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Special Report
Research Department

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.[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 U.S. economy continues to display surprising resiliency, with first-quarter growth of 6.4 percent and second-quarter growth looking to approach double digits. The increasing availability of vaccines could see the U.S. population come close to hitting President Biden's goal of 70 percent of the population being vaccinated by July. Coupled with the outsized

[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 Gillian Courtney and Catherine O'Donnell for their assistance.

stimulus package and accommodative monetary policy, growth should remain well above trend for the remainder of this year and next. Along some dimensions, the economy has already returned to or exceeded its pre-pandemic trend line. With healthy vaccination rates in many areas of the country, there has been a significant relaxation of social-distancing requirements. Along with this relaxation, there has been a steady improvement in many activities that require person-to-person contact. Seated diners at restaurants, hotel occupancy rates, and air travel are all recovering. Economic strength is fairly broadly based, with particular strength in manufacturing, residential investment, retail sales, and business fixed investment. Business contacts continue to express a great deal of optimism, but there are risks. The number of mortgages and rents that are behind in payments is worryingly large, and it is still unclear how much economic scarring has occurred in the labor market and among small businesses. The fiscal stimulus has kept many on their feet, but many small businesses have shuttered and the labor market is a long way from reaching pre-pandemic employment levels. We are witnessing a return to normalcy, but it remains to be seen how much deep structural change will remain as the economy recovers, and adapting to structural change often takes considerable time.

After moderating in the final quarter of last year, growth in economic activity is forecasted to accelerate to around 7.0 percent in 2021 and to remain well above trend in 2022. Currently, non-COVID-affected sectors continue to experience surprisingly robust activity. Manufacturing continues to be a source of economic strength. Regional surveys, including those conducted by this Bank, are indicating strength, and manufacturers' optimism bodes well for future activity. For example, the *Manufacturing Business Outlook Survey's* current activity index remains solidly in expansionary territory, and we are seeing some progress on the filling of back orders. As well, the employment index increased significantly. Regarding future activity, the index is at its highest level in nearly 30 years. Additionally, firms intend to continue hiring and to make capital investments. Both the prices-paid and prices-received indices continue to rise, reaching their highest readings since June 1979 and October 1980, respectively. It appears that price pressures are building among the district's manufacturers. Respondents continue to report supply chain disruptions and difficulty in finding qualified workers. The report reflects the overall national strength in manufacturing, which has grown by 16.3 percent at an annualized rate over the last three months.

Residential real estate activity probably peaked early in the year but continues to be a source of economic strength. Single-family starts bounced back slightly in May, increasing by 4.2 percent, while single-family permits declined for the second straight month, declining by 1.6 percent in May. The slowing in residential construction is most likely due to supply constraints. Although some material prices have begun to moderate, many remain well above pre-pandemic levels. As well, labor market shortages in construction appear to be severe, with the

quit rate in the industry near record levels. The weakening in existing home sales over the three months to April also appears to be driven by a lack of supply and the corresponding large increases in prices. Nationally, the median home price is 24.4 percent above what it was last May. Even so, sales in April were 20 percent higher than a year ago and 19 percent higher than they were two years ago.

Real personal consumption expenditures rose 11.3 percent in the first quarter of this year, and many analysts expect current-quarter growth to rise by even more. Although retail sales retreated in May, overall data on retail sales has surprised to the upside, growing at an average monthly rate of 3.6 percent over the last three months to May. Notably, vehicle sales continue to be strong. We are also seeing a bounce back in a number of sectors that were devastated by the pandemic. Credit and debit card spending on Chase cards is now 1.8 percent above its pre-pandemic trend and is 16.7 percent above its pre-pandemic level. Noticeable improvement has occurred in spending on lodging, on airline travel, and at restaurants. The recent strength in consumption is indicative of pent-up demand and is supported by generous benefits distributed through the American Rescue Plan. As well, households have improved their balance sheets, and accumulated savings throughout the pandemic have been high.

Employment growth has moderated of late, averaging 541,000 net new jobs per month over the last three months ending in May. Growth has been driven by outsized gains in leisure and hospitality and strong growth in education and health services. The moderation in job growth has occurred despite the record level of job openings and the fact that there are over 7.3 million fewer people working than pre-pandemic. Explanations for the slowdown include very generous unemployment insurance (UI) payments, a continued lack of day care and in-class learning, as well as possible job mismatches as laid-off service-sector workers may not have the skills to perform many of the jobs in the rapidly growing sectors of the economy, such as construction and manufacturing.

Inflation has accelerated of late. Over the 12 months through May, the headline consumer price index (CPI) rose by 5.0 percent and the core CPI rose by 3.8 percent—its largest 12-month increase since June 1992. Some of the outsized increase is due to base effects as the 12-month comparison is with respect to very low numbers during the beginning of the pandemic. However, base effects are not the sole reason, as six-month inflation rose at an annualized rate of 7.6 percent for the headline and 4.8 percent for the core. May's consumer price inflation also reflects strong aggregate demand matched with supply side disruptions. Outsized price increases were seen in new and used vehicles and airline fares. Most forecasters view the rise in inflation as temporary, but that position is getting more tenuous with each new data point.

In line with recent data on inflation, market-based measures of inflation expectations continue to firm and now are slightly above the average inflation target. As well, survey measures remain elevated. In our latest inflation expectations survey, trimmed means of overall inflation expectations increased from around 2.5 percent pre-pandemic to 4.8 percent over the next year and 5.6 percent over the next 10 years. At least with respect to these respondents, it appears that the Fed has lost some credibility. More representative is the University of Michigan survey of consumer sentiment. Although declining by 0.4 percent in June, one-year-ahead inflation expectations are elevated at 4.2 percent, and the Philadelphia Fed's Survey of Professional Forecasters is reporting a 0.8 percent jump in expectations of inflation for 2021 and increases in 2022 and 2023. The median forecasts are respectively 3.0 percent, 2.3 percent, and 2.3 percent, indicating that the forecasting community anticipates that the FOMC will attain its inflation objective in the near future.

To conclude, the pace of economic activity has improved substantially, and progress on the pandemic has been remarkable. Overall progress on vaccinations, falling caseloads, and declines in new hospitalizations suggest that the pandemic may be receding in the rearview mirror. Consumers remain active, and manufacturing continues to be a source of strength despite bottlenecks and a shortage of workers. The labor market continues to heal, although at a somewhat slower rate, and residential real estate is still performing well. However, although the risks appear more balanced, the economy still has further to travel before it is truly healed.

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 expenditure (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	$\boldsymbol{\rho}$	$\boldsymbol{\Psi_\pi}$	$\boldsymbol{\Psi_y}$
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. On its own, the baseline rule predicts a sharply negative federal funds rate over the forecast horizon. We add policy shocks to the model, which bring the funds rate up to the ELB over the next three years. Note that this is tantamount to adding contractionary monetary policy shocks to the model.

Model Forecasts Under the Baseline

We generate a forecast assuming that monetary policy follows the baseline policy rule but that policy shocks pin the rate at the ELB. The forecast is generated using observed data through the first quarter of 2021 together with an assumption on how output growth and unemployment will fare in the second quarter of 2021. The forecast then begins in the third quarter of 2021 and extends through the fourth quarter of 2023. 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:

[2] The model calibration implies that the long-run equilibrium value of the federal funds rate is 3.5 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.

[3] The forecast simulations are generated using Bayesian methods. The fan charts show 10 percent quantiles around the median of the posterior predictive distribution.

- Real output is forecast to grow at about a 7.5 percent annual rate in the first half of 2021, and a 5.7 percent pace in the second half of the year.
- Core PCE inflation accelerates from 2.5 percent in the first quarter of 2021 to a peak of 4.1 percent in mid-2022. Inflation then gradually eases to 2.6 percent in the fourth quarter of 2023.
- The unemployment rate averages 5.2 percent in the third quarter of 2021, falling to 4.7 percent in early 2022. Thereafter, the unemployment rate rises gradually to 6 percent at the end of 2023.
- By assumption, the federal funds rate remains at the ELB through mid-2023. Thereafter the model implies the funds rate rises to 0.66 percent at the end of 2023.

The baseline forecast calls for output growth to run at a near 7 percent pace in 2021 and then average about 2.4 percent growth in 2022. Conditioning assumptions for the forecast do incorporate a current-quarter adjustment to government spending to reflect fiscal stimulus. Thereafter, we let the model run without making further adjustments. Consequently, the model is not anticipating fiscal stimulus that might show through in the third quarter. Looking further ahead, the model anticipates output growth will run at an average pace of 1.9 percent in 2023. The model's current-quarter forecast of 8.6 percent is lower than the Federal Reserve Bank of Atlanta's GDPNow forecast of 10.3 percent for the second quarter of 2021 and higher than the Federal Reserve Bank of New York's Staff Nowcast of 4.2 percent. The incoming data since the start of the second quarter have generally pointed to continued strong output growth, and fiscal stimulus is continuing to work its way into the spending data. As well, states are loosening restrictions on economic activity, and the pace of vaccinations, though decelerating, has led to a significant share of the population being vaccinated. On balance, the second quarter is expected to come in quite strong.

The baseline model shows output growth running at a pace that is generally higher than its longer-term trend over the forecast horizon.[4] The unemployment rate falls from 5.7 percent in the current quarter to 4.7 percent early in 2022. By the end of the forecast horizon, the unemployment rate is near the model's estimate of the natural rate of unemployment.

Recent data on inflation have surprised on the upside. The model anticipates that core PCE inflation will run at a 3.2 percent pace in the third quarter of 2021, rising to a peak of 4.1 percent by mid-2022. Thereafter, inflation moderates to run at a 2.6 percent pace in the fourth quarter of 2023. Thus, the model now anticipates that inflation will run above the FOMC target of 2 percent average inflation over the forecast horizon. Under the baseline policy

[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.

parameterization, the output growth and inflation outcomes are consistent with a federal funds rate that remains at the ELB until mid-2023.

The baseline forecast is somewhat weaker on growth and stronger on inflation than the median projections from the second-quarter 2021 Survey of Professional Forecasters (SPF) over the forecast horizon. The respondents expected real output growth of 6.3 percent in 2021, 4.3 percent in 2022, and 2.6 percent in 2023. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 2.3 percent (Q4/Q4) for 2021, edging down to 2 percent in 2022 and 2.1 percent in 2023. The forecasters' path for the unemployment rate is similar in the near term compared with the baseline, but it is generally stronger over the medium term: The median SPF forecast for the unemployment rate is 5.5 percent in 2021, falling to 4.4 percent in 2022 and 3.9 percent in 2023.

The June 2021 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 7 percent in 2021, falling to 3.3 percent in 2022 and 2.4 percent in 2023. The median forecast of the unemployment rate is 4.5 percent at the end of 2021, 3.8 percent at the end of 2022, and 3.5 percent at the end of 2023. Core PCE inflation is projected at 3 percent in 2021, moving down to 2.1 percent in 2022 and 2023. Headline inflation is projected to run at a slightly stronger pace than core inflation over the next three years. The forecast model's baseline forecast for the federal funds rate (Figure 4) is at the central tendency of the June 2021 SEP over the forecast horizon. The baseline forecast is marginally below the market expectations, which call for the funds rate to begin edging up in mid-2023.

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 have 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 2021, and it does not explicitly account for any structural changes that may be induced by the economic response to the pandemic. Based on staff judgment, the model predicts strong growth in the second quarter. The growth rate diminishes in the second half of the year but nonetheless continues at a healthy pace. This is entirely expected as the boost the economy gets from fiscal stimulus and general reopening begins to diminish. Near-term uncertainty surrounding the evolution of the COVID pandemic remains significant, though it continues to diminish. The exercise in this document is best thought of as what might happen if the virus continues to wane and the economy steadily returns to its pre-virus structure. Congress may well pass additional spending and tax bills in

2021 that impact near-term growth. On balance, though, the forecast calls for a healthy rebound in economic activity in 2021 and over the next three years.

Figure 1: Real GDP Growth

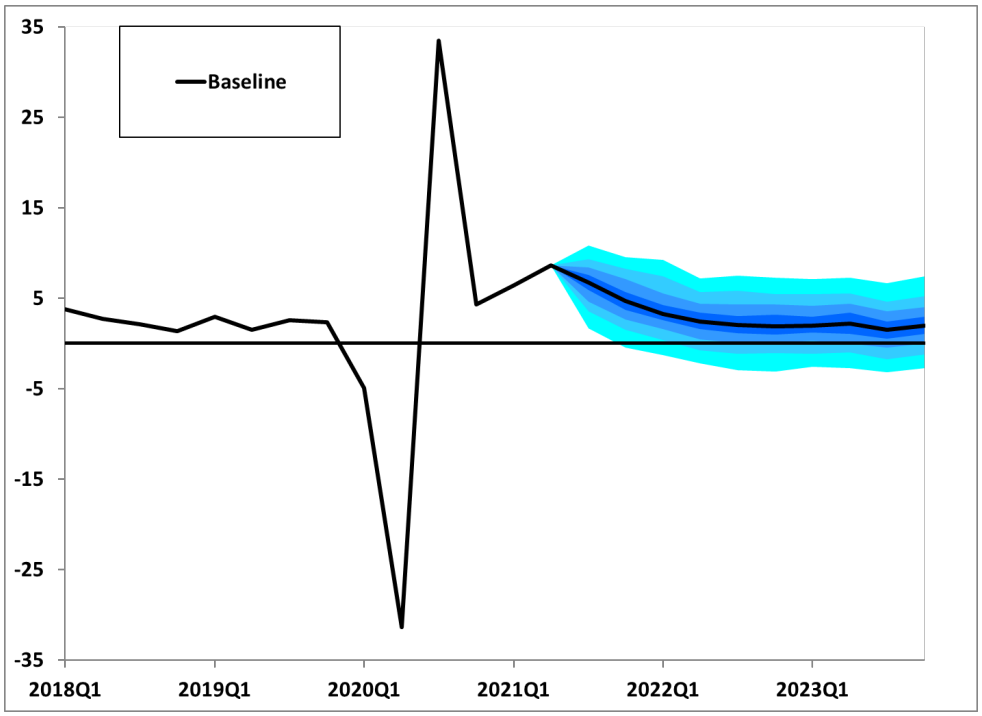


Figure 2: Core PCE Inflation

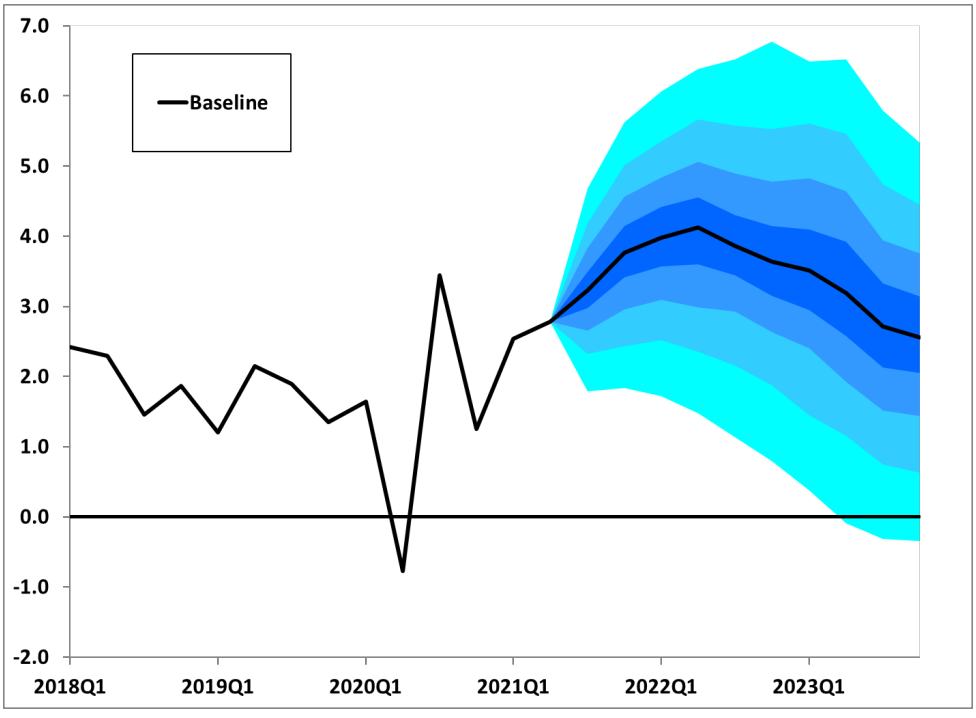


Figure 3: Unemployment Rate

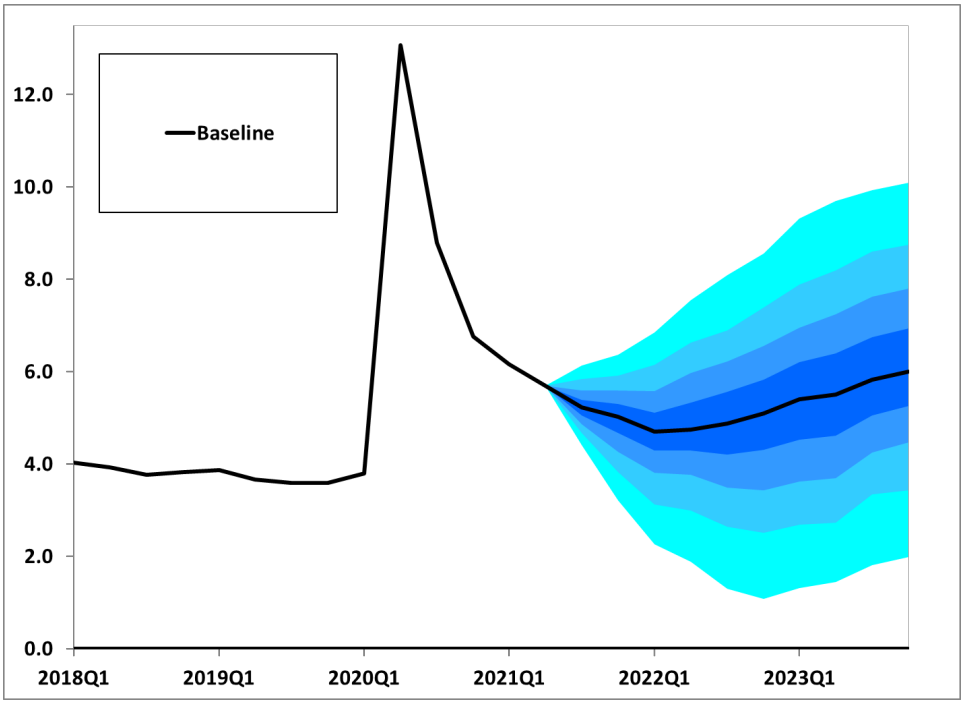


Figure 4: Federal Funds Rate

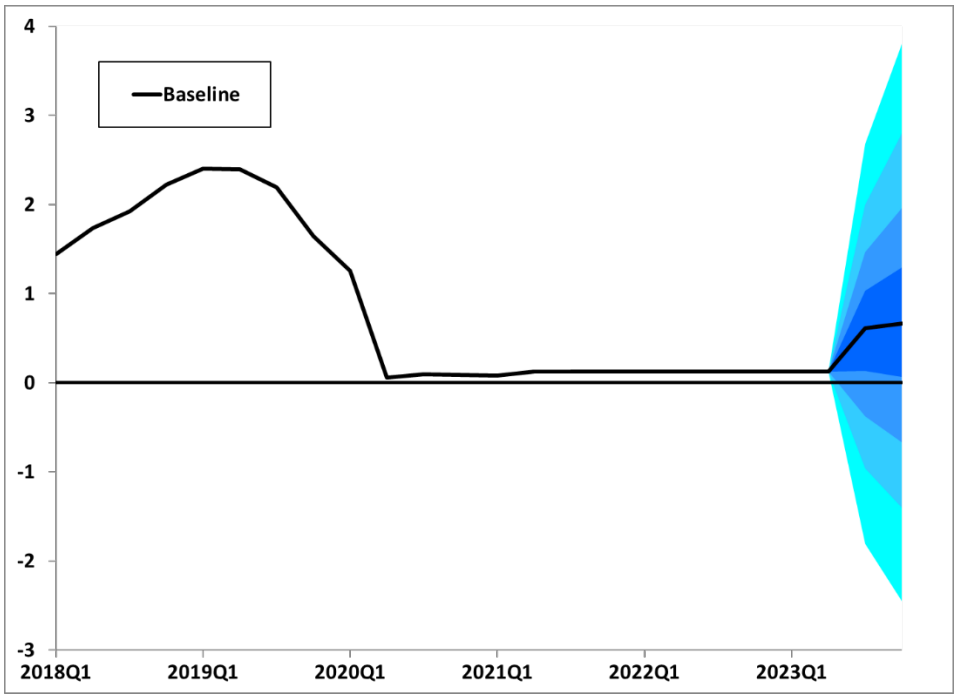


Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

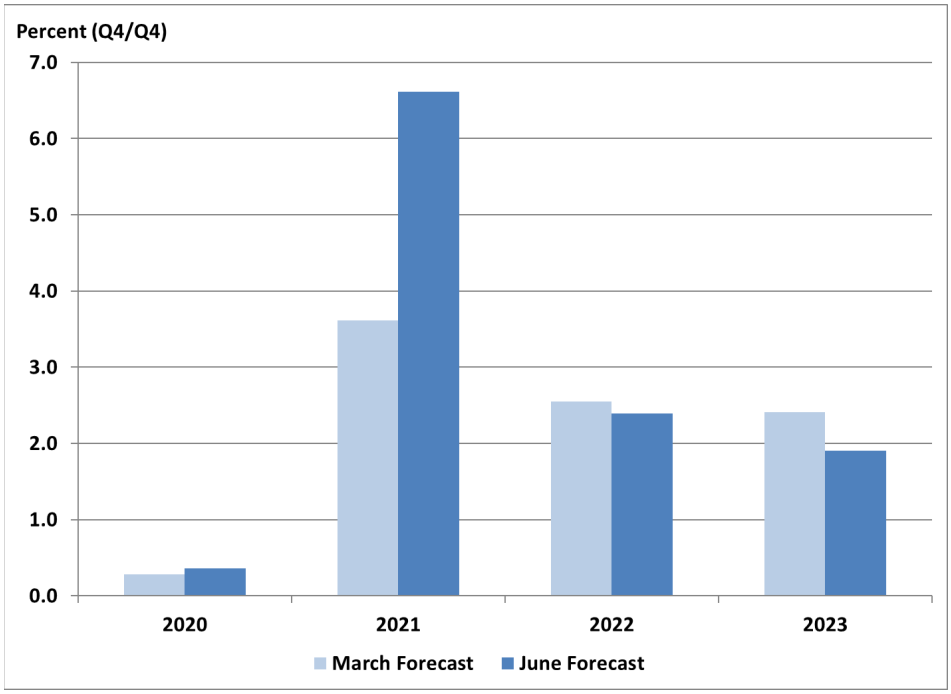


Figure 5b: Core PCE Inflation Growth

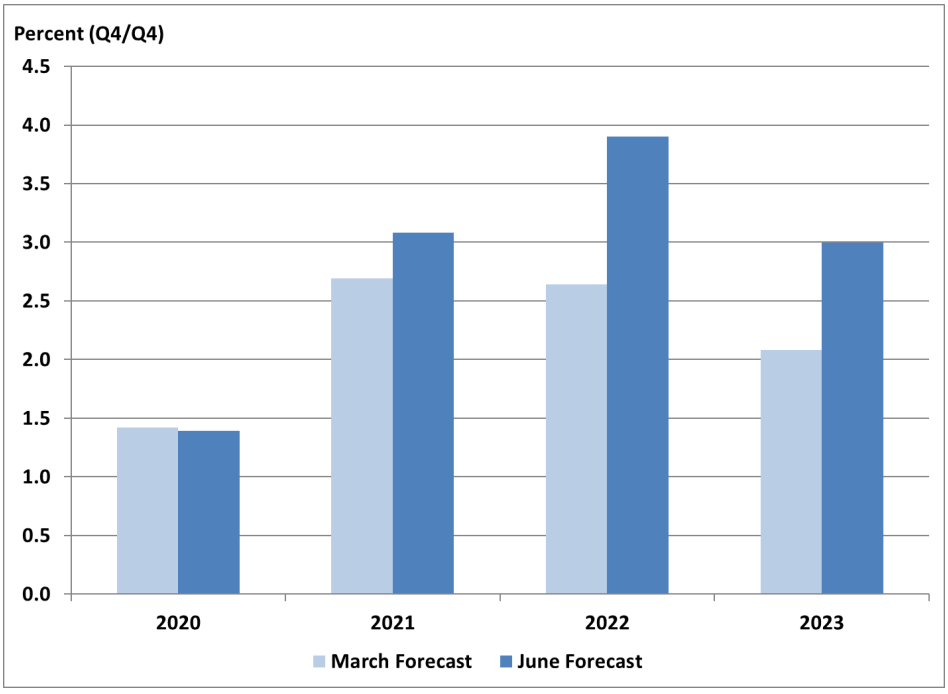


Figure 5c: Unemployment Rate

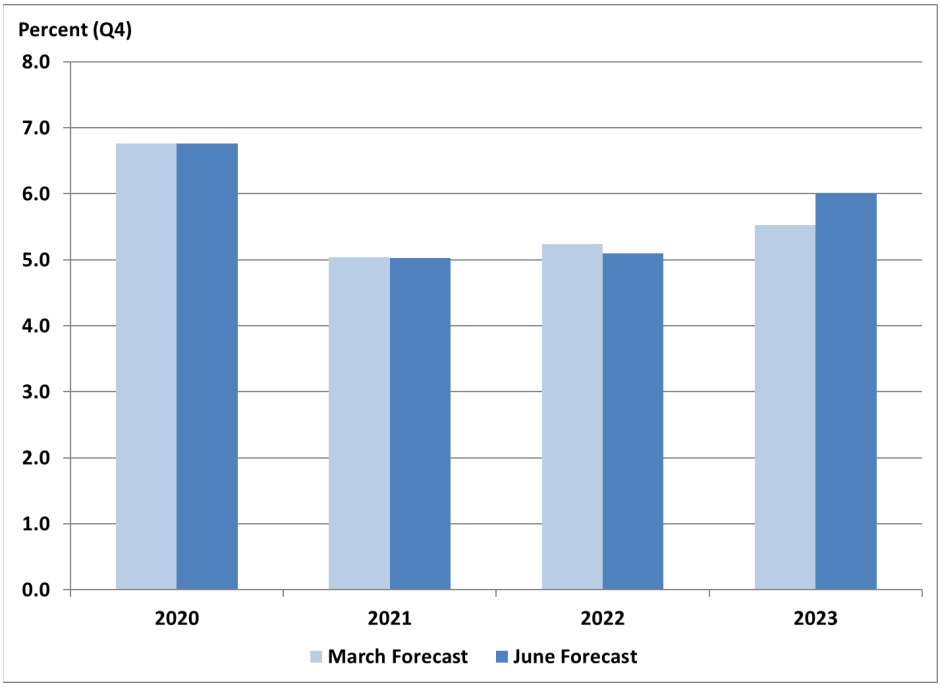
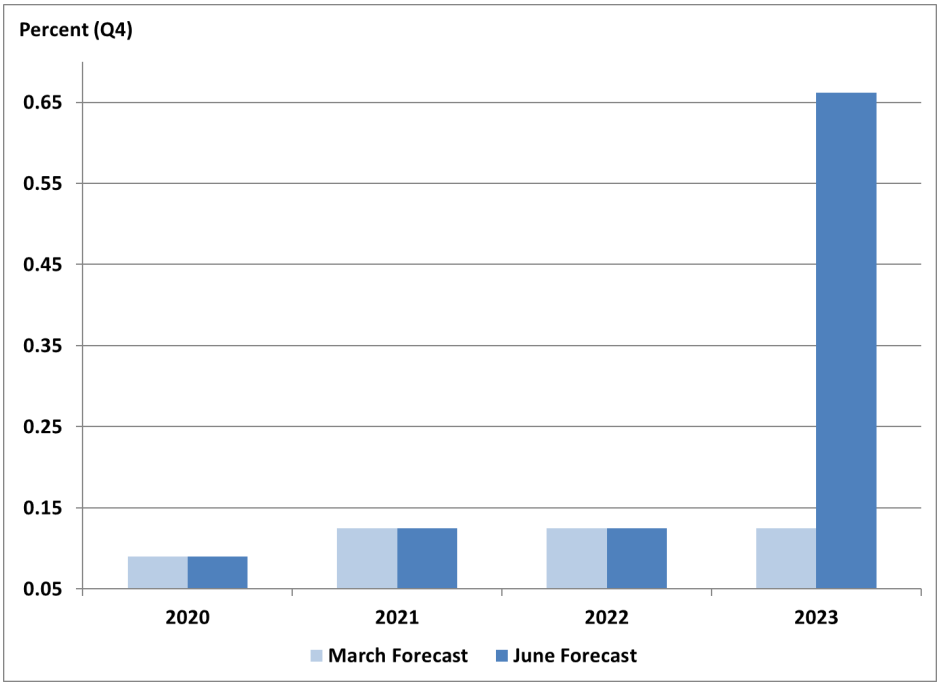


Figure 5d: Federal Funds Rate



Note: Historical data have been retrieved from Haver Analytics.