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 most recent high-frequency data indicate that following robust growth in the fourth quarter of last year, first-quarter growth will barely inch into positive territory. Continuation of supply chain disruptions, difficulty in finding workers, the large spike in energy prices, and the war in Ukraine are all taking their toll on economic activity. Despite these headwinds, economic fundamentals for the U.S. economy remain healthy. The labor market remains historically

tight, wages continue to grow, and demand remains strong. Home and asset values remain at high levels, and jobs are plentiful—all of which should support solid consumer spending over the remainder of the year. Indeed, most forecasters anticipate above-trend growth this year even as the Fed begins removing monetary accommodation. However, inflation pressures continue to increase, and the CPI is now growing at its fastest rate in over 40 years. As well, risks remain elevated. The war in Ukraine could spill over to other countries in Europe, and a new wave of COVID, which is currently running rampant in much of Europe, could similarly afflict the U.S. Absent the unfolding of those events, the U.S. economy should perform well in 2022.

After growing at a robust 6.9 percent annual rate in the fourth quarter, economic growth appears to have pulled back substantially in the first quarter of this year. Despite waning growth rates, the labor market remains robust and very tight by historical standards. The economy added over 1 million net new jobs in the first two months of the year, and the unemployment rate declined to 3.8 percent despite an increase in labor force participation. The job-openings rate remains near an historic high, and there are currently more job openings than there are unemployed workers. Compensation gains continue to advance at a healthy clip, with average hourly earnings growing by 5.1 percent over the last 12 months. As well, the gains have been broad based, and employers continue to indicate difficulties in finding and retaining qualified workers.

Real personal consumption growth stepped up a bit this quarter, driven mainly by the continued strong growth in goods consumption. As the number of COVID-19 cases continues to decline, it is expected that some of the strength in consumption will spill over into services. Recent data on seated dining, air traffic, and hotel room bookings appear to confirm that expectation. Sales of motor vehicles remain below pre-pandemic levels due to continued supply chain issues. However, sales have strengthened somewhat over the last two months. As the supply of microprocessors increases, so will the production and sale of cars. Not all is rosy. Weighed down by inflation and record-high prices at the pump, consumer sentiment continues to fall and is now at levels not seen since August 2011. As well, the end of the pandemic stimulus has markedly slowed the growth in personal income. On net, consumption should support above-trend growth for the economy, but there will likely be some pullback from the robust growth of last year.

Although growth in manufacturing has receded a bit lately, the sector remains healthy despite continued supply chain bottlenecks. The war in Ukraine will only contribute to primary-input shortages. Transportation and distribution activity still face challenges from congestion at major ports and a shortage of truck drivers. As a result, orders for goods continue to outpace shipments, and the volume of unfilled orders continues to grow. To meet above-trend demand

and the need to diversify supply chains, business fixed investment should also help support economic activity in 2022. Additionally, it is possible that the desired level of inventories to sales may increase as the "just in time" model of inventory holdings gives way to a "just in case" precautionary stance for inventory investment.

There are, however, signs that this year's economy will not run as hot as last year's. Residential real estate has been softening of late, with pending home sales falling for four consecutive months. Permits declined in February as well, but starts have continued at a healthy pace. Additionally, real construction spending has declined of late, and the sector is facing headwinds that include rising mortgage rates, a shortage of skilled labor, elevated lumber prices, and a shortage of available lots.

Inflation continues to run higher than the long-run average target of 2 percent, and the current acceleration is showing a good deal of momentum. Over the last year to February, the annualized growth rate of the CPI was 7.9 percent—its highest reading since January 1982. Worryingly, current inflation appears broad based, with the fraction of income spent on goods whose prices are growing by more than 4 percent at an annual rate exceeding 50 percent. Additionally, survey measures of expected inflation have risen. The Philadelphia Fed's survey of manufacturers found that firms expect inflation over the next year to be greater than 5 or 6 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 war in Ukraine are contributing to the slowdown, and present risks are on the upside for inflation and on the downside for growth. In the U.S., the Omicron wave of the virus has abated, but it is possible that the upsurge in cases currently being experienced in Europe could make it to our shores, posing additional risks to COVID-sensitive sectors. Additionally, inflation is running persistently well above the Federal Reserve's desired rate, prompting the need for a removal of monetary accommodation. That too will weigh on future economic activity. That said, many economic fundamentals appear sound. The labor market remains dynamic, and consumption and investment activity should support above-trend growth this year.

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 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 pre-set path through the end of 2022. The forecast is generated using observed data through the fourth quarter of 2021 together with an

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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.

assumption of how output growth and unemployment will fare in the first quarter of 2022. The forecast then begins in the second 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 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 1.2 percent annual rate in 2022, 1.1 percent in 2023, and 1.9 percent in 2024.

- Core PCE inflation runs at a 4.3 percent pace in 2022, falling to 2.9 percent in 2023 and 2.3 percent in 2024.

- The unemployment rate is at 4.8 percent at the end of 2022 and then rises to reach 5.9 percent at the end of 2023 and 5.8 percent at the end of 2024.

- By assumption, the federal funds rate reaches 1.1 percent at the end of 2022. The funds rate is then allowed to rise and reaches 1.9 percent at the end of 2023 and 1.4 percent at the end of 2024.

The baseline forecast now calls for output growth to run at a 5.6 percent annual rate in 2021, up from 4.8 percent in the December forecast. The forecast is now a bit weaker, as the spread of the Omicron variant of COVID-19 and continued supply chain disruptions are holding down economic activity in the first quarter more than was anticipated. As well, labor supply remains below projections. The model now anticipates that output growth will run at an average pace of only 1.2 percent in 2022 and then edge up to 1.9 percent in 2024. The model's current-quarter forecast of 1.7 percent is significantly above the Federal Reserve Bank of Atlanta's GDPNow forecast of 0.7 percent for the first quarter of 2022. The incoming data since the start of the first quarter have generally pointed to significantly weaker economic growth than in the fourth quarter of last year.

The baseline model shows output growth running at a pace that, on average, is below its long-run average over the next three years.[4] The unemployment rate is at its low of 3.9 percent in 2022Q1 and then rises gradually over the forecast horizon to reach 6 percent at the

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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.
[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.

beginning of 2024. This represents 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.

Recent data on inflation have continued to surprise on the upside. The model anticipates that core PCE inflation will run at a 4.9 percent pace in the first quarter of 2022. However, with gradually tightening monetary policy, inflation then moves down over the forecast horizon to average 4.3 percent in 2022 and 2.8 percent in 2023. Inflation edges down further to average about 2.3 percent in 2024. Thus, the model anticipates that inflation will run slightly above the FOMC target of 2 percent average inflation over the forecast horizon.

The baseline forecast remains weaker on growth and stronger on inflation than the median projections from the first-quarter 2022 Survey of Professional Forecasters (SPF) over the forecast horizon. The median respondent expects real output growth of 3.7 percent in 2022, 2.7 percent in 2023, and 2.3 percent in 2024. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 3.1 percent (Q4/Q4) for 2022, edging down to 2.2 percent in 2023 and 2.2 percent in 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 3.7 percent in 2022, falling to 3.4 percent in 2023 and 3.6 percent in 2024.

The March 2022 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 2.8 percent in 2022, falling to 2.2 percent in 2023 and 2 percent in 2024. The median forecast of the unemployment rate is 3.5 percent at the end of 2022, 3.5 percent at the end of 2023, and 3.5 percent at the end of 2024. Core PCE inflation is projected at 4.1 percent in 2022, moving down to 2.6 percent in 2023 and 2.3 percent in 2024. Headline inflation is projected to run at a similar pace as core inflation over the next three years. The forecast model's baseline forecast for the federal funds rate (Figure 4) is below the central tendency of the funds rate forecasts in the March 2022 SEP.

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 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 moderately strong growth in 2022 and inflation above the FOMC target. The model projects growth to run at a near-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 and war in Europe continues. 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 and supply chain disruptions ease quickly. On balance, the forecast calls for continued healthy output growth over the next few years and inflation that eases but remains above the 2 percent average target.

Figure 1: Real GDP Growth
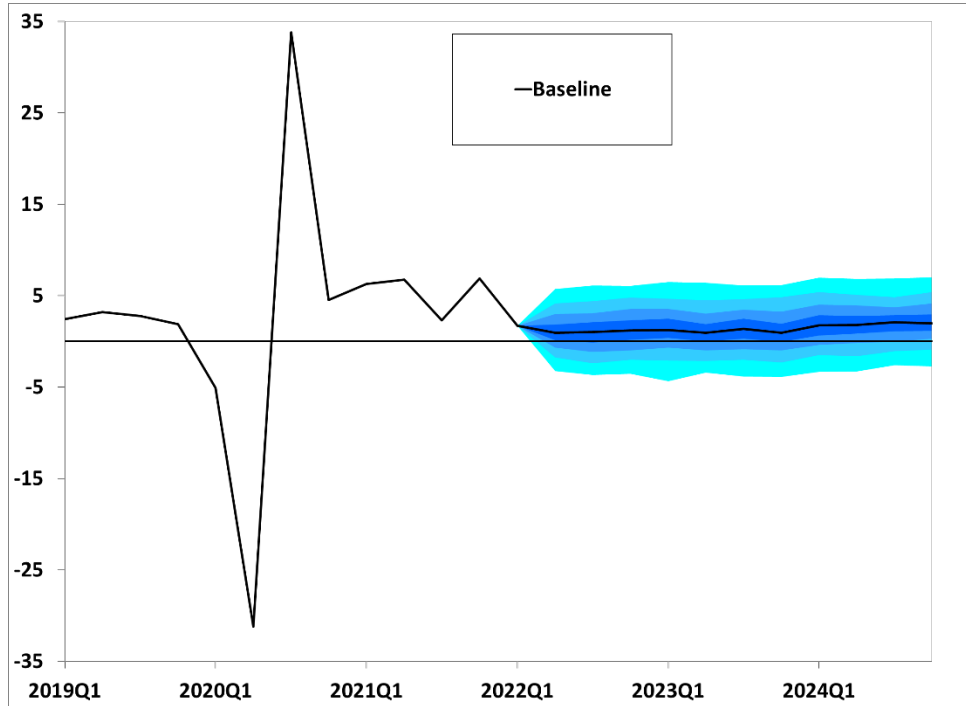
Figure 2: Core PCE Inflation
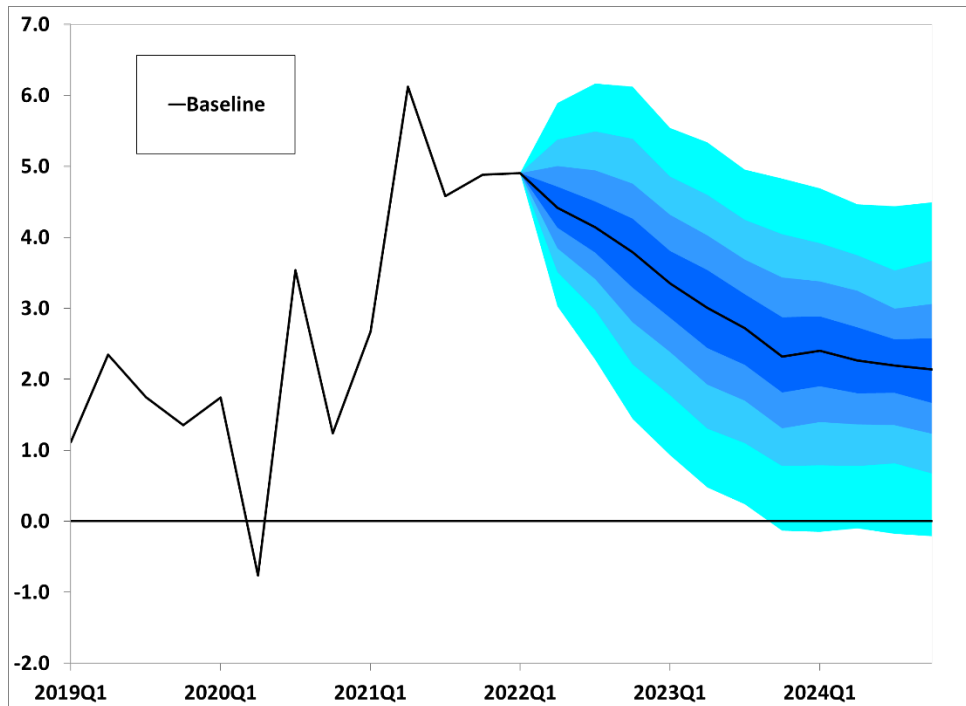
Figure 3: Unemployment Rate
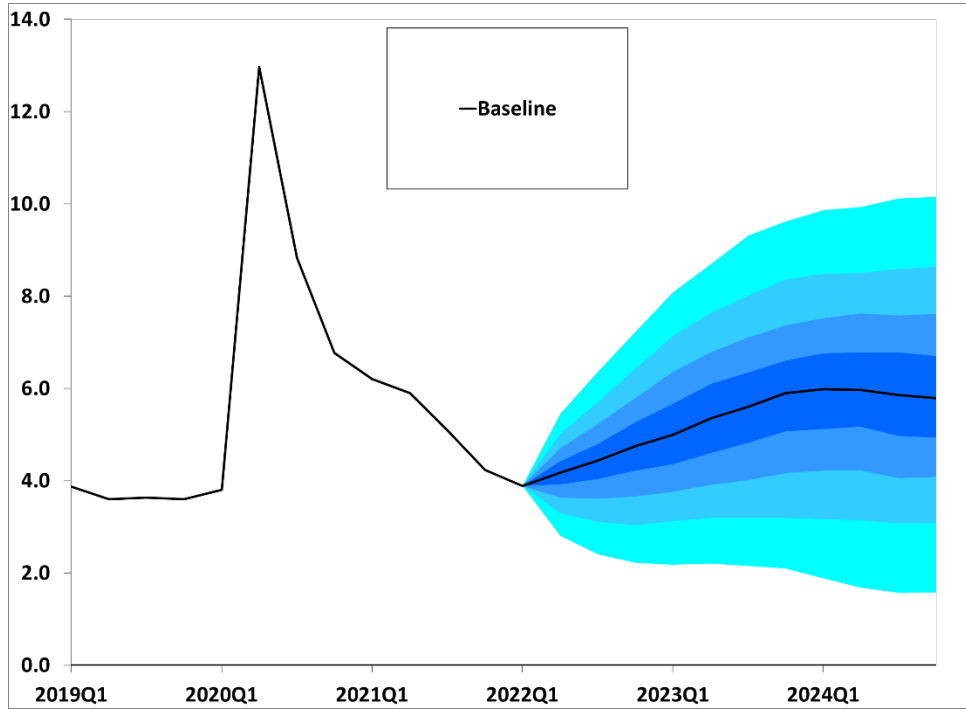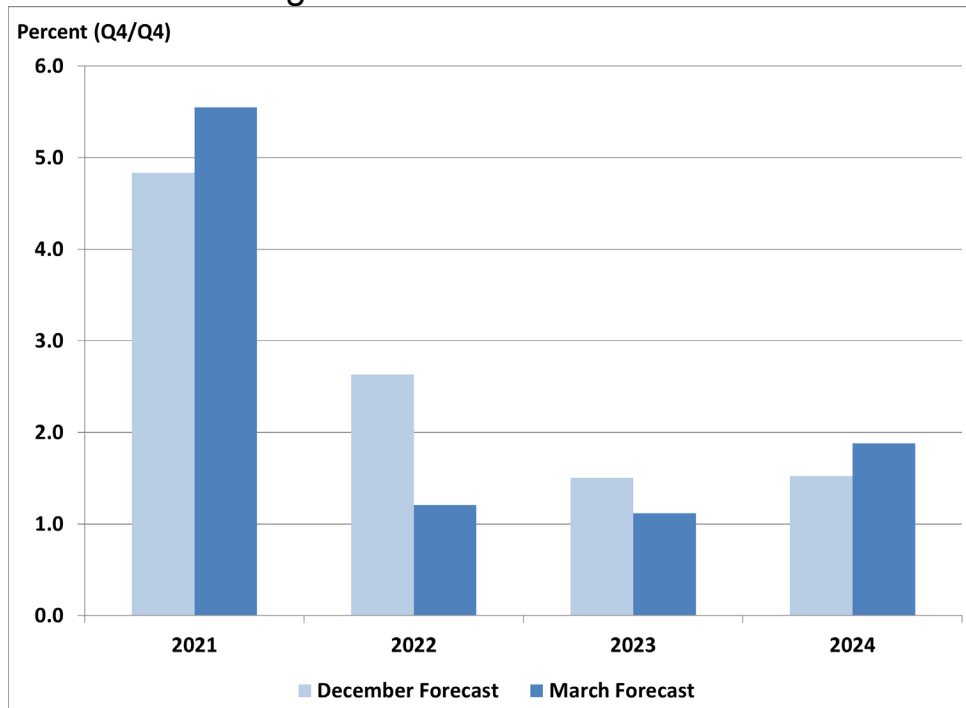

Figure 4: Federal Funds Rate
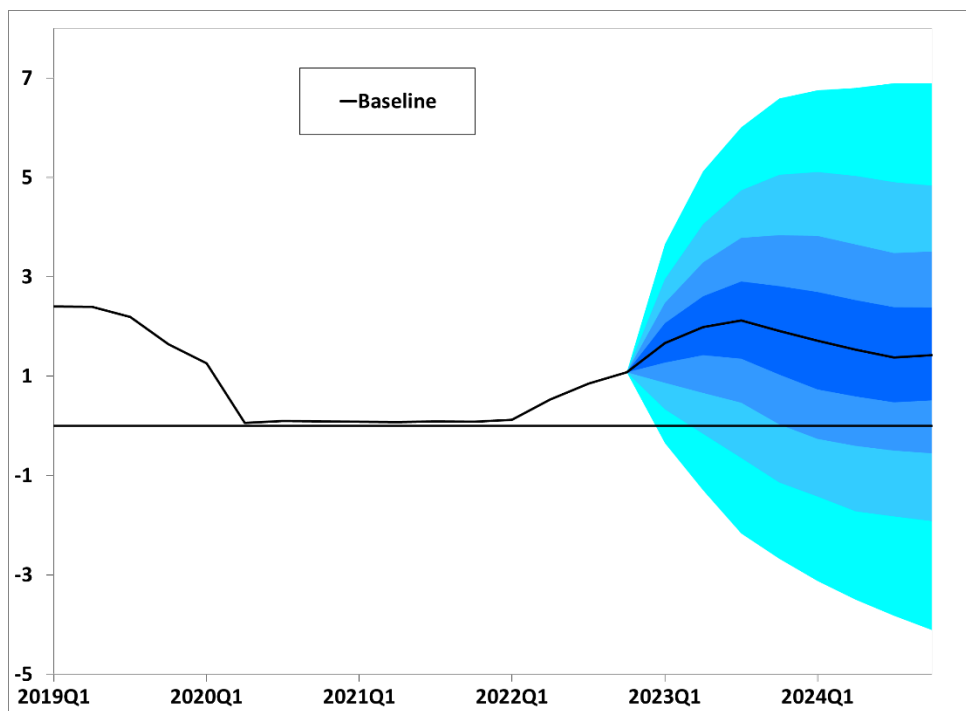
Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

Percent (Q4/Q4)

Figure 5b: Core PCE Inflation Growth

Percent (Q4/Q4)
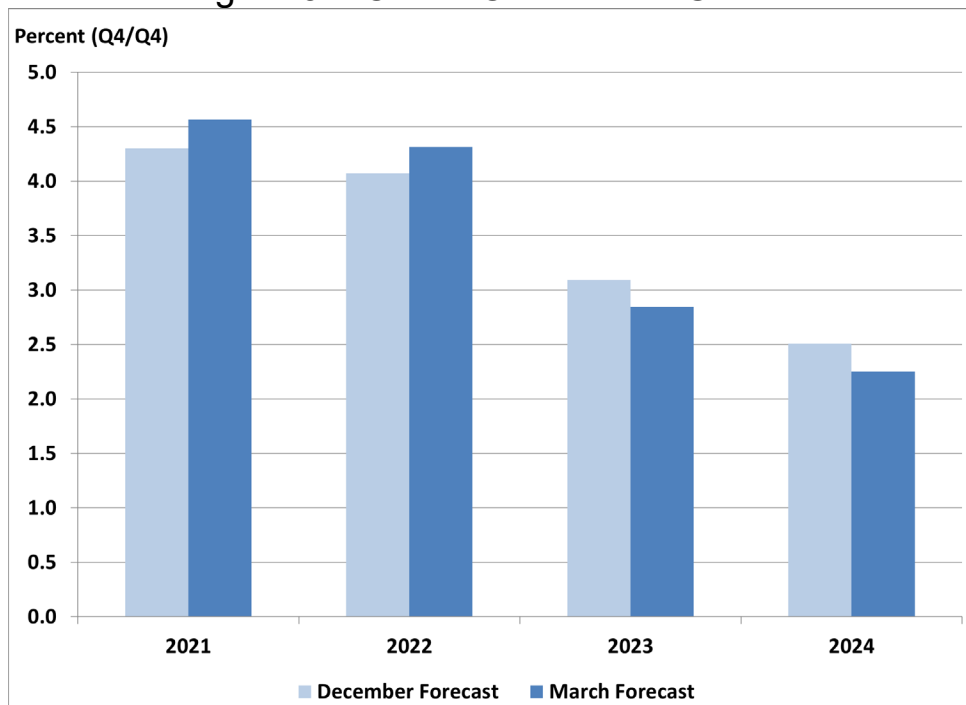
Figure 5c: Unemployment Rate

Percent (Q4)

December Forecast March Forecast
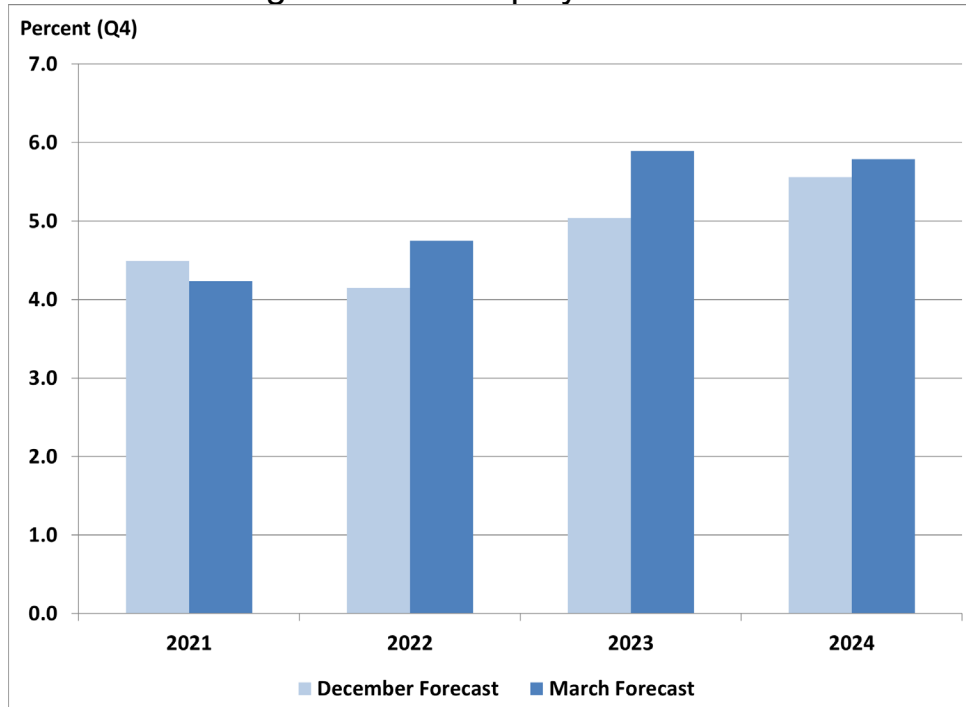
Figure 5d: Federal Funds Rate

Percent (Q4)

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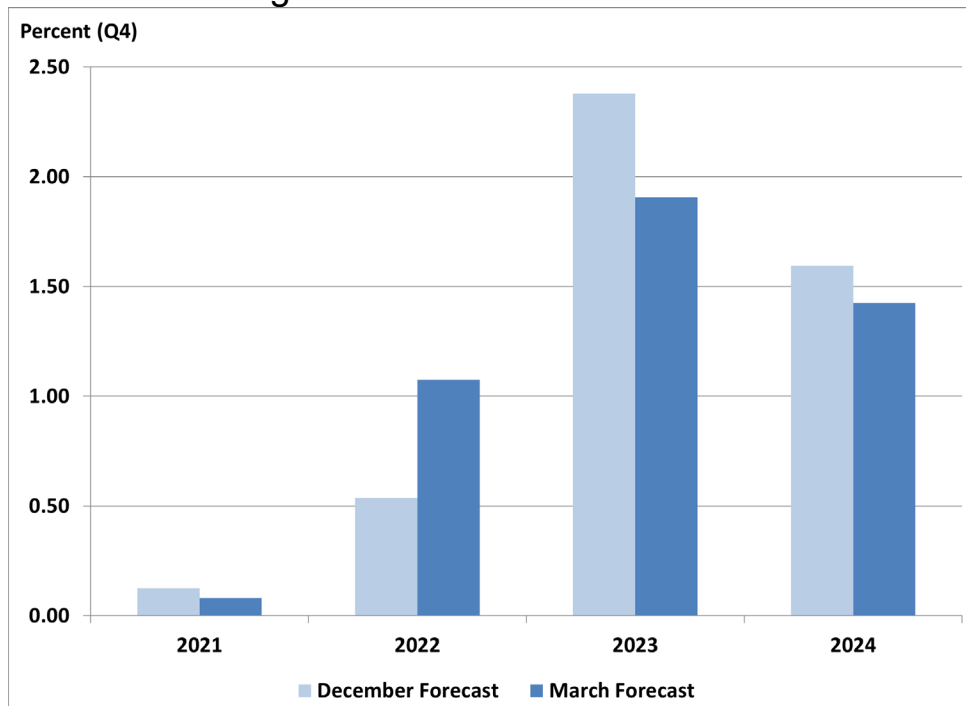
Note: Historical data have been retrieved from Haver Analytics.