

Monetary Policy Report: Using Rules for Benchmarking

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June 2023

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.¹ 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

Recent indicators continue to point to modest growth in production and spending. First-quarter 2023 real gross domestic product (GDP) growth is estimated to have been at a 1.3 percent pace. Incoming data point to somewhat slower growth for the second quarter, in the neighborhood of 1 percent. On the consumption side, household spending increased at a

¹ 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.

healthy pace in April after being flat in March. While real consumption expenditures were up 0.5 percent in April, the outsized gain is unlikely to be sustained. Total retail sales increased 0.4 percent in April after falling 0.7 percent in March, with light-vehicle sales continuing the string of increases we have seen over the past year. Real disposable income was flat in April after rising 0.2 percent in March. With consumption outpacing income, the personal saving rate dropped in April. In a potential signal of weaker spending ahead, consumer confidence deteriorated sharply in May. According to the Reuters/Michigan consumer sentiment index, consumer sentiment fell 7 percent in May amid worries about the path of the economy. Housing activity continued to slow, but it appears that the market may be bottoming out. Total housing starts rose 2.2 percent in April after falling 4.5 percent in March. Building permits fell in April due to weak multifamily activity, while single-family permits were up a bit over 3 percent. Existing home sales decreased 3.4 percent in April, while new single-family home sales rose a bit over 4 percent. Spending on private construction rose in April and was up about 7 percent compared to one year ago. House price appreciation continues to slow, though. The Federal Housing Finance Agency's price index rose for the third consecutive month in March, with year-over-year prices up 3.6 percent. However, in March the S&P CoreLogic Case-Shiller 20-city composite index posted its first year-over-year negative growth number since 2012.

Indicators tied to economic production continue to come in mixed. Industrial production rose 0.5 percent in April after being flat in both February and March. Capacity utilization edged up in April, and new orders for durable-goods manufacturers rose sharply. But the Institute of Supply Management (ISM) manufacturing composite index fell 0.2 percentage point in May and has now been below 50 (the expansion threshold) for seven consecutive months. The Philadelphia Fed Manufacturing Business Outlook Survey (MBOS) general activity index declined slightly in June to -13.7 from -10.4 in May. The MBOS current activity index has been below its nonrecessionary average since March 2022.

Against the slowing growth readings from the production and consumption sides of the economy, the labor market continues to show significant strength. Total nonfarm payroll employment increased by 339,000 jobs in May, and gains have averaged 280,000 over the last three months. Average hourly earnings increased modestly in May and are up 4.3 percent over the last year. The unemployment rate rose from 3.4 percent in April (its lowest reading since 1969) to 3.7 in May, which is still well below most estimates of the natural rate of unemployment. The Job Openings and Labor Turnover Survey (JOLTS) reported 10.1 million job openings on the last business day in April. While still at a very high level by historical standards, the job openings rate is now 1.3 percentage points lower than its peak in March 2022.

Inflation remains elevated. Core CPI inflation rose 0.4 percent in May, the same pace of growth as the previous six months. Headline CPI inflation rose only 0.1 percentage point in May as energy prices fell. Over the last 12 months, core CPI inflation is up 5.3 percent and headline CPI inflation is up 4 percent. Services inflation remains high and continues to be driven by the shelter component. However, removing energy and shelter from the services component of the CPI still leads to elevated inflation of 4.5 percent over the last 12 months, so the story for services inflation is more than just food, energy, and shelter. Core goods prices rose 0.6 percent in May and were up 2 percent over the previous 12 months. Personal consumption expenditures (PCE) core inflation was up 0.4 percentage point in April and 4.7 percent year-over-year. For the most part, the most recent readings on inflation indicators were in line with expectations and are not yet evidencing a decisive movement toward the Federal Open Market Committee's (FOMC's) 2 percent inflation target.

Financial market stresses that followed the banking sector turmoil in March are likely to result in tighter credit conditions for households and businesses over the near term. Consequently, economic activity, employment, and inflation may be somewhat weaker in the months ahead as the economy fights that headwind. The extent and magnitude of these effects remain highly uncertain, though, and it will take some time to see how the stresses play out.

To conclude, the pace of economic activity appears to be modest overall. Past and prospective monetary tightening will weigh negatively on economic prospects, especially in interest-sensitive sectors. However, the labor market remains historically healthy, and the consumer has so far weathered economic headwinds. At present, risks remain to the upside for inflation and balanced for growth. The view that future economic activity is likely to remain weak is reflected in FOMC members' 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 1 percent, while the forecasted unemployment rate at year's end came in at 4.1 percent. Expectations of inflation are at 3.2 percent for headline and 3.9 percent for core in 2023. The median participant sees the federal funds rate reaching 5.6 percent at the end of 2023 and 4.6 percent at the end of 2024. The brightest spot for the economy remains the labor market, with continued healthy gains in employment and a plentitude of job openings.

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

$$R_t = \rho R_{t-1} + (1 - \rho)[\Psi_\pi(\pi_{t|t-4} - \pi^*) + \Psi_y ygap_t + T(T\text{-year-}\bar{\pi}_t - \pi^*)] + \varepsilon_t^R,$$

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, $T\text{-year-}\bar{\pi}_t$ is the T-year-average inflation rate at an annual rate, and ε_t^R is a monetary policy shock.² The parameters ρ , Ψ_π , Ψ_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:

Table 1

Rule	ρ	Ψ_π	Ψ_y	T
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

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 first quarter of 2023, together with an assumption of how output growth, inflation, the federal funds rate, and unemployment will

² The model calibration implies that the long-run equilibrium value of the federal funds rate is 2.1 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.

fare in the second quarter of 2023. The forecast then begins in the third quarter of 2023 and extends through the fourth quarter of 2025. 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.³

The key features of the baseline forecast are as follows:

- Real output growth is forecast to be 0.9 percent in 2022, 0.9 percent in 2023, 1.6 percent in 2024, and 1.9 percent in 2025, on a fourth quarter over fourth quarter basis. This represents a modest upward revision in the forecast for the next year compared to March.
- Core PCE inflation runs at a 4.8 percent pace in 2022, falling to 3.8 percent in 2023, 2.7 percent in 2024, and 2.2 percent in 2025, on a fourth quarter over fourth quarter basis. The near-term path is revised upward compared to March.
- The unemployment rate stood at 3.6 percent at the end of 2022 and is expected to rise over the forecast horizon, reaching 4.1 percent at the end of 2023, 4.8 percent at the end of 2024, and 5.1 percent at the end of 2025. This represents a downward revision in the forecast compared to March.
- The federal funds rate averages 4.7 percent in the fourth quarter of 2023, falling to 3.4 percent in the fourth quarter of 2024 and 2.5 percent in the fourth quarter of 2025. This path is revised significantly upward relative to March.

The near-term forecast for output growth is a tad stronger compared to the March forecast, as the economic data on output have shown less of a slowdown than expected. Our forecast was made prior to the most recent FOMC meeting, and 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 the financial market expectation and the modal forecast from the June 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 further strains in the banking sector, and tighter credit conditions suggest that forecast uncertainty remains elevated. Longer-term interest rates have moved slightly upward since the end of March. The labor market remains healthy, with job openings at high levels, a low unemployment rate, and monthly employment gains running at a robust pace. Consumer confidence decreased, though, and inflation remains well above the FOMC's target.

³ 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 almost 1 percent in 2023 and then increase to about 1.6 percent in 2024 and 1.9 percent in 2025. The model's current-quarter forecast of 0.4 percent is below the Survey of Professional Forecasters (SPF) median projection of 1.0 percent for the second quarter of 2023.

The baseline model shows output growth running at a pace that, on average, is about 1 percentage point below its long-run average over the next three years.⁴ The unemployment rate rises gradually over the forecast horizon to reach 5.1 percent at the end of 2025. 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 on inflation have shown that it remains at an uncomfortably high level. The model anticipates that core PCE inflation will run at a 3.8 percent pace in 2023. With tight monetary policy and modest output growth, inflation then moves down, albeit slowly, over the forecast horizon to average 2.7 percent in 2024, decreasing further to 2.2 percent in 2025. Thus, the model anticipates that inflation will run above the FOMC target of 2 percent average inflation throughout the forecast horizon.

The baseline forecast for 2023 is stronger on growth than the median projections from the second-quarter 2023 SPF. The median respondent expects real output growth of 0.6 percent in 2023. Looking ahead, on an annual-average over annual-average basis, the SPF reports 1 percent in 2024 and 2.4 percent in 2025, slightly below the implied annual average growth of our baseline forecast of 1.3 percent in 2024, but above our projection for 2025 of 1.8 percent. The SPF's core PCE inflation forecast is 3.7 percent (Q4/Q4) for 2023, edging down to 2.3 percent in 2024 and 2.0 percent in 2025. Thus, on inflation, the SPF forecast is broadly similar to the model baseline. The forecasters' path for the unemployment rate is lower over the forecast horizon compared to the baseline: The median SPF forecast for the unemployment rate is 3.7 percent in 2023, increasing to 4.3 percent in 2024, and peaking at 4.4 percent in 2025.

The June 2023 SEP by FOMC participants shows the median projection for output growth at 1 percent in 2023, 1.1 percent in 2024, and 1.8 percent in 2025. The median forecast of the unemployment rate is 4.1 percent at the end of 2023 and 4.5 percent at the end of both 2024 and 2025. Core PCE inflation is projected at 3.9 percent in 2023, 2.6 percent in 2024, and 2.1 percent in 2025. 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 4.6 percent at the end of 2024 and 3.4 percent at the end of 2025.

⁴ 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.

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. This report adds the average inflation targeting rule described in Arias, Bodenstein, Chung, Drautzburg, and Raffo (2020). In this report, we use a two-year symmetric window. 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 similar outcomes to the baseline forecast, the inertial Taylor 1999 and the average inflation targeting rules lead to lower core inflation, lower real output growth (indeed, zero or negative output growth during the next quarter), and a higher unemployment rate over the forecast horizon. Thus, these alternative rules suggest policy should slow the real economy more than in the baseline to bring down inflation more quickly. This is especially the case 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 5.5 in the fourth quarter of 2023 and decreases only slowly thereafter. The Taylor 1999 and Taylor 1993 rules call for sharp spikes in the federal funds rate in the next quarter, which are undone in the following quarter. Consequently, they do not slow the economy relative to the baseline. The inertial Taylor rule, despite having a federal funds rate path closer to the baseline, is able to quash 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 weak output growth in 2023 and only modest, below-average growth over the next two years. Inflation eases slowly and runs above the FOMC target of 2 percent on average over the next three years. Forecast

uncertainty remains very high as the economy deals with war in Europe, 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 March projection, the forecast continues to call for below-trend output growth and inflation above target over the next few years.

Figure 1: Real GDP Growth

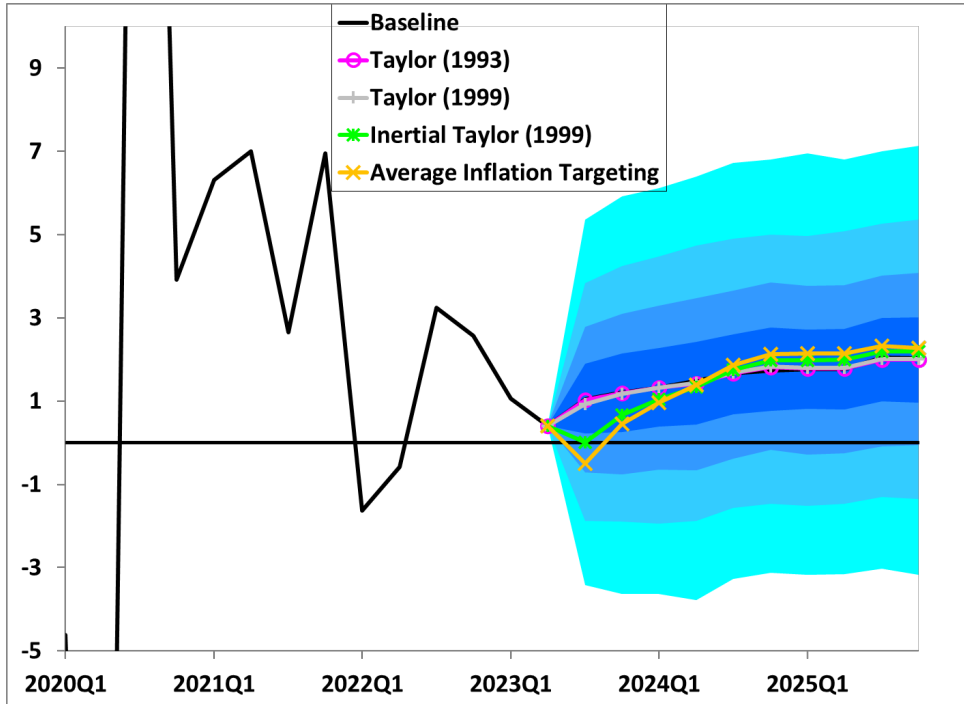


Figure 2: Core PCE Inflation

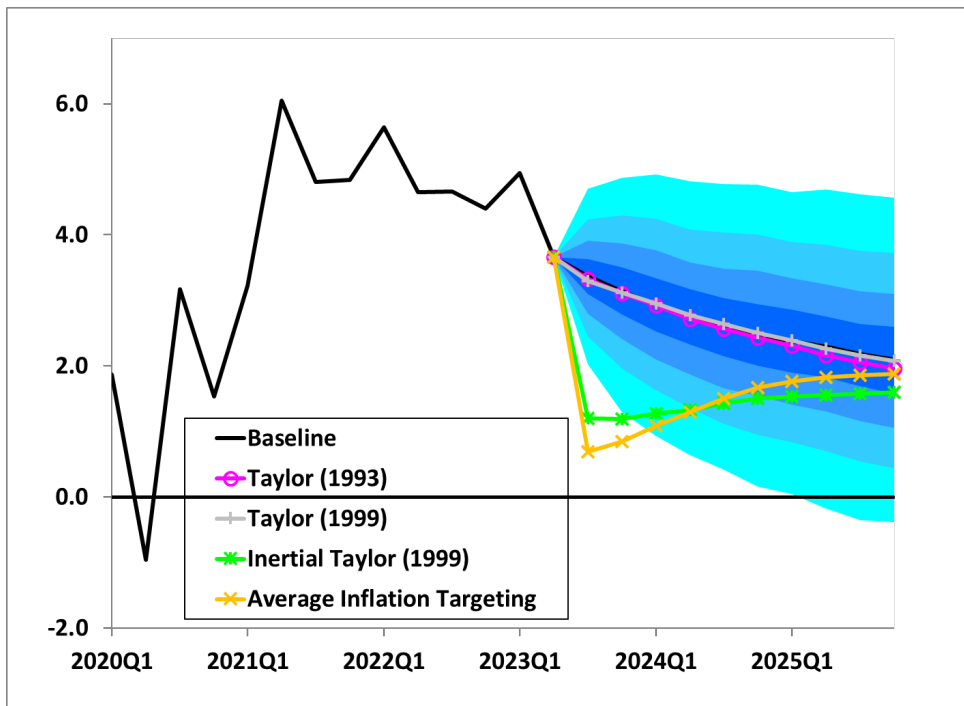


Figure 3: Unemployment Rate

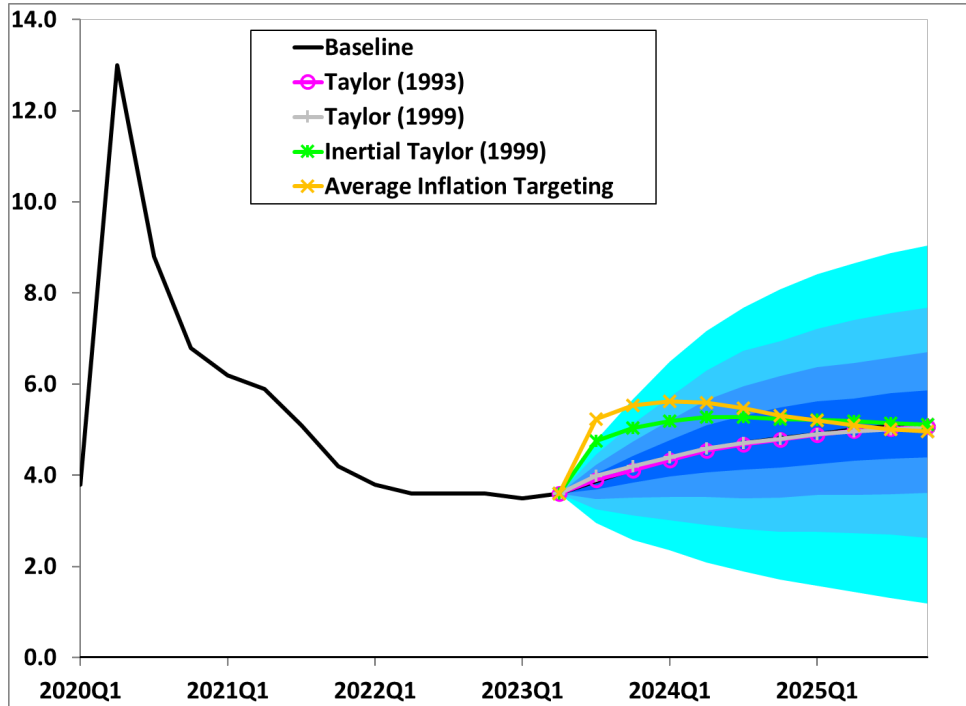


Figure 4: Federal Funds Rate

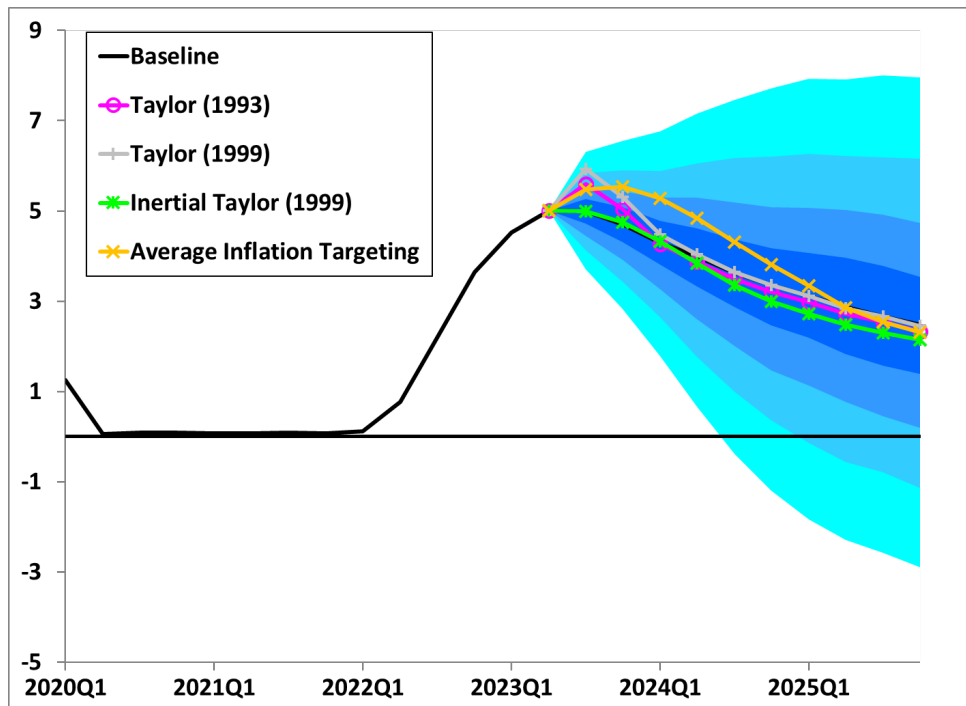


Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

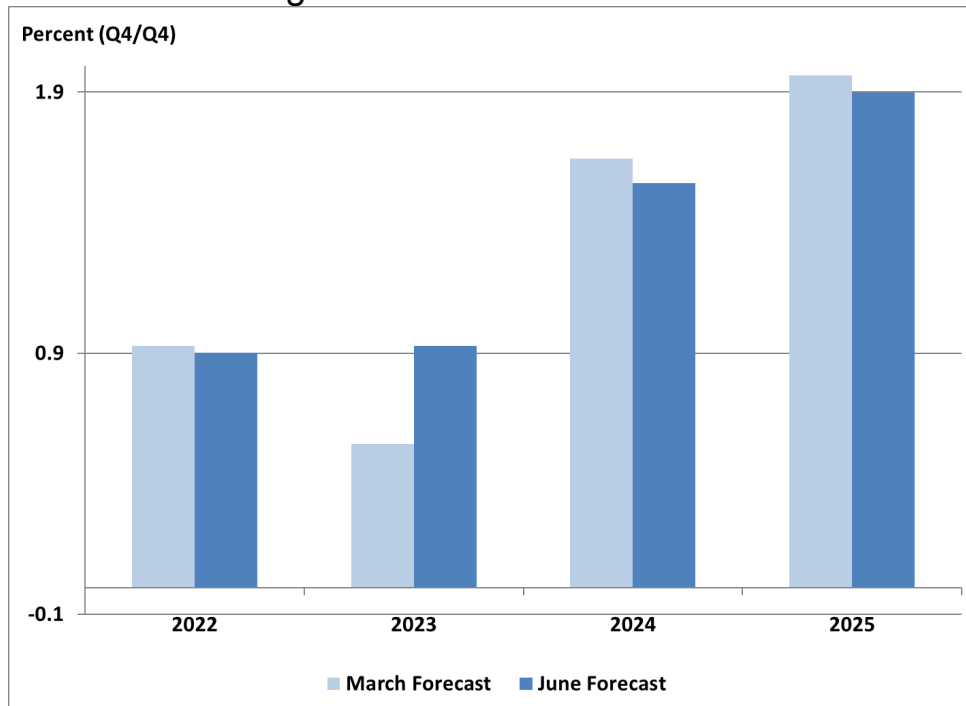


Figure 5b: Core PCE Inflation Growth

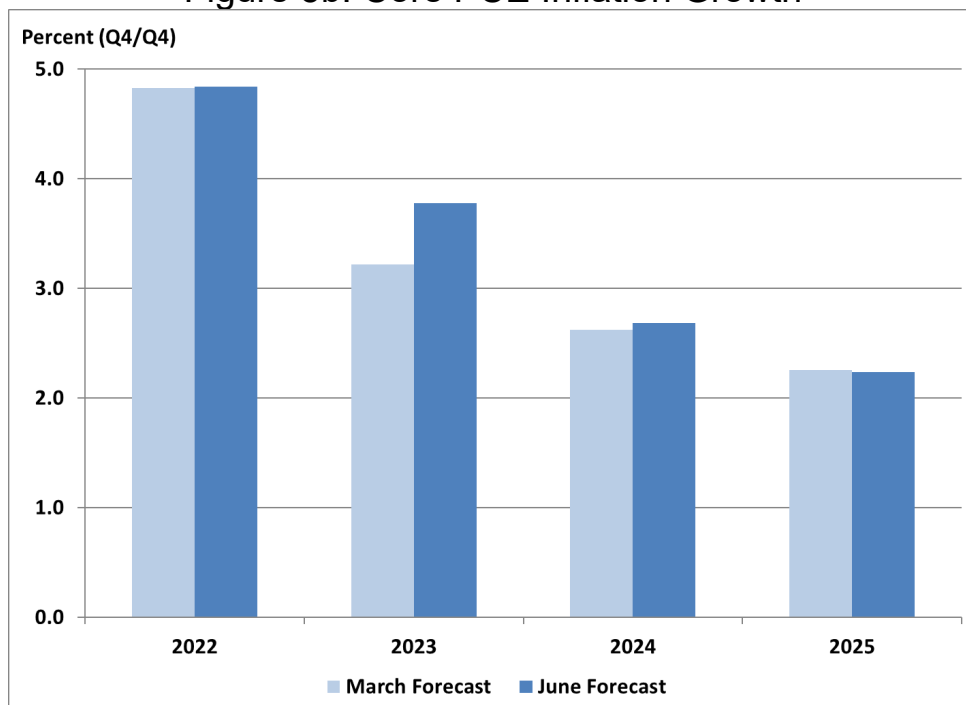


Figure 5c: Unemployment Rate

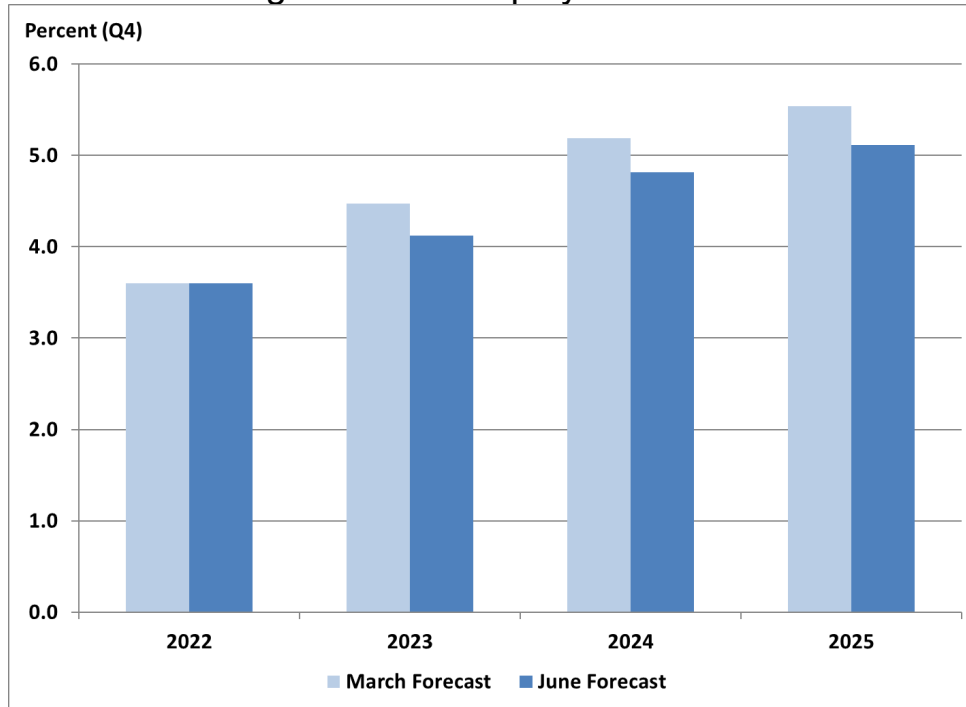
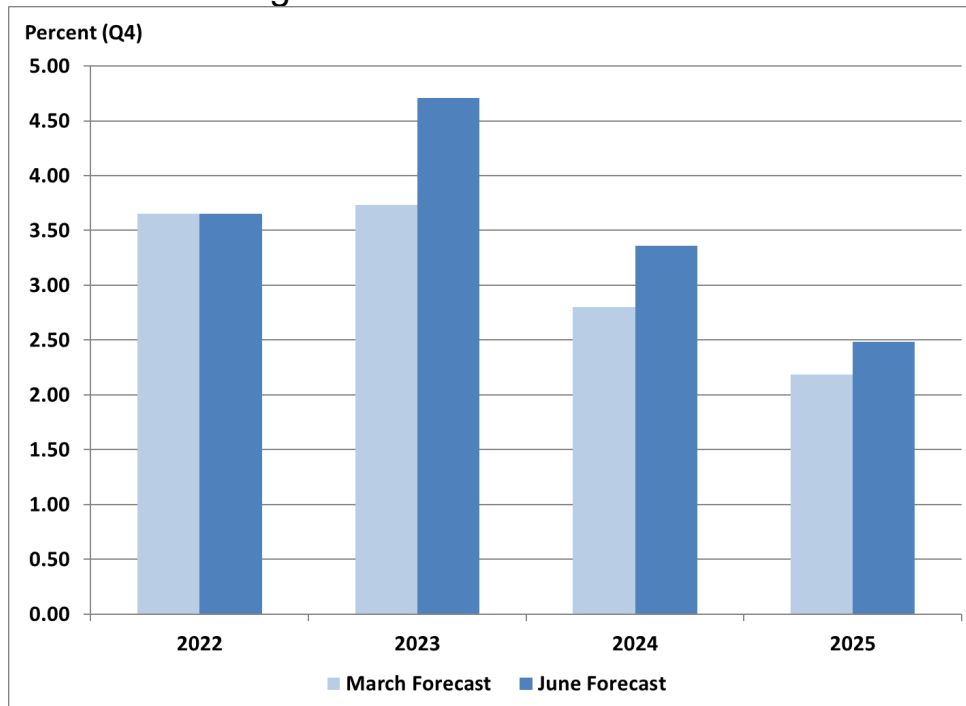


Figure 5d: Federal Funds Rate



Note: Historical data have been retrieved from Haver Analytics.