



# Monetary Policy Report: Using Rules for Benchmarking

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#### Introduction

This special report highlights ongoing work to benchmark the stance of monetary policy using a range of policy rules that are widely employed in studies of monetary economics.<sup>1</sup> We perform this exercise with a structural forecasting model based on the New Keynesian dynamic stochastic general equilibrium methodology. We then employ this model to explore the expected behavior of economic variables, including the policy rate, under alternative policy rules. The policy rules help to benchmark the current stance of the federal funds rate, and they provide guidance on how the path of policy is likely to evolve in the context of the model. Such an exercise as part of a more comprehensive quarterly monetary policy report would enhance communication and promote a more systematic approach to monetary policy.

We begin with an overview of the economy and then discuss the benchmark model we use to generate our forecasts.

#### **Economic Overview**

Inflation has continued to moderate since our last Monetary Policy Report in June. Trends in payroll employment and real wages suggest an improving balance between supply and demand in the labor market. At the same time, consumption and investment have shown remarkable resilience in the face of increases in interest rates over the past year, giving rise

<sup>&</sup>lt;sup>1</sup> The views expressed in this report are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. We thank Anna Benoit and Riley E. Thompson for their assistance.

to significant upward revisions to expected third-quarter real GDP growth. Housing and manufacturing have been retrenching in the face of tighter monetary policy. Salient risks to the near-term prospects for economic growth are posed by the United Auto Workers (UAW) strike and the possibility of a government shutdown in October.

Most measures of core inflation have continued to moderate over the last few months. The three-month average of core CPI inflation was 2.4 percent (SAAR) in August while the three-month average of core PCE inflation was 2.9 percent (SAAR) in July. Headline inflation is getting a boost from a runup in oil and gasoline prices. However, medium- and longer-term inflation expectations remain anchored. Compared to a year ago, headline CPI inflation was up 3.7 percent in August while core inflation was up 4.3 percent. This remains significantly higher than the FOMC target of 2 percent. As of August, goods price inflation has moderated significantly over the past year. While shelter inflation has begun to ease, the pace of easing is modest and is running at about a 7 percent pace (yoy). Inflation in core services excluding housing remains elevated at about 4 percent (yoy). Wage growth has decelerated but remains higher than prepandemic levels. Real wages reacted in a sluggish manner to the postpandemic rise in inflation but have been catching up. Real hourly earnings for all workers are now less than 2 percent below trend, while real wages for production and nonsupervisory workers have essentially caught up to trend.

Labor market tightness is easing but remains significant. Nonfarm payrolls rose by 185 thousand in August, and the three-month average gain for the period ended in August was 150 thousand jobs per month. This compared to a long-run natural rate of job growth of around 100 thousand jobs per month. The education and health services sector has been a big contributor to job growth and added about 100 thousand jobs in August. Leisure and hospitality and construction have added notably to employment growth over the past three months as well. The unemployment rate moved up to 3.8 percent in August from 3.5 percent in July, the highest reading since February 2022. However, with most estimates of the natural rate of unemployment at around 4 percent, the labor market remains in healthy shape. The labor force participation rate and the employment-to-population ratio have continued to edge up as workers return to the labor force. However, both remain somewhat below their prepandemic peaks.

Real GDP grew by 2.1 percent in the second quarter, driven by growth in personal consumption expenditures of 1.7 percent. The strength of consumer spending in the face of a rapid increase in interest rates over the past year has been something of a surprise. Consumption growth slowed in July, rising 0.2 percent. On a year-over-year basis, nominal consumption rose 5.9 percent in August compared to 6.2 percent in July. Real personal spending rose 0.6 percent in July. Retail sales surprised to the upside in August, rising 0.6

percent. Outsized growth in August retail sales was driven by a surge in spending on gasoline. Over the last two months, sales of bigger-ticket items such as motor vehicles and parts, furniture, electronics, and appliances has been flat to decreasing. Sales of new light vehicles pulled back in August to 15 million units from 15.7 million in July. Growth in average transaction prices for new vehicles has slowed but remains nearly 20 percent the 2019 average. However, the UAW strike poses a significant threat to the recovery in auto production.

Sales of new homes have continued to grow while sales of existing homes are near the lowest levels recorded in more than a decade. New single-family home sales for July were at a level near the top end of the prepandemic range and, compared to a year ago, were up more than 32 percent. Existing home sales remain anemic, having fallen in July and thus extending a slide that began in February 2023. However, the price of existing homes has held up, and are up nearly 4 percent relative to a year ago. Lack of inventory is the driving factor in these price dynamics.

To conclude, the pace of economic activity appears to be healthy overall, though some risk to near-term growth is present in the UAW strike and a possible federal government shutdown. Past and prospective monetary tightening will continue to weigh negatively on economic prospects, especially in interest-sensitive sectors. The labor market remains healthy and is coming into better supply and demand balance. So far, the consumer has proven surprisingly resilient to higher interest rates. At present, risks remain to the upside for inflation and balanced for growth. The view that future economic activity is likely to soften is reflected in FOMC members' September projections of economic activity, which continue to anticipate modest growth and above-target inflation. This year's median expected real GDP growth is now at 2.1 percent for 2023, falling to 1.5 percent for 2024. The unemployment rate is expected to average 3.8 percent in the fourth quarter of 2023, rising to 4.1 percent in the fourth quarter of 2024. Expectations for PCE inflation are at 3.3 percent for headline and 3.7 percent for core in 2023, falling to about 2.5 percent in 2024. The median participant sees the federal funds rate reaching 5.6 percent at the end of 2023 and 5.1 percent at the end of 2024.

# The Benchmark Model

To create our forecast, we use a structural forecasting model based on the New Keynesian dynamic stochastic general equilibrium (NKDSGE) methodology, which is at the forefront of macroeconomic modeling and forecasting. Our model features households and firms that are forward-looking and that make decisions while facing resource constraints. The model includes a labor market in which firms and households engage in search-and-matching behavior—allowing us to model the unemployment rate in a meaningful way. The model features a rich menu of shocks as well as adjustment costs that make wages and prices less

than fully flexible in responding to changes in economic conditions. We have added additional shocks to the model to account for the pandemic—but we have not changed the model's structural equations in response to the pandemic. Implicit in this view is that the structure of the economy has returned to a prepandemic state now that the virus has been mitigated. While through the lens of our model some economic effects of the pandemic linger, this forecast is largely based on the economy's prepandemic structure. Detailed documentation on the model structure is available from the authors upon request.

The underlying baseline policy rule in the model is a response function of the form

$$R_{t} = \rho R_{t-1} + (1-\rho) [\Psi_{\pi}(\pi_{t|t-4} - \pi^{*}) + \Psi_{y} y gap_{t} + T(\text{T-year-}\bar{\pi}_{t} - \pi^{*})] + \varepsilon_{t}^{R},$$

where  $R_t$  is the deviation of the effective federal funds rate from its long-run equilibrium value,  $\pi_{t|t-4}$  is the four-quarter change in core PCE inflation (the one-year-average inflation rate),  $ygap_t$  is a measure of the output gap, T-year- $\bar{\pi}_t$  is the T-year-average inflation rate at an annual rate, and  $\varepsilon_t^R$  is a monetary policy shock.<sup>2</sup> The parameters  $\rho$ ,  $\Psi_{\pi}$ ,  $\Psi_y$ , and *T* determine how monetary policy reacts to economic conditions. We run forecast simulations under five different versions of the basic rule shown here:

Rule	ρ	$\Psi_{\pi}$	$\Psi_y$	Τ
Baseline	0.8	2.5	0.5	0.0
Taylor (1993)	0.0	1.5	0.5	0.0
Taylor (1999)	0.0	1.5	1.0	0.0
Inertial Taylor (1999)	0.85	1.5	1.0	0.0
Average Inflation Targeting	0.85	1.0	1.0	2.0

# Table 1

The baseline rule uses parameter values that are estimated from the data using the full NKDSGE model. That is, the baseline rule depicts the historical behavior of monetary policymakers.

# Model Forecasts Under the Baseline

The forecast is generated using observed data through the second quarter of 2023, together with an assumption of how output growth, inflation, the federal funds rate, and unemployment will fare in the third quarter of 2023. The forecast then begins in the fourth quarter of 2023 and

<sup>&</sup>lt;sup>2</sup> The model calibration implies that the long-run equilibrium value of the federal funds rate is 2.3 percent. The output gap is calculated using the flexible-price version of the model. The gap is then measured as the log difference of realized output from its flexible-price counterpart. For the baseline rule, the output gap is a growth gap—the deviation of realized output growth from its longer-run trend.

extends through the fourth quarter of 2026. The forecast under the baseline is shown in Figures 1–4. The baseline forecast is represented by the dark solid line. The colored bands around the baseline forecast represent 10 percent confidence intervals of the predictive distribution around the median of the baseline forecast.<sup>3</sup>

The key features of the baseline forecast are as follows:

- Real output growth is forecast to be 2 percent in 2023, 1.7 percent in 2024, 1.9 percent in 2025, and 2 percent in 2026, on a fourth quarter over fourth quarter basis. This represents a significant upward revision in the forecast for this year and an unchanged forecast for the remainder of the forecast horizon, compared to the June forecast.
- Core PCE inflation runs at a 3.6 percent pace in 2023, falling to 2.6 percent in 2024, 2.3 percent in 2025, and 2 percent in 2026, on a fourth quarter over fourth quarter basis. The forecast for this year is revised slightly downward compared to June.
- The unemployment rate is projected at 3.7 percent at the end of 2023 and is expected to rise over the forecast horizon, reaching 4.3 percent at the end of 2024, 4.6 percent at the end of 2025, and 4.9 percent at the end of 2026. This represents a downward revision of about 0.5 percentage point throughout the forecast horizon compared to June.
- The federal funds rate averages 5.3 percent in the fourth quarter of 2023, falling to 4.1 percent in the fourth quarter of 2024, 3.1 percent in the fourth quarter of 2025, and 2.4 percent by end-2026. This path is revised noticeably upward relative to June.

The forecast for output growth in 2023 is significantly stronger compared to the June forecast, as the economic data on consumption and investment have outpaced the model projections. Our forecast was made prior to the most recent FOMC meeting and prior to the UAW strike. The forecast for the federal funds rate is completely data determined according to the model's policy reaction function. The model path for the federal funds rate is below both the financial market expectation and the median forecast from the September Summary of Economic Projections (SEP). There remains a great deal of uncertainty about how the economy will evolve over the near term. Although the pandemic has abated both domestically and abroad, war in Europe, the possibility of a prolonged and broad-based strike by the UAW with spillovers to other sectors, a flare-up of the strains in the banking sector observed in the first half of this year, and the uncertainty about policy tightening lags suggest that forecast uncertainty remains elevated.

<sup>&</sup>lt;sup>3</sup> The forecast simulations are generated using Bayesian methods. The fan charts show 10 percent quantiles around the median of the posterior predictive distribution.

The model anticipates that output growth will be 2 percent in 2023 and then slow down to about 1.7 percent in 2024 and 1.9 percent in 2025, rebounding to 2 percent by the end of the forecast horizon. The model's current-quarter forecast of 2.4 percent is above the Survey of Professional Forecasters (SPF) median projection of 1.9 percent for the third quarter of 2023. The baseline model shows output growth decelerating next year to a pace that, on average, is about 0.7 percentage point below its long-run average, and subsequently gradually rebounding to reach 2 percent in 2026.<sup>4</sup>

The labor market is cooling, but it remains tight. The model anticipates that the unemployment rate will be at 3.7 percent at year-end and then will rise gradually over the forecast horizon to reach 4.9 percent at the end of 2026. This is above the model's natural rate of unemployment—i.e., the level of unemployment that the model returns to in the long run, which is 4.4 percent.

Recent data have shown that inflation is easing relative to a year ago. The model anticipates that core PCE inflation will run at a 3.6 percent pace in 2023. With tight monetary policy and below-trend output growth, inflation then moves down over the forecast horizon to average 2.6 percent in 2024, decreasing further to 2.3 percent in 2025 and 2 percent in 2026. Thus, the model anticipates that inflation will run somewhat above the FOMC target of 2 percent average inflation over the next two years.

The baseline forecast for 2023 is stronger on growth than the median projections from the third-quarter 2023 SPF. The median respondent expects real output growth of 1.9 percent in 2023. Looking ahead, on an annual average over annual average basis, the SPF expects 1.3 percent in 2024, 2.1 percent in 2025, and 1.7 percent in 2026. The projection for 2024 is below the implied annual average growth of our baseline forecast of 1.8 percent in 2024, but the SPF forecast for 2025 is above our projection, at 1.8 percent. At the end of the forecast horizon, the SPF expects less growth than our model implied growth rate of 2 percent. The SPF's core PCE inflation forecast is 3.7 percent (Q4/Q4) for 2023, edging down to 2.4 percent in 2024 and 2.1 percent in 2025. Thus, on inflation, the SPF forecast is roughly similar to the model baseline. The forecasters' path for the unemployment rate is lower over the forecast for the unemployment rate is 3.6 percent in 2023, increasing to 4 percent in 2024, peaking at 4.2 percent in 2025, and decreasing slightly to 4.1 percent in 2026.

The September 2023 SEP by FOMC participants shows the median projection for output growth at 2.1 percent in 2023, 1.5 percent in 2024, and 1.8 percent in both 2025 and 2026.

<sup>&</sup>lt;sup>4</sup> The model estimates long-run real per capita output growth of about 1.6 percent. We then assume that population growth averages 0.8 percent per year over the forecast horizon.

The median forecast of the unemployment rate is 3.8 percent at the end of 2023, 4.1 percent at the end of both 2024 and 2025, and 4 percent at the end of 2026. Core PCE inflation is projected at 3.7 percent in 2023, 2.6 percent in 2024, 2.3 percent in 2025, and 2 percent in 2026. The median Committee member forecast anticipates that the federal funds rate will reach 5.6 percent at the end of 2023 and then move down to 5.1 percent at the end of 2024, 3.9 percent at the end of 2025, and 2.9 percent at the end of 2026.

#### **Alternative Policy Rules**

With this edition of the Monetary Policy Report, we continue to analyze traditional alternative policy rules from the literature as prescriptions for the course of monetary policy over the next few years, as well as the average inflation targeting rule (described in Arias, Bodenstein, Chung, Drautzburg, and Raffo [2020]) under a two-year symmetric window, which we included in the June Report. As indicated in Table 1, the alternative rules are forms of the monetary policy rule described above, with differing weights on the inflation gap, the output gap, and the lagged interest rate. Although the Taylor 1993 and 1999 rules lead to outcomes similar to the baseline forecast, the inertial Taylor 1999 and the average inflation targeting rules lead to remarkably lower core inflation, lower real output growth, and a higher unemployment rate over the forecast horizon. Thus, these alternative rules would suggest policy should slow the real economy more than in the baseline to bring down inflation more quickly. This is especially pronounced for the average inflation targeting rule, shown in Figure 4, which implies a commitment to maintain a higher federal funds rate for longer in response to an extended period of above-target inflation. Under this rule, the federal funds rate peaks at 5.6 in the fourth quarter of 2023 and decreases only slowly thereafter. The Taylor 1999 rule also calls for an additional 25-basis-point increase in the federal funds rate in the fourth quarter, but the federal funds rate declines sharply in the first quarter of next year. The Taylor 1993 tracks the baseline in the second half of this year but calls for a 50-basis-point rate cut in the first quarter of 2024. Thus, both the Taylor 1999 and the Taylor 1993 rules have lower rates than in the baseline and do not slow the economy relative to the baseline forecast. The inertial Taylor rule, despite inducing a federal funds rate path closer to the baseline, quashes the output gap quickly, which is manifested in slower near-term output growth and a higher path for the unemployment rate. Consequently, inflation comes down by about the same order of magnitude as in the average inflation targeting rule. This works through the expectations channel as households act on the expectation that monetary policymakers will respond more aggressively to the output gap compared to the baseline. All else equal, the inertial Taylor rule implies that interest rates would remain high even after inflation and the output gap have been brought down. Instead, forward-looking households and firms adjust their demand and prices immediately, lowering the output gap and inflation, and increasing the unemployment rate,

allowing the monetary authority not to have to follow through on the threat of persistently higher rates.

#### Summary

The baseline NKDSGE model uses historical correlations in the data to generate its forecasts and does not incorporate significant judgmental adjustment. The NKDSGE model also does not explicitly account for any structural changes to the economy that may have been induced by the pandemic or the war in Europe. The model projects a near trend-like pace of output growth in 2023, followed by below-average growth over the next two years. Inflation eases gradually and runs above the FOMC target of 2 percent until the end of 2025. Forecast uncertainty remains very high as the economy deals with war in Europe, the effects of the UAW strike, tighter financial conditions, and the possibility of further strains in the banking sector. These factors are not incorporated into the model forecast. On balance, as in the June projection, the forecast continues to call for below-trend output growth and inflation above target over the next few years.



Figure 2: Core PCE Inflation





Figure 4: Federal Funds Rate











Figure 5c: Unemployment Rate



Note: Historical data have been retrieved from Haver Analytics.