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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 fourth-quarter 2020 growth of 4.1 percent and first-quarter growth looking to exceed that number. The increasing availability of vaccines could see the U.S. population mostly vaccinated by the end of the summer. Coupled with the outsized stimulus package and accommodative monetary policy,

[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.

growth is expected to accelerate this year, and the economy may return to its pre-pandemic trend line by late this year or early next. As the number of people who have been vaccinated increases, there will be less need for social distancing, and those sectors of the economy that rely on in-person contact could recover rapidly. Economic strength is fairly broadly based, and most sectors are performing robustly. Housing and manufacturing continue to boom, and business contacts are expressing a great deal of optimism. There are risks. The number of mortgages and rents that are behind in payments is worryingly large, and it is unclear how much economic scarring has occurred in the labor market and among small businesses. The fiscal stimulus has hopefully kept and will continue to keep enough people on their feet as the economy continues to recover. We may see a return to normalcy in the not-too-distant future. However, the pandemic has acted as an accelerator of structural change, and the eventual adjustment to those changes will require additional time.

After moderating in the final quarter of last year, growth in economic activity is forecasted to accelerate to around 6.0 percent in 2021. Currently, non-COVID-affected sectors are by and large performing quite well. 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 is at a decades-long high, and the future activity index has sustained elevated readings since last fall. Projects that were on hold owing to the pandemic are now going forward. The survey data point to a bounce back from February's somewhat disappointing 2.2 percent decline in industrial production. Much of that decline appears to be weather induced, but supply chain backlogs, especially in semiconductor chips, are acting to dampen activity as production lines wait for parts. Despite the backlogs, manufacturing orders and shipments are noticeably above where they were a year ago.

Residential real estate, which has been an important contributor to economic growth, stumbled in February. Single-family permits declined by a whopping 10 percent after increasing in each of the previous nine months and as of January were at their highest level since August 2006. Some of the slowdown was no doubt weather induced, as February was historically frigid. Other contributors to the recent slowdown are the rise in mortgage rates and the increase in the price of building materials. Although still expected to contribute to overall growth, this sector may be a bit more subdued going forward. Despite February's decline in existing home sales, sales have remained strong over the past year, growing by 16.2 percent through January. Some of the weakness was attributed to a lack of inventory, which remains quite low. Additionally, median home price increases are in double-digit territory.

Consumption growth has been mixed, with those sectors most seriously affected by the pandemic, such as leisure and hospitality, operating at a fraction of their pre-pandemic levels. There are signs of improvement, although it is unclear how quickly these sectors will bounce back once a sizable fraction of the population is inoculated. February saw a pullback in retail sales after a 7.6 percent surge in January. Retail sales is a volatile series, and taken as a whole, most forecasters have upgraded their predictions for first-quarter consumption growth. In addition, as of March 14, credit and debit card spending on Chase cards is up 5.3 percent from a year ago but still remains below its pre-COVID trend line. Spending at wholesale clubs remains robust, while spending at restaurants is still more than 20 percent below trend. States that have eased restrictions, like Texas and Florida, are exhibiting much greater activity in OpenTable dining than those that have been locked down, like New York and California. This behavior hopefully is a harbinger for recovery in the leisure and hospitality sector as vaccines roll out and lockdowns ease. As well, the fiscal stimulus fueled an 11.0 percent increase in disposable income and should serve to buttress strong consumption activity in the months ahead. That expectation is supported by the boost in consumer sentiment that accompanied the passage of the most recent legislation.

After moderating at the end of last year, employment growth has resumed at a robust pace, and many analysts anticipate that it will accelerate further. February saw a gain of 379,000 net new jobs despite a weather-induced decline of 61,000 jobs in the construction sector. Most of the gain was in the leisure and hospitality sector, providing further evidence that this sector may be starting to recover—but like the economy as a whole, it still has a way to go, as there are approximately 9.5 million fewer jobs than there were pre-pandemic. The unemployment rate continues to decline, but at 6.2 percent it remains almost 3 percent above the rate from last March. The rate does not fully reflect the labor market scarring resulting from the pandemic, as many parents must remain at home helping children with their schooling. The anticipated reopening of schools in the fall should prompt a return of a significant portion of the labor force, further fueling the economic recovery. Of note is that a number of indicators that reflect the dynamism of the labor market have returned to pre-pandemic levels. Among them are the separation rate and the quit rate.

Inflation remains stubbornly below the Federal Reserve's 2.0 percent target, and there is only slight evidence that it is beginning to firm. Year over year, the headline consumer price index (CPI) has risen 1.7 percent, while the core CPI has increased a mere 1.3 percent. Weak price growth in goods and service sectors that have been heavily impacted by the pandemic continue to dampen overall price pressures. However, prices of durable goods are growing at their fastest rate in decades, and as the effect of the pandemic wanes, many forecasters are expecting inflation to rise to slightly more than 2.0 percent over the year. Supporting this notion has been the modest increase in market-based measures of inflation expectations and

the firming in bond yields, especially in longer maturity bonds. The firming is due to stronger inflation expectations and a more optimistic view of the economy going forward.

To conclude, the pace of economic activity continues to improve, and progress on the vaccine, falling caseloads, and declines in new hospitalizations could mean that we are approaching a more normal existence. Manufacturing activity continues to expand, and housing, although it fell a bit in February, should provide additional support for economic growth. The labor market is gaining momentum after weak growth at the end of last year, and fiscal support should underpin consumption growth going forward. There is likely a lot of pent-up demand, implying that by summer we should see some recovery in the most severely affected sectors of the economy. However, the number of employed is still roughly 9.5 million less than it was pre-pandemic, and there has been significant scarring to the economic landscape. The economy still has a way to go before it is back to full health.

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 fourth quarter of 2020 together with an assumption on how output growth and unemployment will fare in the first quarter of 2021. The forecast then begins in the second 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:

- Real output is forecast to grow at about a 4.6 percent annual rate in the first half of 2021, and a 2.6 percent pace in the second half of the year.
- Core PCE inflation accelerates from 1.9 percent in the first quarter of 2021 to 3 percent at midyear. Inflation then gradually eases to 2 percent in mid-2023.

[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.

- The unemployment rate averages 6.3 percent in the first quarter of 2021, falling to 4.8 percent in early 2022. Thereafter, the unemployment rate rises gradually to 5.5 percent at the end of 2023.
- By assumption, the federal funds rate remains at the ELB through the end of 2023.

The baseline forecast calls for output growth to accelerate slightly from its fourth-quarter 2020 pace over the next two quarters to an average pace of about 4.6 percent. Thereafter, growth decelerates to about 2.6 percent in the second half of the year. 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 second quarter. Looking further ahead, the model anticipates output growth will decelerate to 2.2 percent at the end of 2022 and then rise to about 2.5 percent at the end of 2023. The model's current quarter forecast is lower than the Federal Reserve Bank of Atlanta's GDPNow forecast of 5.7 percent for the first quarter of 2021 and lower than the Federal Reserve Bank of New York's Staff Nowcast of 8.6 percent. The incoming data since the start of the fourth quarter have generally been stronger than expected, and additional fiscal stimulus is beginning to work its way into the spending data. As well, states are beginning to loosen restrictions on economic activity, and the pace of vaccinations is accelerating as the pace of new cases of COVID decline nationwide. On balance, the first quarter is expected to now come in quite strong.

The baseline model shows output growth running at a pace that is somewhat higher than its longer-term trend over the forecast horizon.[4] The unemployment rate averages 6.3 percent in the first quarter of 2021 and then falls to 5 percent in the fourth quarter of 2021. The unemployment rate then begins a slight rise to reach 5.5 percent at the end of 2023.

Robust growth leads to an acceleration of inflation over the near term, with core PCE inflation reaching an average 3 percent in the first half of 2021. With inflation expectations well anchored, inflation then gradually declines over the remainder of the forecast horizon to run at 2 percent in 2023. Thus, the model now anticipates that inflation will run somewhat above the FOMC target of 2 percent average inflation over the forecast horizon. Under the baseline policy parameterization, the output growth and inflation outcomes are consistent with a federal funds rate that remains at the ELB over the next three years.

The baseline forecast is somewhat weaker on growth and stronger on inflation than the median projections from the first-quarter 2021 Survey of Professional Forecasters (SPF) over

[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.

the forecast horizon. The respondents expected real output growth of 4.5 percent in 2021, 3.7 percent in 2022, and 3.1 percent in 2023. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 1.8 percent (Q4/Q4) for 2021, edging up to 1.9 percent in 2022 and 2 percent in 2023. The forecasters' path for the unemployment rate is somewhat weaker in the near term compared with the baseline, but generally stronger over the medium term: The median SPF forecast for the unemployment rate is 5.9 percent in 2021, falling to 4.8 percent in 2022 and 4.2 percent in 2023.

The March 2021 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 6.5 percent in 2021, falling to 3.3 percent in 2022 and 2.2 percent in 2023. The median forecast of the unemployment rate is 4.5 percent at the end of 2021, 3.9 percent at the end of 2022, and 3.5 percent at the end of 2023. Core PCE inflation is projected at 2.2 percent in 2021, edging down to 2 percent in 2022 and 2.1 percent in 2023. Headline inflation is projected to run at about the same pace as 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 March 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 early 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 fourth quarter of 2020, 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 fairly strong growth in the first quarter, which then continues through the second quarter. This is entirely expected as the economy gets a boost from fiscal stimulus and then moves toward more average growth. Near-term uncertainty surrounding the evolution of the COVID pandemic remains significant, though diminishing. 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. Those assumptions, however, do not fully account for fiscal stimulus in the pipeline and the economic response to continued support through the second quarter. 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.

Figure 1: Real GDP Growth

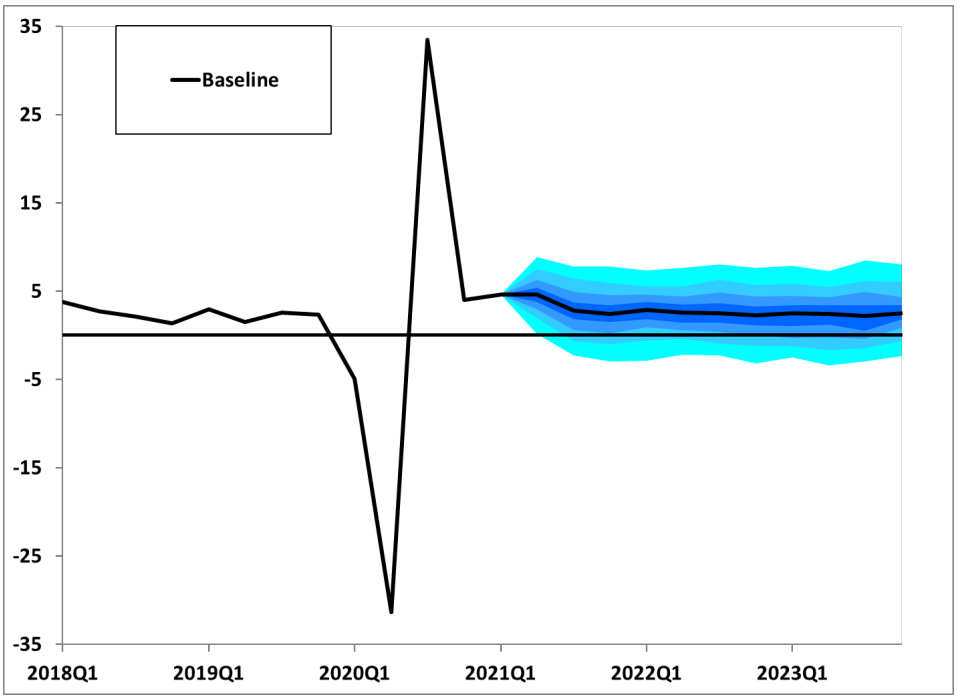


Figure 2: Core PCE Inflation

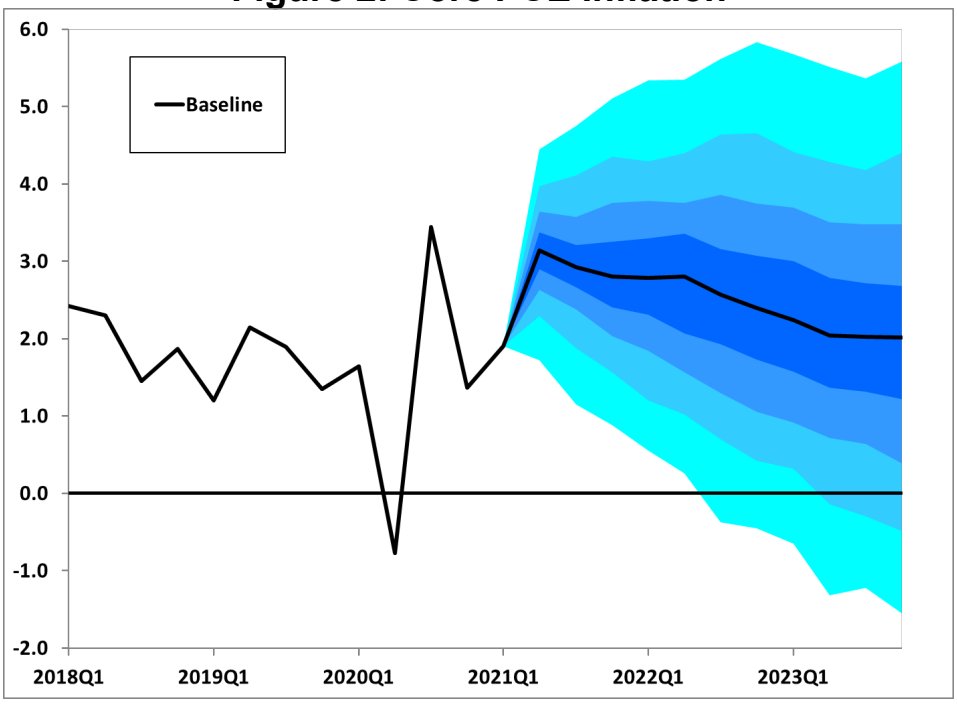


Figure 3: Unemployment Rate

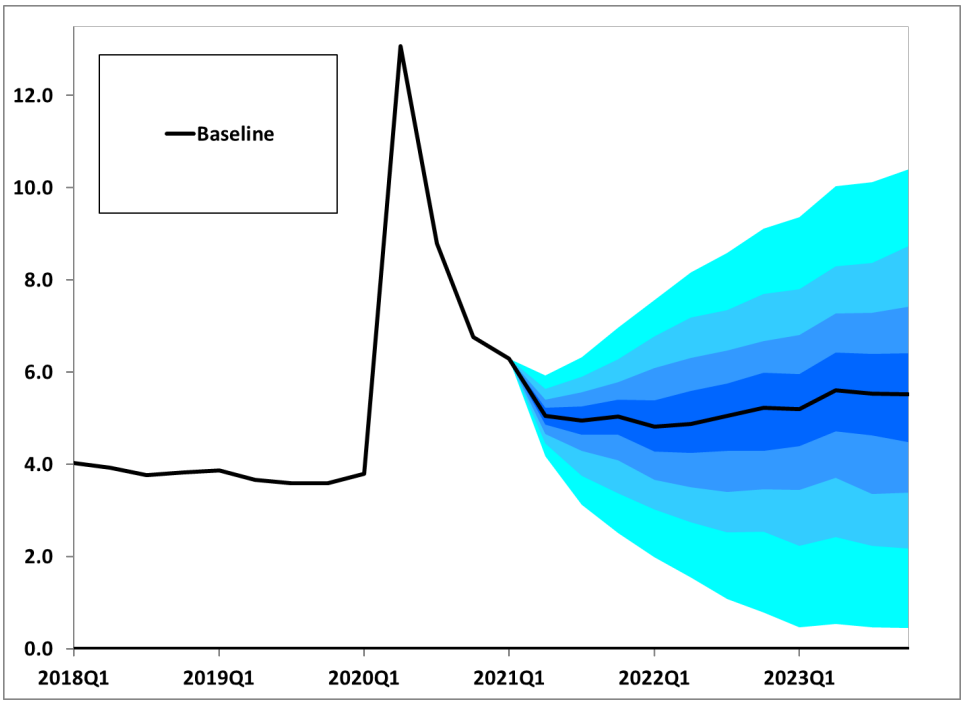


Figure 4: Federal Funds Rate

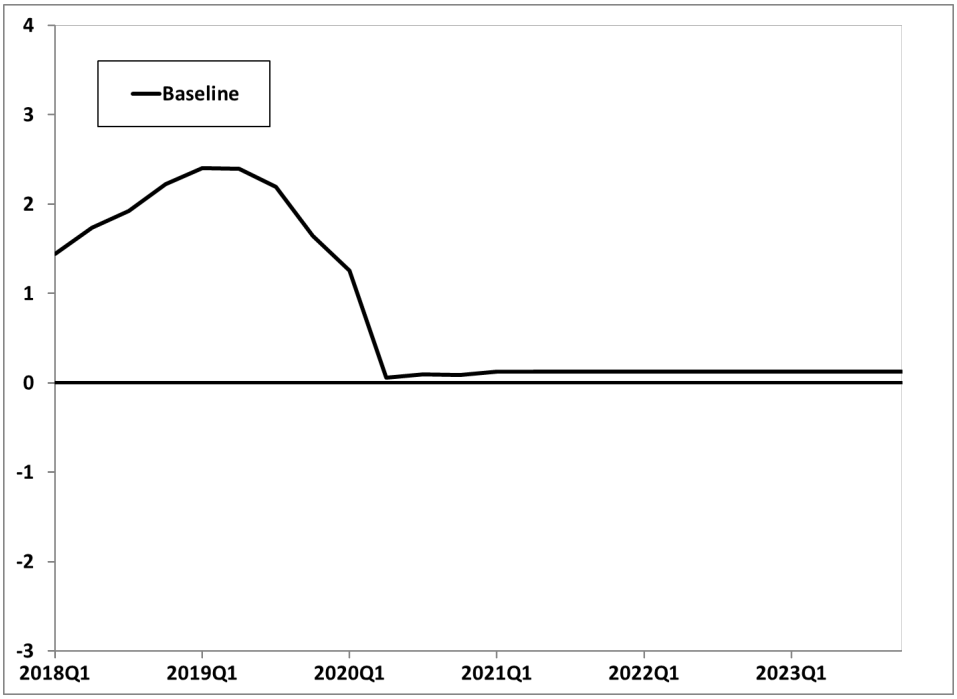


Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

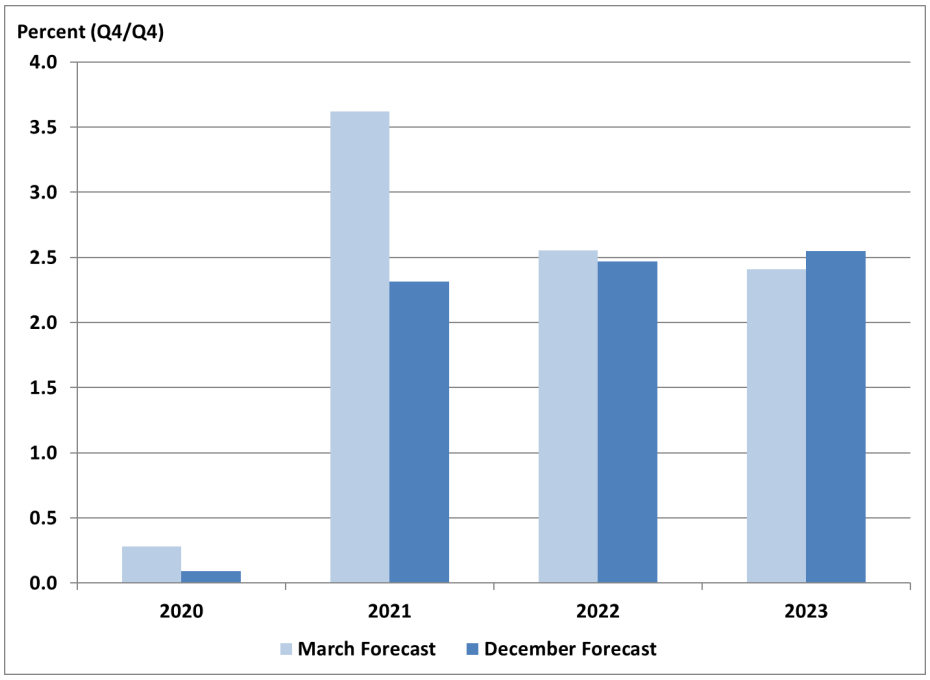


Figure 5b: Core PCE Inflation Growth

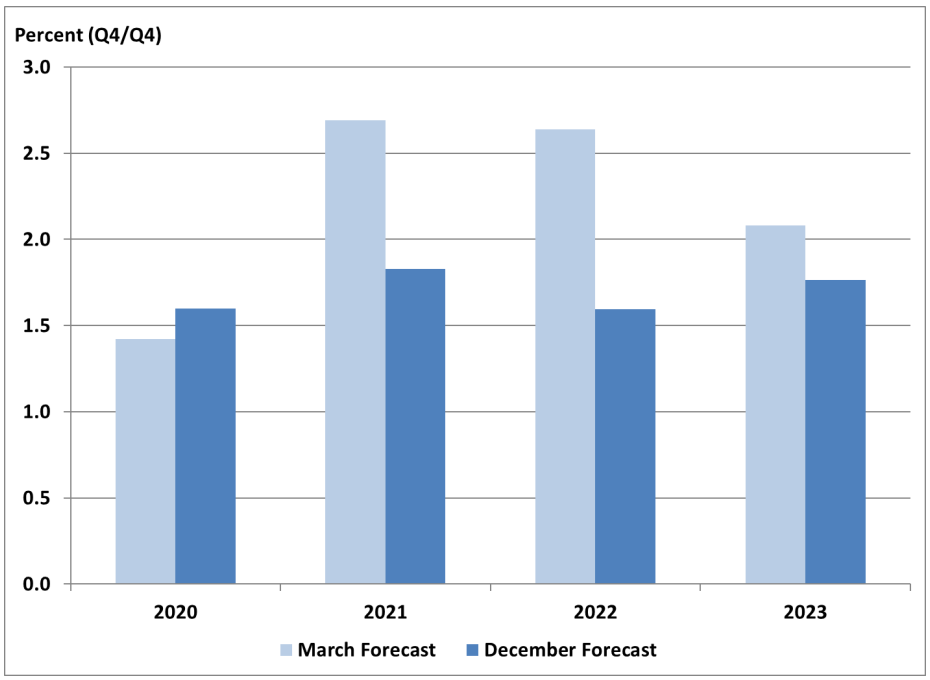


Figure 5c: Unemployment Rate

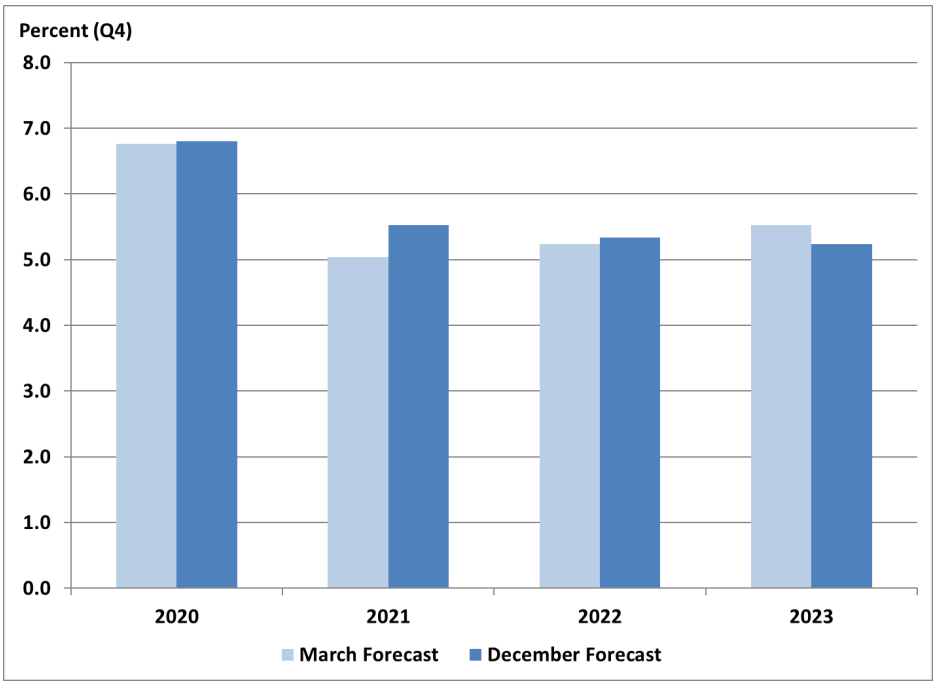
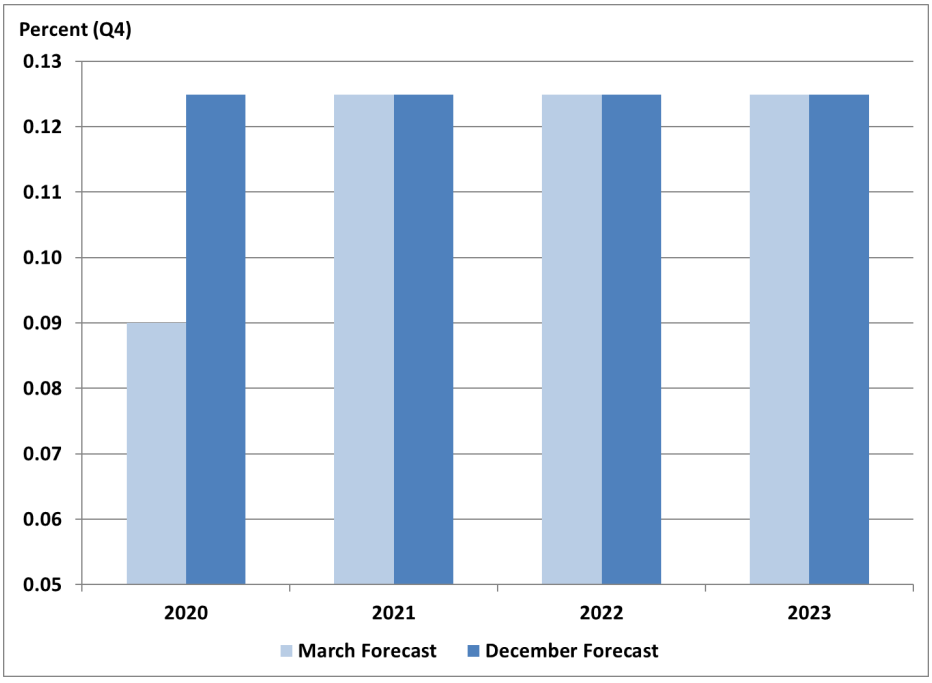


Figure 5d: Federal Funds Rate



Note: Historical data have been retrieved from Haver Analytics.