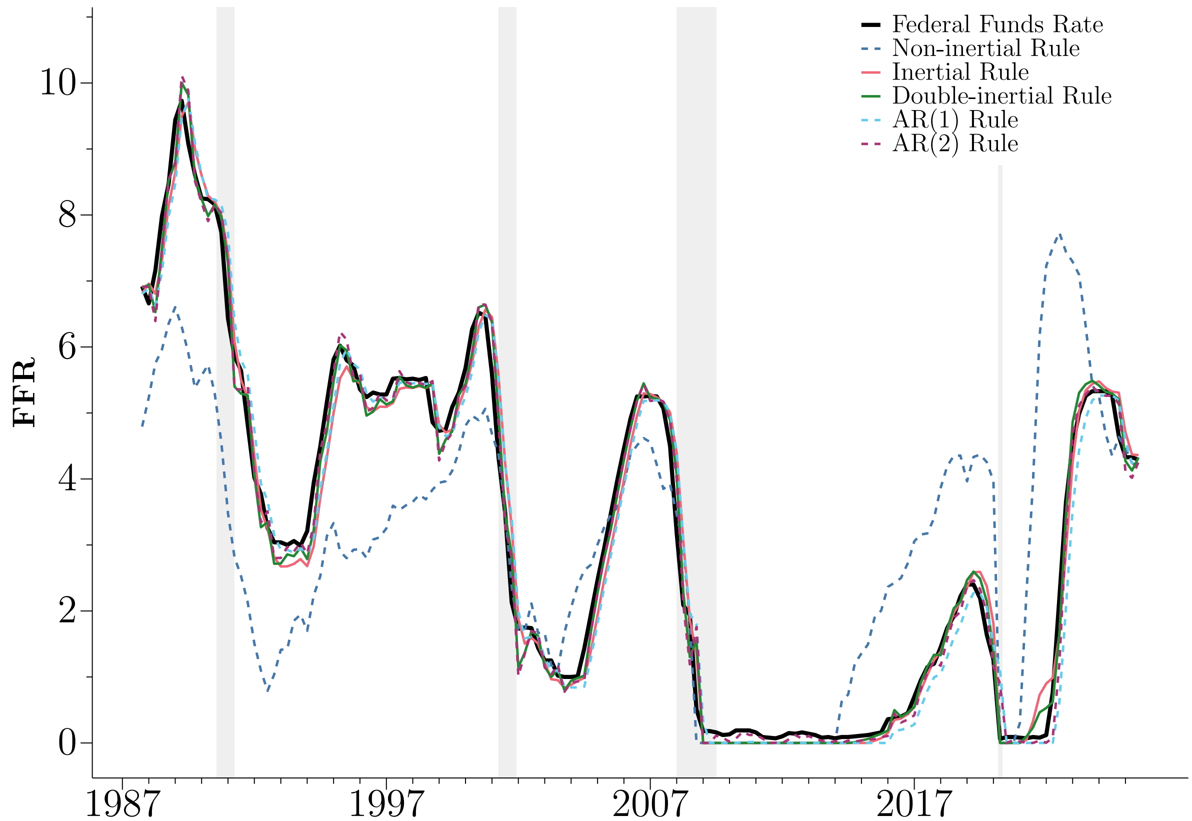
The performance of each rule in levels across the extended sample is visualized in Figure 1. All rules and benchmarks except for the non-inertial rule track the level of the federal funds rate closely. Only upon careful inspection does the reduced phase shift of the double-inertial rule become visible, as Carlstrom and Fuerst (2014) highlight, particularly during the hiking cycles of the mid-1990s and mid-2000s and the cutting cycle associated with the 2001 recession.

We therefore construct a second R^2 variant which evaluates the rules' predictions of *changes* to the policy rate, rather than its levels. We view this metric as especially relevant for the common narratives around FOMC meetings, where policymakers and the public alike often focus on potential *changes* to the policy rate. In essence, this "one-quarter changes" R^2 measure, which we denote R^2_Δ, compares realized changes in the policy rate to the changes predicted by each rule. The predicted adjustment is taken to be the difference between the rule-implied rate and the lagged realized policy rate. Formally,

$$R^2_\Delta = 1 - \frac{\sum_t \left[(i_t - i_{t-1}) - (\hat{i}_t - i_{t-1})\right]^2}{\sum_t \left[(i_t - i_{t-1}) - \overline{\Delta i}\right]^2} = 1 - \frac{\sum_t \left(i_t - \hat{i}_t\right)^2}{\sum_t \left[(i_t - i_{t-1}) - \overline{\Delta i}\right]^2}, \tag{10}$$

where $\overline{\Delta i}$ is the average change in the federal funds rate over the sample. Because this measure evaluates predicted changes relative to the lagged realized policy rate, and the non-inertial rule is not anchored to that value, its performance is far worse than a rule which simply takes the average change as its prediction in each period.

Figure 1: One-Quarter-Ahead Federal Funds Rate Predictions for Estimated Rules

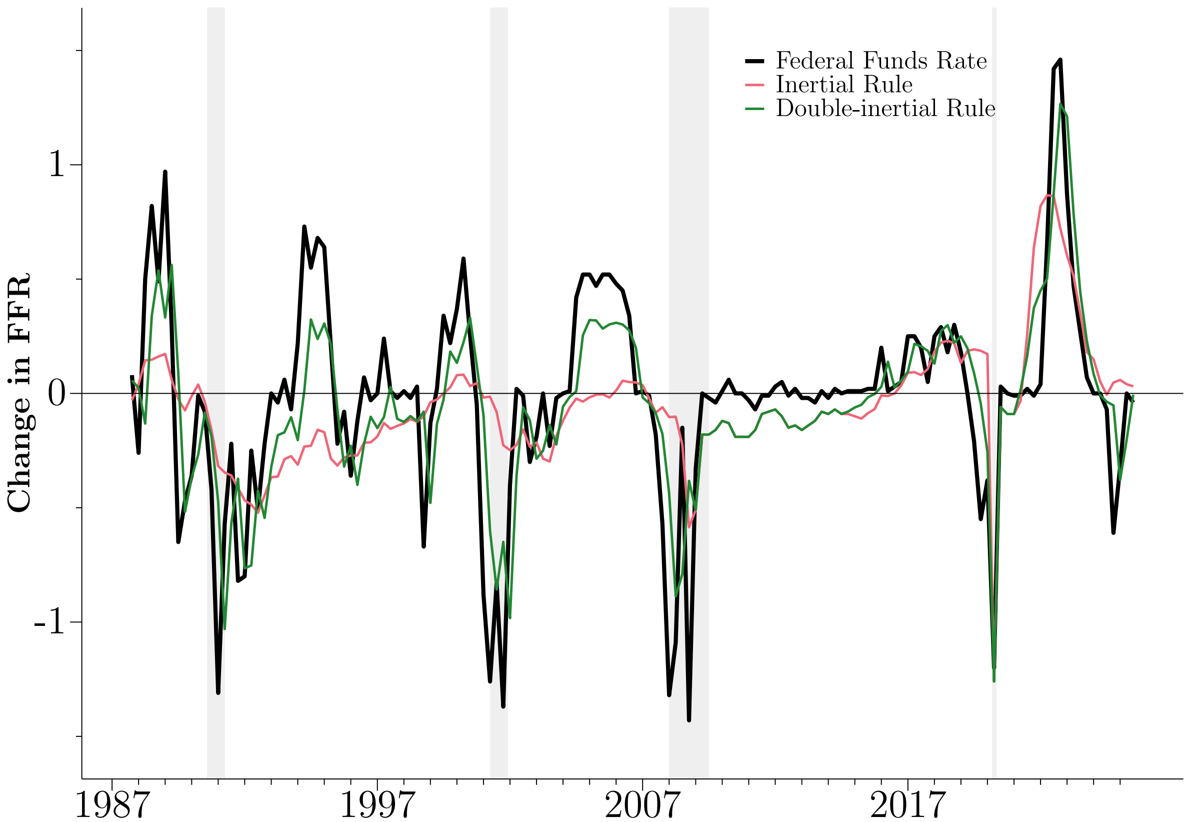


Note: This figure displays the one-quarter-ahead predictions of the level of the federal funds rate from 1987:Q4 through 2025:Q3 for each specification in Section 2. The black line plots the realized quarterly averages of the effective federal funds rate over the same period. All rules are estimated over the full 'Post-1987' sample using Tobit regressions. The prediction in quarter t is computed using the realized values of π_t, u_t, and u_t^*, the relevant lagged values of the federal funds rate, $\pi^* = 2$, and the estimated parameters $\hat{r}^*$, $\hat{\beta}_\pi$, $\hat{\beta}_u$, $\hat{\rho}$, and $\hat{\gamma}$ from Table 1.
Source: FRED.

These values are reported in the R^2_Δ columns of Table 2. In the pre-2007 sample, the explanatory power of the estimated single- and double-inertial rules differ markedly. The single-inertial rule explains only 30 percent of the variation in changes in the federal funds rate, while the double-inertial rule explains 59 percent. The same pattern appears in the full sample, where the single-inertial rule explains 27 percent of the variation in policy rate adjustments and the double-inertial rule explains 57 percent. The double-inertial rule's superior explanatory power strongly supports our thesis that gradualism in monetary policy encompasses persistence in the *pace* of policy adjustments in addition to the level of the policy rate.

The implications of this finding are substantial. Imagine a policymaker who, given the current stance of policy, uses a rule to set the federal funds rate in the next period. Using a conventional single-inertial Taylor rule, the implied adjustments would bear only a limited resemblance to actual policy. By contrast, augmenting the rule to capture

Figure 2: One-Quarter-Ahead Federal Funds Rate Adjustment Predictions for Estimated Rules



Note: This figure displays the predicted adjustments to the federal funds rate from 1987:Q4 through 2025:Q3 for the single- and double-inertial specifications in Section 2. The black line plots the realized changes to the quarterly averages of the effective federal funds rate over the same period. The rules are estimated over the full 'Post-1987' sample using Tobit regressions. The prediction in quarter t is computed using the realized values of π_t, u_t, and u_t^*, the relevant lagged values of the federal funds rate, $\pi^* = 2$, and the estimated parameters $\hat{r}^*$, $\hat{\beta}_\pi$, $\hat{\beta}_u$, $\hat{\rho}$, and $\hat{\gamma}$ from Table 1.
Source: FRED.

persistence in policy changes dramatically improves its ability to reproduce the actual pattern of adjustments. In effect, the double-inertial rule captures the empirical regularity that adjustments to the policy rate tend to be in the same direction and with a similar magnitude across successive meetings.

A visualization of this hypothetical over the extended post-1987 period is provided in Figure 2. The path of adjustments prescribed by the double-inertial rule closely tracks the realized adjustments to the policy rate, albeit with some delay and often with a moderate reduction in magnitude. The single-inertial rule, by contrast, captures little more than broad directional shifts in policy. An intuitive explanation follows easily from these results. In first-differences, the single-inertial rule is no longer guided by the past: movements are based on the deviation of the Taylor rule target from the policy rate, which strictly varies with economic fundamentals. The double-inertial rule, however, uses the previous adjustment as an anchor, effectively accelerating policy adjustments when the previous adjustment indicates the need for urgency, and curtailing them otherwise.

The importance of the pace of adjustments in explaining the federal funds rate is especially evident when comparing liftoff from the ELB in late 2015 to that of early 2022 in Figure 2. In 2015, the single- and double-inertial rules track the change in the federal funds rate quite closely. This is because the pace of policy adjustments were quite slow and inflation and unemployment remained near their respective targets. However, the double-inertial rule outperforms its single-inertial counterpart in 2022 when inflation was well above target and the pace of adjustments in the policy rate was rapid. Because the coefficient on the level of the federal funds rate ρ is quite high in either specification, the immediate response to above-target inflation $(1-\hat{\rho})\hat{\beta}_\pi$ is low, which results in a relatively slower than realized pace of adjustments in 2022. The double-inertial rule suffers less from this problem, however, because it propagates the realized pace of rate increases Δi_{t-1} forward with a large coefficient γ.

Our final R^2 variant is designed to gauge the longer-term predictive power of the estimated policy rules at the one-year horizon. To calculate this "four-quarter levels" R-squared for a particular rule, we generate predictions of each rule conditional on the value of the policy rate four quarters ago. Specifically, we recursively generate four consecutive predictions from the rule using the data values of inflation and the unemployment rate gap as rule inputs, but where any lagged levels of the federal funds rate are taken from the previous rule prediction instead of the realized policy rate. We then evaluate the goodness of fit of the resulting four-quarter ahead prediction as:

$$R_4^2 = 1 - \frac{\sum_t \left(i_t - \hat{i}_{t|i_{t-4}}\right)^2}{\sum_t \left(i_t - \bar{i}\right)^2}, \tag{11}$$

where the prediction conditional on the realized policy rate at period s is defined as:

$$\hat{i}_{t|i_s} = \begin{cases} \max\{\underline{i}, \hat{\theta}_0 + \hat{\theta}_1\pi_t + \hat{\theta}_2(u_t - u_t^*) + \hat{\theta}_3\hat{i}_{t-1|i_s} + \hat{\theta}_4\hat{i}_{t-2|i_s}\} & \text{for } t > s \\ i_t & \text{for } t \leq s. \end{cases} \tag{12}$$

For $s = t-1$ this is just the rule itself ($\hat{i}_{t|i_{t-1}} = \hat{i}_t$), using lagged realized values of the policy rate as inputs. For $s > 1$ the rule prediction still uses current realized values of inflation and economic activity, but only uses realized values of the federal funds rate from s periods ago.

The four-quarter metric R_4^2 provides a more policy-relevant assessment of rule performance by putting the policy rule in place for longer than just one quarter. The resulting R-squared measure evaluates how well the rule would characterize policy decisions if a policymaker were to adhere consistently to the rule's prescriptions over a four-quarter period, allowing the rule itself to generate the path of interest rates endogenously in response to evolving economic conditions. This approach more closely approximates the manner in which policy rules would be employed as a systematic approach over multiple decision points, rather than as single-period adjustments.

The R_4^2 columns in Table 2 report the measures under each rule. Because non-inertial Taylor rules do not use lagged values of the policy rate to generate predictions, their predictions and R^2 values are unchanged from the simple next-quarter level R^2 values. They therefore serve as a useful benchmark against which to evaluate the deterioration in performance of the rules with inertial components. At 0.80 and 0.82 respectively, the explanatory power of the single-inertial rules falls by 16 to 17 percentage points in both subsets relative to the next-quarter levels predictions. The deterioration in explanatory power is similar for the double-inertial rules. These results highlight how imprecision surrounding the policy rate realizations compounds over time: four-quarter lagged realizations of the policy rate are substantially less correlated with current period settings than the most recent lag.

Table 2 also reports model log-likelihood based values of the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). Both criteria penalize the size of the model, imposing a tradeoff between goodness of fit and parsimony in selecting the best model. In both the pre-2007 and full samples, the double-inertial model is the clear winner, with substantially lower AIC and BIC values than its single-inertial counterpart. This additional evidence corroborates similar analysis by Coibion and Gorodnichenko (2012), and supports our claim that double inertia is an important component of monetary policy and should be included in Taylor rule specifications.

4.3 Comparison to autoregressive benchmarks

A natural concern, raised by Nakamura et al. (2025), is that the predictive performance of inertial rules merely reflects the well-known persistence of interest rates. After all, low-order autoregressive models often exhibit strikingly good forecast performance. To evaluate this view, we compare the single- and double-inertial rules to simple AR(1) and AR(2) benchmarks.

In Table 2, the AR(1) and AR(2) benchmarks perform virtually as well as the single- and double-inertial Taylor rules in terms of the one-quarter levels R^2 measure. The AR(2) benchmark, in particular, essentially matches the fit of the double-inertial rule and even slightly outperforms the single-inertial rule, achieving an R^2 of 0.98 in both the pre-2007 sample and the full sample. Remarkably, this implies that the second autoregressive term is more useful for next-quarter predictions than the inclusion of economic fundamentals, highlighting the quantitative importance of inertia in the rate of change of the policy rate.

For the one-quarter change measure R_Δ^2, the relative advantage of the AR(2) benchmark over the single-inertial Taylor rule is further emphasized. In the full sample, the AR(2) benchmark explains 50 percent of the variation in changes to the federal funds rate, corresponding to a 23 percentage point advantage, which is almost twice the magnitude of explanatory power retained by the single-inertial rule in this space. This AR(2) benchmark, based solely on recent realizations of the policy rate, substantially outperforms a single-inertial rule grounded in economic fundamentals.

The values of the AIC and BIC criteria for the AR(2) benchmark further support this implication. In both samples, these criteria suggest that the parsimonious AR(2) specification outperforms the standard-inertial rule. However, the double-inertial rule retains a slight advantage over the AR(2) benchmark, particularly in the full post-1987 sample, confirming that it provides the best overall fit among the models tested.

While it is true that inflation and the unemployment gap do not contribute meaningful additional predictive power at the one-quarter horizon once lags of the policy rate are included, short-term forecasts are not the sole purpose of Taylor rules. Interest rate rules are meant to describe salient considerations facing policymakers, and to be interpreted in a context where the rule is in place over a longer period. Indeed, when we observe the course and direction of our Taylor rules and the settings of the policy rate over a longer horizon, the importance of economic fundamentals in guiding policymaking becomes far more evident.

From the R_4^2 columns of Table 2, it can be seen that the four-quarter measure R_4^2 for the AR(2) rule falls to 0.70 in the pre-2007 sample and 0.76 in the full sample, both of which are substantially lower than those of the single- and double-inertial rules. Over the one-year horizon, a forecaster would be much better off assuming that policymakers follow a single-inertial Taylor rule than by generating forecasts based only on recent realizations of the policy rate. In other words, at the one-year horizon, the contribution of economic fundamentals to policymaking appears to outweigh that of double inertia. This result is both intuitive and reassuring: economic conditions should be the primary guide for the path of policy, while the influence of gradualism naturally diminishes over longer horizons.

Another way to view the greater importance of economic fundamentals over longer horizons is to compare the AR(2) benchmark with the double-inertial rule. As illustrated in Figure 3, neither rule perfectly tracks the realized policy rate at the four-quarter horizon, and both exhibit some degree of phase shift relative to the realized path. However, their difference becomes particularly apparent following liftoff from the effective lower bound. Through the late 2010s and early 2020s, the prescriptions of the double-inertial rule move almost contemporaneously with the realized path of policy, while the AR(2) rule responds with over a year of delay.

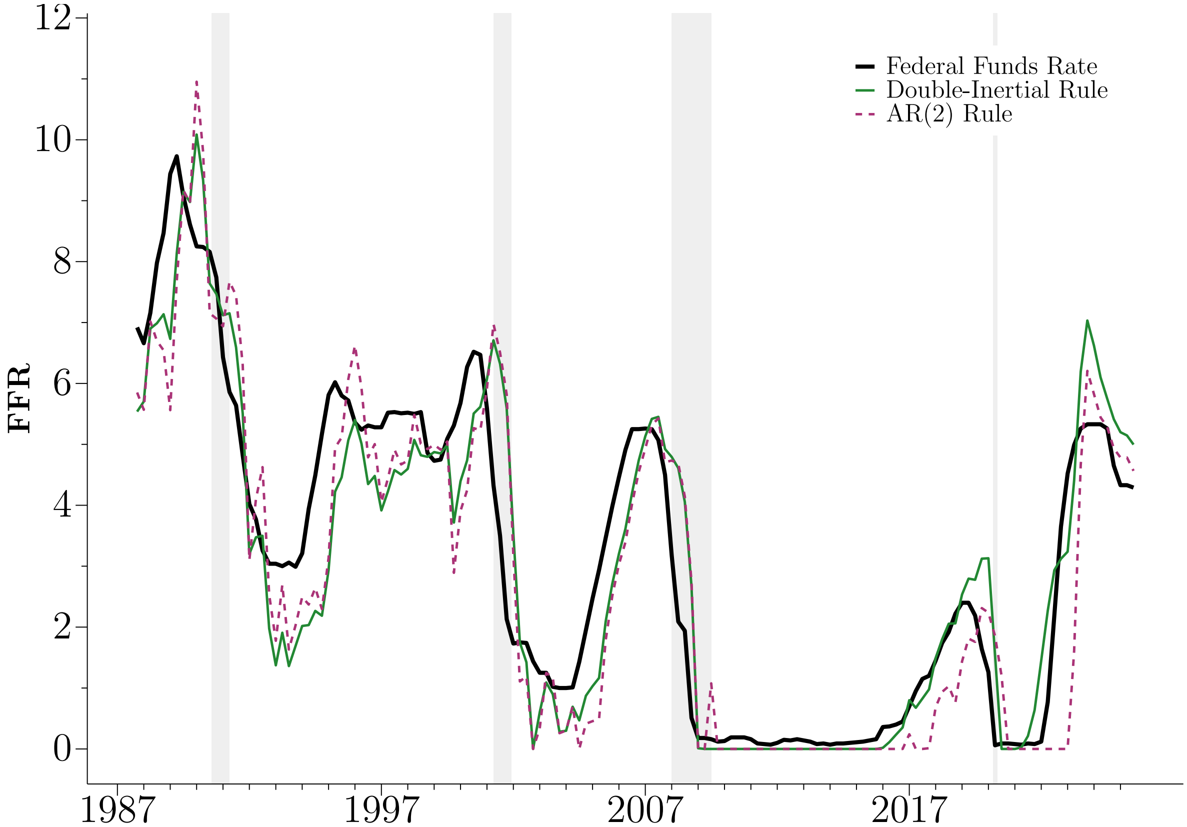
4.4 Policy inertia before gradualism

Whereas the evidence presented thus far supports double inertia as a description of gradualism in U.S. monetary policy over the last four decades, we now document that there is no evidence for double inertia in the pre-1987 period. This is consistent with Duffee (2026) documenting that inertia in U.S. monetary policymaking increased in the early 1990s.

We report the estimated parameters for each of our Taylor rules in the pre-1987 sample in Table 3. With the exception of the unemployment gap coefficient for the non-inertial rule, the estimates imply a policy reaction function that responds to economic developments in the anticipated direction and with reasonable magnitudes.

However, the estimated value of the double-inertial coefficient, γ, contrasts sharply with the estimates acquired in the more recent samples. At 0.17, the coefficient has less than a third of the magnitude of its equivalent in both post-1987 samples, suggesting a vastly reduced persistence in policy rate changes over the period. We fail to reject the null hypothesis that the double-inertia parameter is equal to zero. Nevertheless, there is

Figure 3: Year-ahead Federal Funds Rate Predictions for Estimated Rules



Note: This figure displays the year-ahead predictions for the level of the federal funds rate from 1987:Q4 through 2025:Q3 for the AR(2) and double-inertial specifications in Section 2. The black line plots the realized quarterly averages of the effective federal funds rate over the same period. The rules are estimated over the full 'Post-1987' sample using Tobit regressions. Year-ahead predictions are constructed recursively, with predicted federal funds rate values replacing realized lagged rates in subsequent forecast steps. The predictions are conditional on realized values of π, u, and u^* over the forecast horizon, use $\pi^* = 2$, and use the estimated parameters from Table 1. See Section 4.2 for details. *Source*: FRED.

still evidence for persistence in the level of the policy rate, as indicated by the estimates of ρ.

These results suggest that double inertia plays little role in describing the dynamics of policy rate adjustments prior to the late 1980s shift toward gradualism. It is only in the more recent period that the evidence for double inertia emerges.

5 Robustness

In this section, we carry out an assortment of robustness exercises to ensure that our primary empirical result, namely the predictive importance of double inertia in Taylor rules over the last few decades, is not specific to our particular data and procedures. We conduct two types of robustness checks. First, we vary the sample period across five

Table 3: Recovered Rule Parameters, Pre-1987 Sample

Parameter	(1) Non-inertial	(2) Single-inertial	(3) Double-inertial
$\hat{r}^*$	2.23	2.12	2.26
	(0.40)	(1.34)	(1.05)
$\hat{\beta}_\pi$	1.15	1.48	1.31
	(0.21)	(0.63)	(0.57)
$\hat{\beta}_u$	0.03	-2.17	-1.25
	(0.25)	(1.38)	(0.73)
$\hat{\rho}$		0.90	0.88
		(0.05)	(0.04)
$\hat{\gamma}$			0.17
			(0.11)
N	111	111	111

Note: This table presents estimates for the specifications detailed in Section 2. The rules are estimated using quarterly data from FRED, as detailed in Section 3. Parameters $\hat{r}^*$, $\hat{\beta}_\pi$, $\hat{\beta}_u$, $\hat{\rho}$, and $\hat{\gamma}$ are recovered from the regression coefficients, and Newey–West standard errors with a lag length of 4 are computed via the delta method. The 'Pre-1987' sample runs from 1960:Q1 to 1987:Q3, and is estimated with OLS.

alternative windows, with the resulting performance for each Taylor rule variant reported in Table 4. Second, we modify the data construction in three ways: using real-time data, shadow rates during ELB periods, and the output gap instead of unemployment gap, with results reported in Table 5.

5.1 Sample periods

We create the first two robustness samples by adjusting the starting date for our main samples from 1987:Q4 to 1983:Q1. This extended window captures the second half of Paul Volcker's term as Chair of the Federal Reserve, a period associated with enhanced central bank credibility, reduced inflation expectations, and macroeconomic stability. Gradualism in the United States is sometimes interpreted as beginning during the Great Moderation in the mid 1980s. In this extended sample, the double-inertial rule still explains more than twice the variation in changes to the policy rate than the single-inertial rule.

The next robustness sample covers exactly the extended window from the main specification, running from 1987:Q4 through 2025:Q3. However, rather than running a Tobit regression to address the censorship of the ELB, we run an OLS regression on the subset of the sample that *excludes* ELB windows. This exercise serves to ensure that our evidence for double inertia is not merely a product of a censored regression. Again, our findings prove robust, with the double-inertial rule explaining an additional 28 percentage points of variation in changes to the federal funds rate than can the single-inertial rule.

The penultimate robustness sample reports results estimated from 2007:Q1 through 2025:Q3. As previous work on double inertia has reported primarily on the period prior to 2007, this window corresponds exclusively to the window of new data that our extended specification offers. Here, the relevance of smoothing the pace of changes in policy rate settings remains, as the double-inertial rule is able to explain substantially more variation in changes to the policy rate than can the single-inertial rule. However, relative to other specifications, general explanatory power rises and the advantage is somewhat reduced. The federal funds rate was held at the ELB for much of the period, and thus there was substantially less variation, which can, in part, account for this finding.

Finally, we report results for a specification including the entire sample, running from 1960:Q1 through 2025:Q3. Here, the benefits from including double inertia in the specification are quite small. This comes as no surprise, however, as the results simply reflect how the inclusion of the pre-gradualism window in the sample dominates the positive results in recent decades. This finding once again highlights the connection between double inertia and monetary policy gradualism.

5.2 Data construction

For our second set of robustness exercises shown in Table 5, we use our main sample from 1987:Q4 to 2025:Q3 and consider several alternative data series. Overall, each exercise supports the finding that the double-inertial rule outperforms its single-inertial counterpart.

Table 4: Model Fit Statistics, Additional Samples

Subset	Statistic	Non-inertial	Single-inertial	Double-inertial	AR(1)	AR(2)
Post-1983, Pre-2007	R^2	0.68	0.96	0.97	0.96	0.97
	${R^2}_\Delta$	-5.97	0.14	0.38	0.03	0.32
	BIC	223.43	27.10	0.00	29.87	-0.42
Post-1983 Tobit	R^2	0.41	0.98	0.98	0.97	0.98
	${R^2}_\Delta$	-20.92	0.19	0.41	-0.05	0.34
	BIC	512.58	37.57	0.00	77.05	17.20
Post-1987, No ELB	R^2	0.33	0.97	0.98	0.95	0.98
	${R^2}_\Delta$	-12.30	0.31	0.59	0.03	0.55
	BIC	395.51	56.41	0.00	86.91	2.30
Post-2007 Tobit	R^2	0.50	0.98	0.98	0.94	0.97
	${R^2}_\Delta$	-8.37	0.56	0.71	-0.22	0.48
	BIC	145.53	13.67	0.00	62.39	27.29
Full Sample Tobit	R^2	0.58	0.95	0.95	0.94	0.95
	${R^2}_\Delta$	-6.31	0.12	0.16	-0.02	0.06
	BIC	517.64	0.92	0.00	44.07	32.10

Note: The reported statistics are for the estimated models described in Section 2. Predictions below 0 are truncated for the calculation of the goodness of fit measures. R^2 measures fit for one-quarter-ahead levels of the FFR, and ${R^2}_\Delta$ measures fit for one-quarter-ahead changes. The computation procedures are detailed in Section 4.2. BIC is computed from the model log-likelihoods and normalized to zero for the double-inertial model. Sample periods are as specified in Section 5.1.

First, in the spirit of Orphanides (2001), we replace our "realized" measures of the inflation and unemployment gaps with real-time data constructed using the Philadelphia Fed's Tealbook (formerly Greenbook) Data Set. Specifically, for each quarter, we average the nowcasts from all Greenbooks released during that quarter for the NAIRU and UNEMP variables, using the resulting series to construct a real-time measure of the unemployment gap. We similarly average the quarterly nowcasts for the PCPIX and PPCEX variables, stitching the two inflation series together in 2000 to construct a real-time measure of inflation. These alterations eliminate potential endogeneity concerns stemming from ex-post revisions, and allow us to model policy responses as a function of the data that policymakers observed in real time. However, because of limitations on available information in this dataset, our estimation window is restricted from 1989:Q1 to 2020:Q4. The top panel of Table 5 shows that the single-inertial rule is able to explain only 24 percent of variation in changes to the federal funds rate over the period while the double-inertial rule is able to explain 53 percent.

Next, we use data on the shadow Fed Funds rate of Wu and Xia (2016) to replace our observations for the effective federal funds rate during the ELB periods in the 1987 through 2025 sample. Because the shadow rate provides a plausible, uncensored proxy for the latent policy rate over the ELB episodes, we use OLS rather than Tobit regression. This exercise allows us to incorporate information about the latent stance of policy derived from a term-structure model and Treasury yields into our analysis. The middle panel of Table 5 shows that the single- and double-inertial rules achieve next-quarter change R^2 values of 0.22 and 0.54, respectively, such that the double-inertial rule again outperforms the single-inertial rule.

Finally, we test the robustness of our results to an output-gap based Taylor rule specification as opposed to the unemployment-gap based specification in our main results. To construct our output-gap measure, we simply calculate percent deviations between the GDPC1 and GDPOT measures from the St. Louis FRED database. The bottom panel of Table 5 shows that the output-gap based versions of the rules both performed even better, and the double-inertial rule maintained its advantage in the next-quarter changes R^2 metric. That is, at 0.59, the double-inertial rule explains an additional 27 percentage points of variation in changes to the federal funds rate over the relevant period as compared to the standard single-inertial rule.

Both the quantitative significance of these results from alternative data constructions and their implications for the prevalence of double inertia in monetary policy are nearly identical to the previous results reported for our main findings.

6 Conclusion

In this paper, we studied the descriptive performance of the double-inertial Taylor rule in characterizing U.S. monetary policy. While the standard single-inertial Taylor rule models policy rate settings as based on partial adjustments towards an intermediate rate target prescribed by an embedded Taylor rule, the double-inertial rule also incorporates persistence in past changes to the policy rate. In this sense, the double-inertial rule

Table 5: Model Fit Statistics, Robustness Exercises

Exercise	Statistic	Non-inertial	Single-inertial	Double-inertial	AR(1)	AR(2)
Real-time Data	R^2	0.78	0.98	0.99	0.97	0.98
	${R^2}_\Delta$	-6.73	0.24	0.53	-0.05	0.46
	BIC	274.76	41.55	0.00	75.66	14.51
Wu-Xia Shadow Rate	R^2	0.39	0.98	0.99	0.97	0.99
	${R^2}_\Delta$	-20.72	0.22	0.54	0.01	0.47
	BIC	479.56	48.33	0.00	81.79	6.76
Output-gap Specification	R^2	0.47	0.98	0.99	0.97	0.98
	${R^2}_\Delta$	-16.52	0.32	0.59	-0.07	0.50
	BIC	460.13	54.82	0.00	109.29	23.03

Note: The reported statistics are for the estimated models described in Section 2. Predictions below 0 are truncated for the calculation of the goodness of fit measures. R^2 measures fit for one-quarter-ahead levels of the FFR, and ${R^2}_\Delta$ measures fit for one-quarter-ahead changes. The computation procedures are detailed in Section 4.2. BIC is computed from the model log-likelihoods and normalized to zero for the double-inertial model. Sample periods and exercises are as specified in Section 5.

captures a more nuanced picture of how gradualism in monetary policy may operate by suggesting that policymakers are interested in smoothing both the level and the pace of change of the policy rate.

Over the post-Volcker period, the double-inertial Taylor rule explains more than double the variation in policy rate changes than its single-inertial counterpart. This result supports the interpretation of monetary policy gradualism as persistence in both the level and pace of adjustments in the policy rate. In addition, the exceptional performance of our $AR(2)$ benchmark underscores the importance of the pace of changes in the short term, though our findings also confirm the greater explanatory power of fundamentals over longer horizons. Finally, we document that double inertia was considerably weaker in the period preceding Volcker's resignation, a finding consistent both with structural changes in monetary policy identified in the existing literature and our interpretation of our results in the context of gradualism.

The explanatory power of double-inertial Taylor rules has important implications for policymakers, private agents, and researchers. Our results suggest that the current practice of modeling monetary policy through a single-inertial rule in estimated New-Keynesian models should be revisited to avoid model misspecification, especially when including liftoff from the ELB in 2022. Furthermore, policy analysis and forecasting in central banks and the private sector should consider a double-inertial rule when characterizing U.S. monetary policy. Future research could extend the analysis to other countries and study the normative implications of smoothing the rate of change, rather than just the level, of the policy rate.

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