Monetary Policy Report:
Using Rules for Benchmarking

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June 2022

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. The forecasts are generated with the federal funds rate at its effective lower bound (ELB) throughout the forecast horizon.

Economic Overview

The most recent high-frequency data indicate that the economy is running out of steam. First-quarter growth was negative and current-quarter growth is tepid. Supply chains have yet to recover, and the periodic lockdowns in China are making it hard for them to normalize. Additionally, firms continue to face challenges in attracting and retaining workers, energy prices remain high, and the war in Ukraine is affecting the supply of key commodities. The

rise in mortgage rates is negatively affecting the residential real estate market, and business surveys, such as our own MBOS, are showing an increase in pessimism, which could negatively affect investment going forward. Inflation pressures continue to increase, and the consumer price index (CPI) is now growing at its fastest rate in over 40 years. As well, risks remain elevated, and the FOMC is anticipating the need for greater tightening than it did at the time of our last report.

After declining by 1.5 percent in the first quarter, the economy is now only expected to grow slowly in the current quarter, perhaps at a less-than-trend-like pace. The latest data on retail sales declined slightly in May, and motor vehicle sales were weak. Key components for autos continue to be in short supply, constraining production. Nevertheless, consumption is still expected to be a driver of the economy during the remainder of the year, but higher food and energy prices are weighing on consumer sentiment. The latest reading from the University of Michigan Consumer Sentiment Index is at its lowest level since May 1980, which coincided with the trough of a very deep recession. As well, the FOMC's forward guidance is having the intended effect on financial markets, with conditions tightening significantly. Asset prices have plunged, and mortgage rates have approximately doubled. Thus, consumption, while remaining a positive contributor to growth, is unlikely to grow much above trend. As COVID-19's effects on the economy wane, there are signs that consumption activity is moving away from goods and toward services. Mobility data indicate that domestic airline travel, revenue at hotels, and dining away from home are returning or have returned to pre-COVID levels of activity. Thus, we are starting to see some normalization in consumer activity.

On the bright side, the labor market remains robust and very tight by historical standards, despite a decline in economic growth. The economy has added more than 2.4 million net new jobs so far this year, and May's employment growth of 390,000 net new jobs, although somewhat lower than previous months, represents extraordinarily strong job growth. Job-opening rates remain near historically high levels, and nominal compensation gained 5.2 percent over the last 12 months; both are signs of a healthy labor market. However, nominal wage gains are not keeping up with inflation, implying that earning power has decreased somewhat over the past year.

Growth in nominal manufacturing activity has receded, with all of the growth being more than accounted for by increasing prices. Thus, the sector has been contracting over the three months to April. Lockdowns in China and primary-input shortages due to the war in Ukraine are hampering production, and these negative influences are likely to continue for the foreseeable future. Additionally, capacity utilization is at its highest level since April 2007, indicating that price pressures in the manufacturing sector are likely to persist.

Although residential real estate is still performing well, with the number of homes under construction at a seasonally adjusted all-time high of 1.67 million units as of April, this data predates the rapid runup in mortgage rates, which have recently roughly doubled. Since March, both single-family permits and starts have declined for three straight months, with the decline in May housing starts being extremely sharp. Combined with high house prices, the rise in mortgage rates is likely to attenuate activity in this sector going forward.

Turning to inflation, it continues to rise, with the headline CPI rising by 8.6 percent over the last 12 months, its highest rate since December 1981. The war in Ukraine has added to the momentum in food and energy prices, but price pressures are pervasive in a wide range of goods, with the core CPI rising by 6.0 percent over the same time period. And survey measures of inflation expectations continue to rise. For example, the Philadelphia Fed's survey of manufacturers found that firms expect inflation over the next year to be in the neighborhood of 7 percent, and the price indices in the Bank's Manufacturing Business Outlook Survey remain extremely elevated. Fortunately, market-based measures of inflation expectations indicate that inflation expectations continue to remain well anchored at around 2 percent, indicating that markets remain confident that the Fed will eventually rein in inflation.

To conclude, the pace of economic activity has slowed substantially from its robust growth rate in the fourth quarter of last year. The continued supply bottlenecks as well as the war in Ukraine are contributing to the slowdown. At present, risks are to the upside for inflation and on the downside for growth. In the U.S., the Omicron wave has abated, and consumption activity continues to normalize. Additionally, inflation is running persistently well above the Federal Reserve's desired rate, prompting the need for the recent 75 basis point increase in the federal funds rate. Continued forward guidance of additional future rate hikes has considerably tightened financial conditions. That too will weigh on future economic activity, and that view is embodied in FOMC members' projections of economic activity, which have been significantly downgraded since the March FOMC meeting. The only significant bright spot continues to be the labor market, with rapid gains in employment and a plenitude 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 will return to a pre-pandemic state once the virus is mitigated. There is of course a high degree of uncertainty surrounding that assumption. This forecast might then best be described as having two parts: a judgmental estimate of pandemic dynamics and their persistence, and a model-based forecast for the aftermath of the pandemic. 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

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

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 personal consumption expenditures (PCE) inflation, $ygap_t$ is a measure of the output gap, and ε_t^R is a monetary policy shock.[2] The parameters ρ, Ψ_π, and Ψ_y determine how monetary policy reacts to economic conditions.

Table 1

Rule	ρ	Ψ_π	Ψ_y
Baseline	0.85	2.62	0.53

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

We generate a forecast assuming that monetary policy follows the baseline policy rule but that policy shocks set the funds rate on a preset path through the end of 2022. The forecast is generated using observed data through the first quarter of 2022 together with an assumption of how output growth and unemployment will fare in the second quarter of 2022. The forecast then begins in the third quarter of 2022 and extends through the fourth quarter of 2024. The forecast under the baseline is shown in Figures 1–4. The baseline forecast is represented by

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[2] The model calibration implies that the long-run equilibrium value of the federal funds rate is 1.95 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.

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 is forecast to grow at about a 1.1 percent annual rate in 2022, 1.5 percent in 2023, and 2.1 percent in 2024.

- Core PCE inflation runs at a 3.9 percent pace in 2022, falling to 2.5 percent in 2023 and 2.2 percent in 2024.

- The unemployment rate is at 4.1 percent at the end of 2022 and then rises to reach 4.8 percent at the end of 2023 and 5.3 percent at the end of 2024.

- By assumption, the federal funds rate reaches 2.3 percent at the end of 2022. The funds rate is then allowed to rise but holds steady at 2.3 percent at the end of 2023 and moves down to 1.7 percent at the end of 2024.

The forecast for output growth is a bit stronger compared to the March projection, even as the incoming data has been a bit weaker than expected. Our forecast was made prior to the most recent FOMC meeting and embodies a federal funds rate path in 2022 that was consistent with market expectations. Shortly before the June FOMC meeting, the expected path for the federal funds rate, as embodied in futures prices, suggested a significantly steeper path for the funds rate over the next two years than is contained in our current forecast. That said, there remains a great deal of uncertainty about how the economy will evolve over the near term. Although the pandemic seems to have abated, war in Europe and lockdowns in China suggest a longer horizon for the resolution of supply shocks and supply chain disruptions. Although longer-term interest rates have been moving higher, the labor market remains healthy, with job openings at high levels, a low unemployment rate, and monthly employment gains running at a healthy clip. That said, consumer confidence has deteriorated as inflation remains high and there is increasing discussion in the press about the possibility of a recession over the medium term.

The model now anticipates that output growth will run at an average pace of only 1.1 percent in 2022 and then move up to 2.1 percent in 2024. The model's current-quarter forecast of 1.9 percent is significantly above the Federal Reserve Bank of Atlanta's GDPNow forecast of 0 percent for the second quarter of 2022.

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[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 baseline model shows output growth running at a pace that, on average, is nearly 1 percentage point below its long-run average over the next three years.[4] The unemployment rate is at its low of 3.6 percent in 2022Q2 and then rises gradually over the forecast horizon to reach 5.3 percent at the end of 2024. This is somewhat below the model's estimate of the natural rate of unemployment—i.e., the level of unemployment that the model returns to in the long run, which is 6 percent.

Recent data on inflation have continued to surprise on the upside. The model anticipates that core PCE inflation will run at a 3.9 percent pace in the second quarter of 2022. With gradually tightening monetary policy and modest output growth, inflation then moves down over the forecast horizon to average 3 percent in 2022Q4, 2.5 percent in 2023, and 2.2 percent in 2024. Thus, the model anticipates that inflation will run above the FOMC target of 2 percent average inflation over the forecast horizon.

The baseline forecast remains weaker on growth than the median projections from the second-quarter 2022 Survey of Professional Forecasters (SPF) over the forecast horizon. The median respondent expects real output growth of 2.5 percent in 2022, 2.3 percent in 2023, and 2 percent in 2024. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 5 percent (Q4/Q4) for 2022, edging down to 2.5 percent in 2023 and 2.2 percent in 2024. Thus, the SPF is stronger on inflation in 2022 but similar to the model projection in 2023 and 2024. The forecasters' path for the unemployment rate is generally lower over the forecast horizon compared to the baseline: The median SPF forecast for the unemployment rate is 3.6 percent in 2022 and 2023, rising to 3.8 percent in 2024.

The June 2022 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 1.7 percent in 2022 and 2023, edging up to 1.9 percent in 2024. The median forecast of the unemployment rate is 3.7 percent at the end of 2022, 3.9 percent at the end of 2023, and 4.1 percent at the end of 2024. Core PCE inflation is projected at 4.3 percent in 2022, moving down to 2.7 percent in 2023 and 2.3 percent in 2024. Headline inflation is projected to run at a stronger 5.2 percent pace in 2022 but then match core inflation in 2023 and 2024. The median Committee member forecast now anticipates that the federal funds rate will reach 3.4 percent at the end of 2022, 3.8 percent at the end of 2023, and 3.4 percent at the end of 2024.

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[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.

Summary

The baseline NKDSGE model uses historical correlations in the data to generate its forecasts and does not incorporate significant judgmental adjustment. To model the economic effects of the pandemic, we introduced judgment via short-lived shocks tailored to explain the pandemic dynamics. The NKDSGE model also does not include released data—besides the federal funds rate—after the first quarter of 2022, and it does not explicitly account for any structural changes that may be induced by the economic response to the pandemic or the war in Europe. Based on staff judgment, the model predicts moderately strong growth in 2022 and inflation above the FOMC target. The model projects growth to run at a below-trend pace over the next three years and for inflation to ease but nonetheless remain above the FOMC target 2 percent average. Forecast uncertainty remains very high as the economy emerges from the pandemic, war in Europe continues, and China sticks with its zero-COVID policy. These key factors are not incorporated into the model forecast, which is run solely off of existing quarterly data. The exercise in this document is best thought of as what might happen if the virus continues to wane globally and supply chain disruptions wane fairly quickly. On balance, the forecast calls for continued moderate output growth over the next few years and inflation that eases but remains above the 2 percent average target.
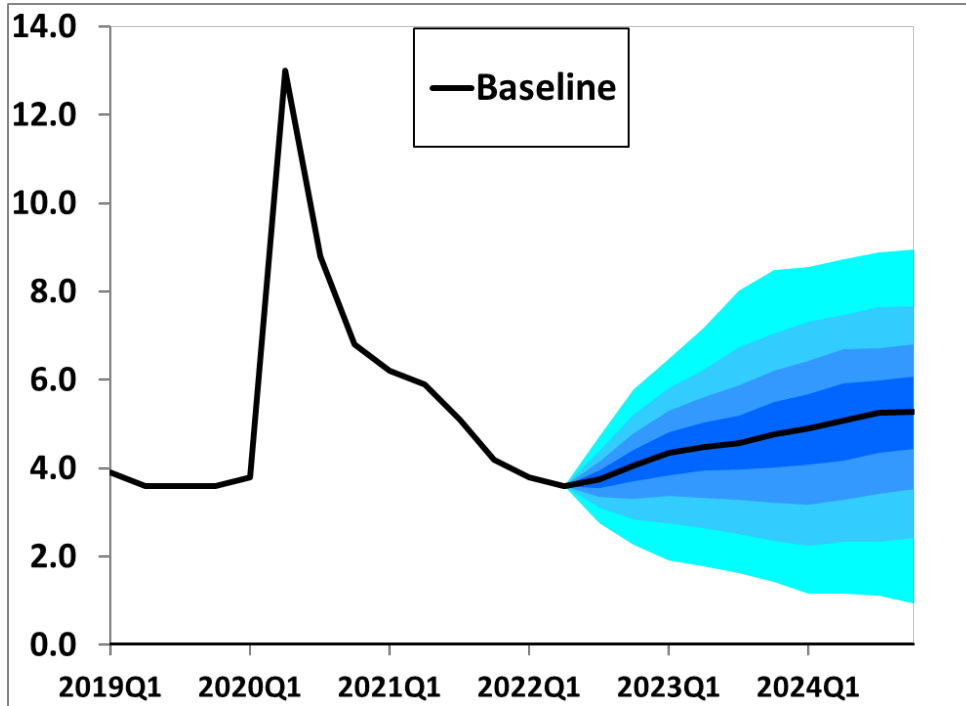
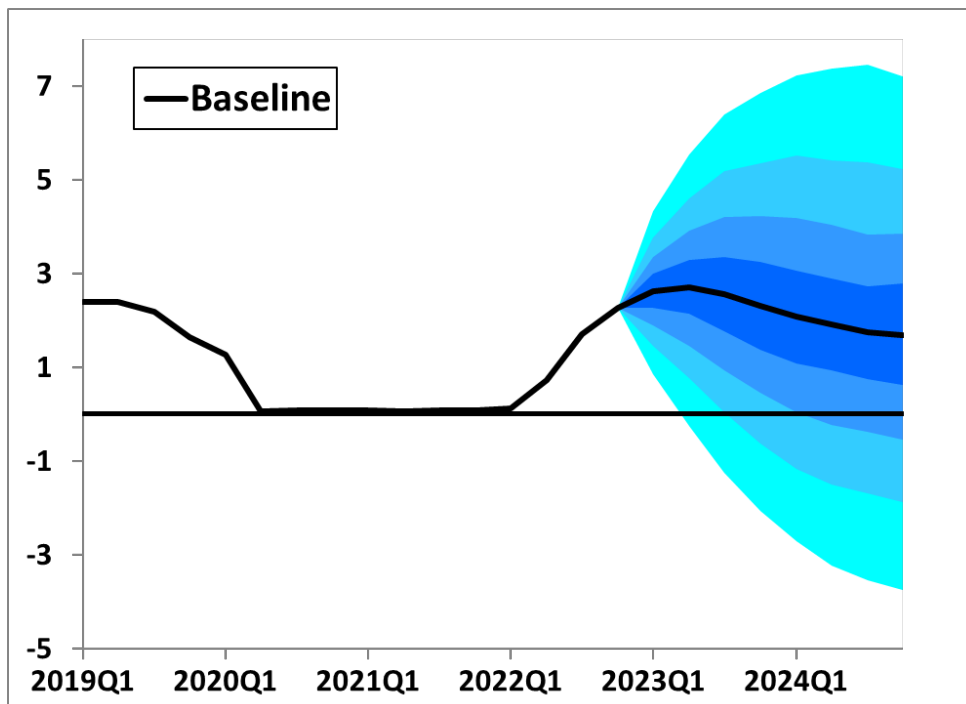## Figure 1: Real GDP Growth
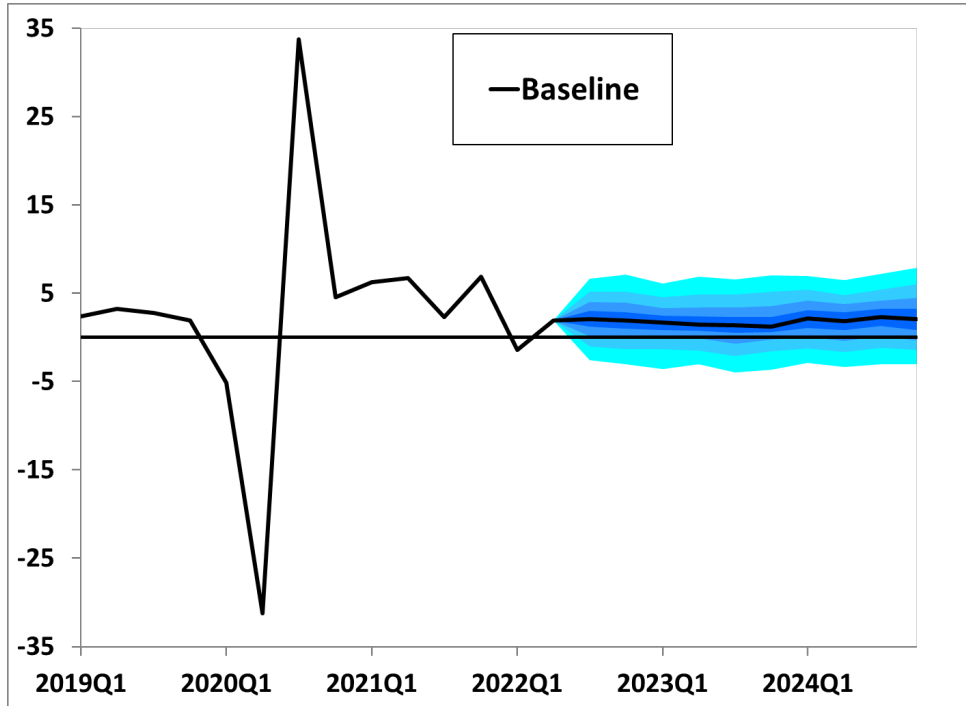
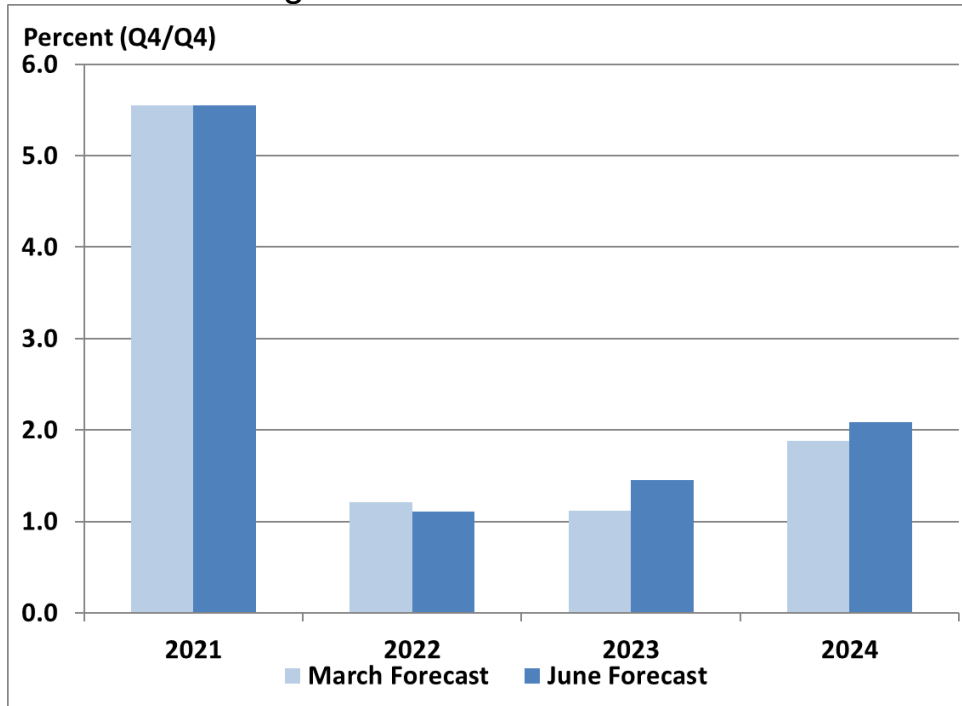## Figure 2: Core PCE Inflation
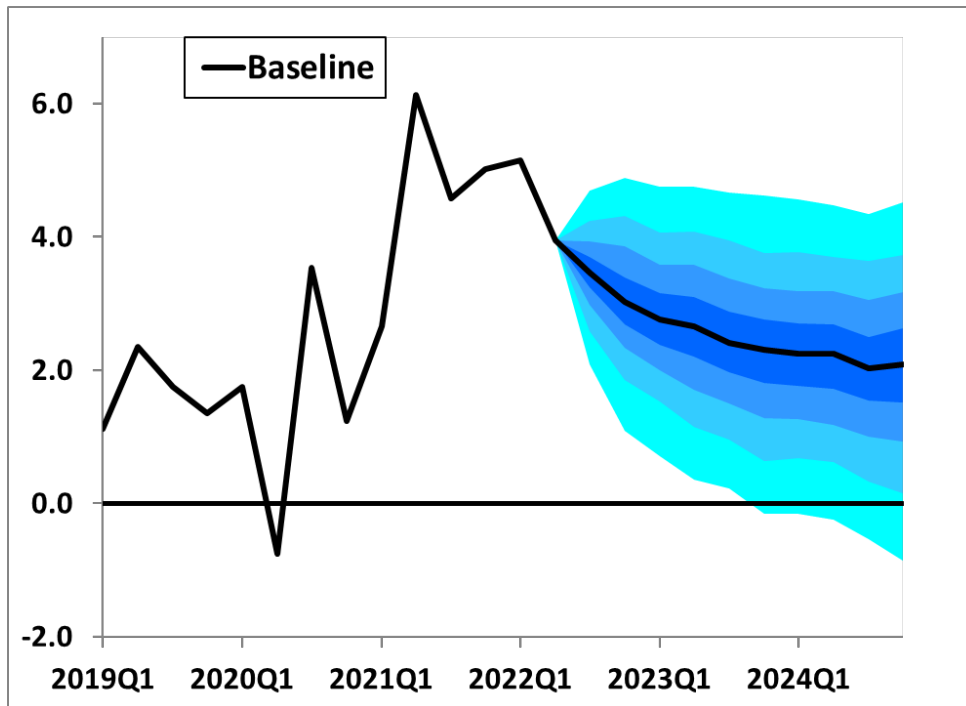
Figure 3: Unemployment Rate

Figure 4: Federal Funds Rate

Figure 5: Baseline Forecast Comparisons

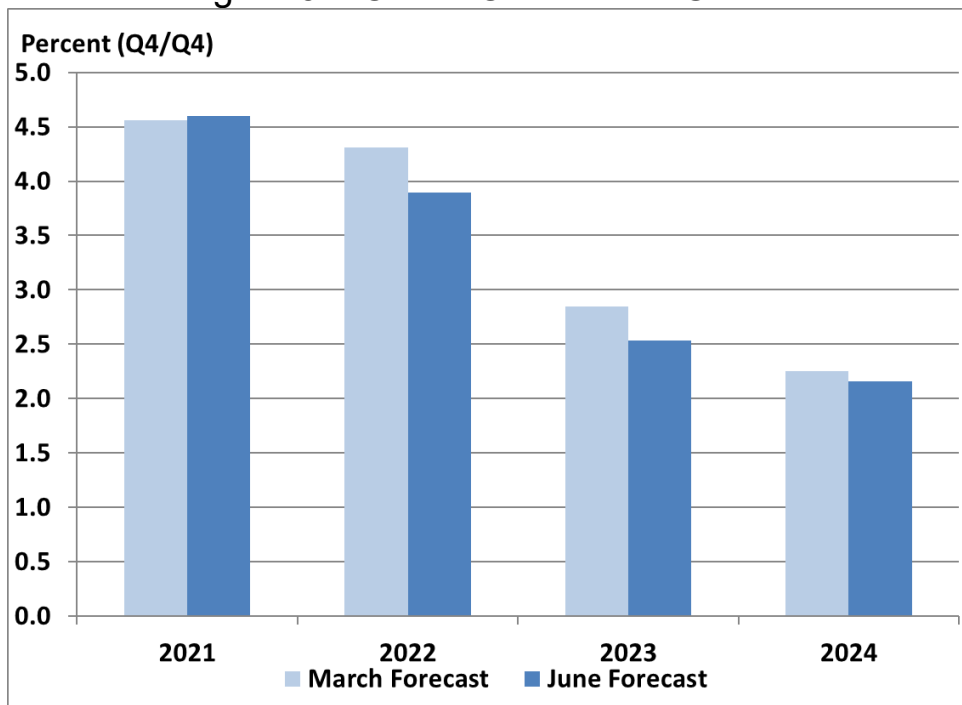## Figure 5a: Real GDP Growth

Figure 5b: Core PCE Inflation Growth

Figure 5c: Unemployment Rate

Percent (Q4)

March Forecast June Forecast

Figure 5d: Federal Funds Rate

Percent (Q4)

March Forecast June Forecast
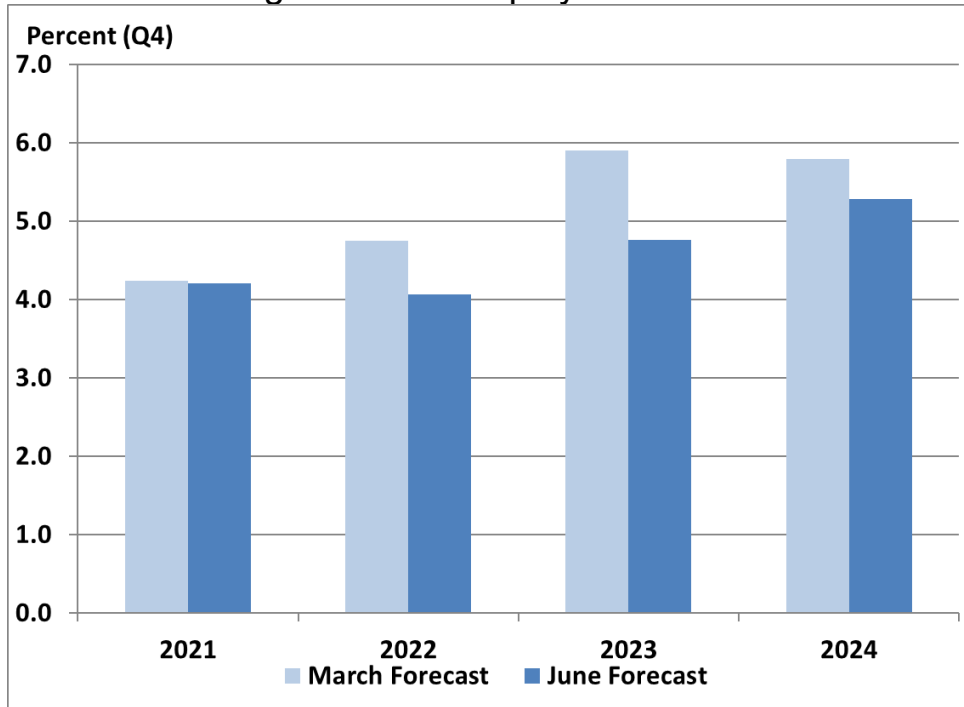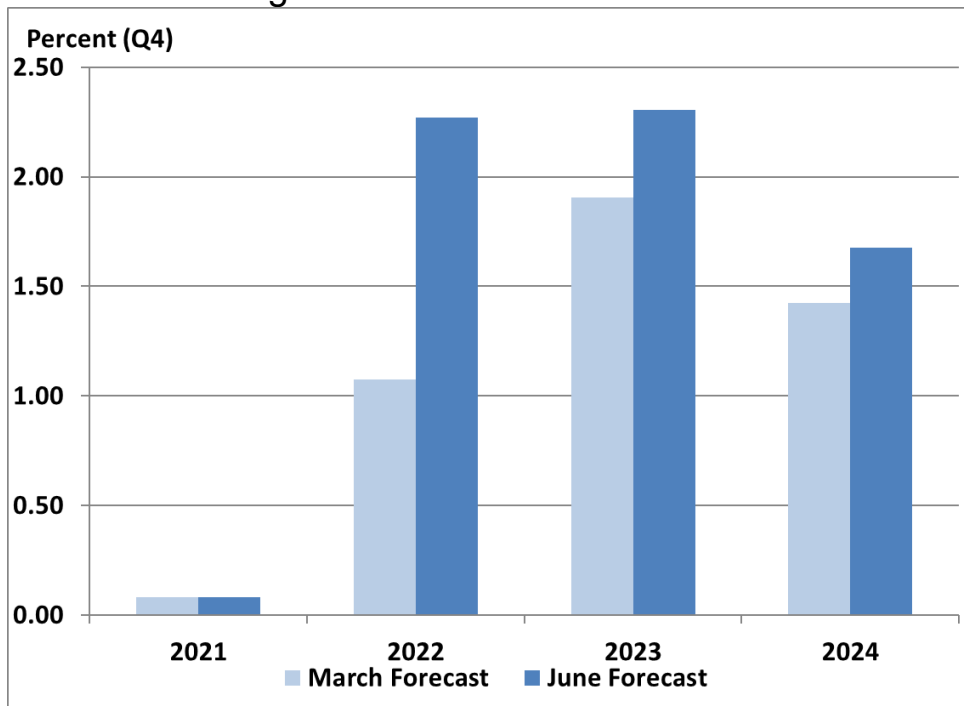
Note: Historical data have been retrieved from Haver Analytics.