Monetary Policy Report: Using Rules for Benchmarking

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December 2021

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 fourth-quarter economic growth has substantially accelerated after a somewhat disappointing third quarter. Despite the ending of stimulus payments, the economy continues to add jobs and job openings, consumer spending remains healthy, and real estate activity remains on solid footing. Manufacturing remains robust and activity in the service sector is healthy. Supply chain disruptions and the lack of

[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 Veronika Konovalova and Tal Roded for their assistance.

available labor continue to inhibit growth. Nonetheless, the economy is working around these constraints. The Omicron variant of the virus raises new concerns, as it appears to be even more transmissible than the Delta variant. With a significant portion of the population unvaccinated, another serious wave may be in the offing.

After growing at a trend-like 2.1 percent annual rate in the third quarter, economic growth appears to have accelerated substantially this quarter, probably in the neighborhood of 7.0 percent. For the year as a whole, growth will be quite strong, likely exceeding 5.0 percent, and the current economic strength is expected to carry over into next year. The rebound in growth is buttressed by robust consumer spending. Although total retail sales grew by 0.3 percent in November, they have risen by an astonishing 18.2 percent over the last 12 months to November. Full recovery in COVID-related sectors will probably await a significant reduction in pandemic-related illnesses.

The strength in consumption has been supported by strong gains in personal income, which has increased by 5.9 percent over the year to October. As well, asset markets continue to provide additional wealth to the consumer, and job opportunities are plentiful. Consumers, however, appear to have lost some confidence in part due to the resurgence of the Delta variant and rising inflation.

Led by manufacturing, non-COVID-related sectors continue to experience growth. Total industrial production rose 0.5 percent in November, with manufacturing IP advancing by 0.7 percent. Over the last 12 months to November, manufacturing output has grown by 4.6 percent. The strength in manufacturing is also reflected in manufacturing orders, which rose by 1.0 percent in October and are up 15.2 percent over the preceding 12 months. A significant fraction of the gains in orders is due to rapidly increasing prices. For example, through October, prices on primary metals have risen by almost 64 percent. However, light-vehicle sales remain depressed relative to their pre-pandemic levels. Supply disruptions, especially those pertaining to microchips, continue to constrain production, and vehicle inventories remain depressed. As a result, the inventory-to-sales ratio is at historically low levels. Availability of models remains somewhat problematic, which brings to mind Henry Ford's famous quip, "You can have any color car you want so long as it is black." Unlike the decline in consumer optimism, manufacturers remain upbeat about both current and future prospects. For example, the Federal Reserve Bank of Philadelphia's November manufacturing survey points to strong current activity, with increases in both new orders and shipments. As well, the employment index is at its historic high and the price indices remain quite elevated. Optimism remains, with continuing plans for additional capital expenditures, robust additional hiring, and a continuation of price increases. With regard to Third District services, views regarding future activity are high. Contacts, however, point to continuing problems with supply chains and with shipping costs, so although bottlenecks and labor shortages continue to plague the manufacturing sector, the sector is continuing to grow.

The economy continues to add jobs at a solid pace, although November's establishment report was a bit disappointing, with a mere 210,000 net new jobs added. The household survey told a markedly different story, with civilian employment surging by 1.1 million jobs, driving the unemployment rate down to 4.2 percent. Additionally, more people were entering the labor force, and the labor force participation rate rose significantly by 0.2 percentage point to 61.8, its highest reading during the current recovery. The labor market remains healthy, with the number of job openings per available worker at an all-time high. There are now close to one-and-one-half job openings for every unemployed worker. Quits remain elevated as employees move to more attractive jobs. Notably, initial claims for unemployment insurance have declined to their lowest level since 1969. Part of the continued recent decline in claims may be due to the ending of various unemployment benefits associated with pandemic relief. As well, wage growth is strong, with average hourly earnings rising by 4.8 percent over the last 12 months. As mentioned, many contacts report difficulty in attracting and retaining qualified workers, and we hear of increasing use of retention bonuses and more flexible work schedules where possible.

Residential real estate activity peaked early in the year but has recently shown some revival and continues to be a source of economic strength. Although largely on a downward trend since January, single-family permits increased by 2.7 percent in November. As well, the number of new homes under construction has risen to 1.49 million, which is the highest number since December 1973. Despite headwinds due to supply constraints, total housing starts are on pace to achieve their best performance since 2006. House price appreciation continues to be robust, with median existing home prices rising by 13.1 percent since last October. These rates are significantly lower than the exceptionally rapid increases earlier in the year but are nevertheless outsized. All told, total nominal residential real estate construction has grown by 16.7 percent over the past 12 months to October.

Inflation continues to run higher than the long-run average target of 2 percent, and it is difficult to characterize the recent rates of inflation as transitory. Since last October, the PCE price index has risen by 5.0 percent, and as of November, CPI inflation, at 6.8 percent, is at its highest in three decades. Inflation continues to surprise forecasters to the upside, and the increase in prices is becoming more broad-based. As mentioned, the behavior of inflation is beginning to weigh on consumer optimism as the prices of key consumption goods continue to rise significantly, and there is now evidence of increasing inflation in rents.

However, market-based measures of inflation expectations indicate that inflation expectations continue to remain well anchored at around 2 percent, although some recent survey measures on consumers from the New York Fed and on firms from the Philadelphia Fed show a marked increase in near-term inflation expectations. The latest Philadelphia Fed survey indicates inflation expectations by firms in the neighborhood of 5 percent, and the New York Fed's survey of consumers points to inflation expectations of around 6 percent.

To conclude, the pace of economic activity has picked up substantially from its modest growth rate in the third quarter. The resurgence of COVID-19, the continuation of supply bottlenecks, and the slow growth in the labor force have been drags on recent activity. The most recent data on retail sales point to a bounce-back in consumption activity, and despite supply constraints, the manufacturing sector continues to hum along. The labor market continues to heal, and people appear to be once again entering the labor force. Residential real estate—while having peaked—is still performing well. However, risks may be slightly tilted to the downside on economic activity and to the upside on inflation, and the economy, while improving noticeably, still has further to travel before it has fully recovered.

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	$\boldsymbol{\rho}$	$\boldsymbol{\Psi_\pi}$	$\boldsymbol{\Psi_y}$
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 few quarters. 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 through the middle of 2022. The forecast is generated using observed data through the third quarter of 2021 together with an assumption on how output growth and unemployment will fare in the fourth quarter of 2021. The forecast then begins in the first 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 2.6 percent annual rate in 2022, falling to 1.5 percent in 2023 and 2024.
- Core PCE inflation runs at a 4.1 percent pace in 2022, falling to 3.1 percent in 2023 and 2.5 percent in 2024.
- The unemployment rate is at 4.2 percent at the end of 2022 and then rises slightly to reach 5 percent at the end of 2023 and 5.6 percent at the end of 2024.

[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.

- By assumption, the federal funds rate remains at the ELB until mid-2022. The funds rate is then allowed to rise and reaches 0.5 percent at the end of 2022, 2.4 percent at the end of 2023, and 1.6 percent at the end of 2024.

The baseline forecast now calls for output growth to run at a 4.8 percent annual rate in 2021, down from 5.7 percent in the September forecast. The forecast is bit weaker, as the spread of the Delta variant of COVID-19 led to less-robust economic activity in the third quarter and concerns about the Omicron wave's impact are rising. As well, supply-side constraints continue to impact growth, and labor supply remains below projections. Conditioning assumptions for the forecast do not explicitly incorporate adjustment for pending fiscal stimulus should current budget proposals pass Congress. Consequently, the model is not anticipating fiscal stimulus that might show through in 2022. Looking further ahead, the model anticipates output growth will run at an average pace of 2.6 percent in 2022 and 1.5 percent in 2023 and 2024. The model's current-quarter forecast of 4.3 percent is significantly lower than the Federal Reserve Bank of Atlanta's GDPNow forecast of 7.2 percent for the fourth quarter of 2021. The incoming data since the start of the fourth quarter have generally pointed to significantly stronger economic growth than in the third quarter.

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 falls from 4.5 percent in 2021Q4 to a low of 4 percent in 2022Q3. The unemployment rate then begins to rise and by the end of the forecast horizon, at 5.6 percent, is above 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 3.9 percent pace in the fourth quarter of 2021, rising to a peak of 4.1 percent in 2022Q3. Thereafter, inflation moderates to run at a 2.4 percent pace in the fourth quarter of 2024. Thus, the model anticipates that inflation will run 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 until mid-2022.

The baseline forecast is weaker on growth and stronger on inflation than the median projections from the fourth-quarter 2021 Survey of Professional Forecasters (SPF) over the forecast horizon. The respondents expected real output growth of 3.9 percent in 2022, 2.6 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 2.3 percent (Q4/Q4) for 2022, edging down to 2.1 percent in 2023. The forecasters' path for the unemployment

[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.

rate is generally lower over the forecast horizon compared to the baseline: The median SPF forecast for the unemployment rate is 4.1 percent in 2022, falling to about 3.6 percent in 2023 and 2024.

The December 2021 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 4 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 2.7 percent in 2022, moving down to 2.3 percent in 2023 and 2.1 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 within the range of the December 2021 SEP over the forecast horizon. The baseline forecast is outside the central tendency of the SEP, being somewhat below at the end of 2022 and well above at the end of 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 third 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 well above the FOMC target. The projections for output growth and inflation are similar to those of the September forecast for 2022 through 2024. The growth rate diminishes over the forecast horizon, and inflation moves down toward the 2 percent average target. Near-term uncertainty surrounding the evolution of the COVID pandemic remains very high. The exercise in this document is best thought of as what might happen if the virus continues to wane and if the economy steadily returns to its pre-virus structure. On balance, the forecast calls for continued healthy output growth over the next few years and inflation that eases over the next three years but that remains above the 2 percent average target.

Figure 1: Real GDP Growth

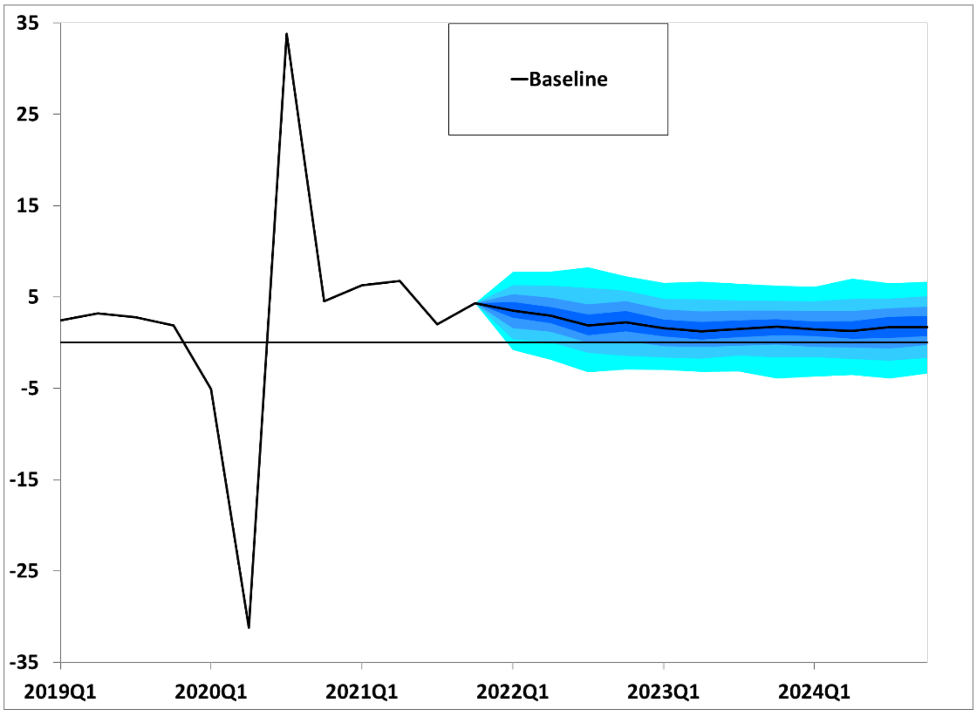


Figure 2: Core PCE Inflation

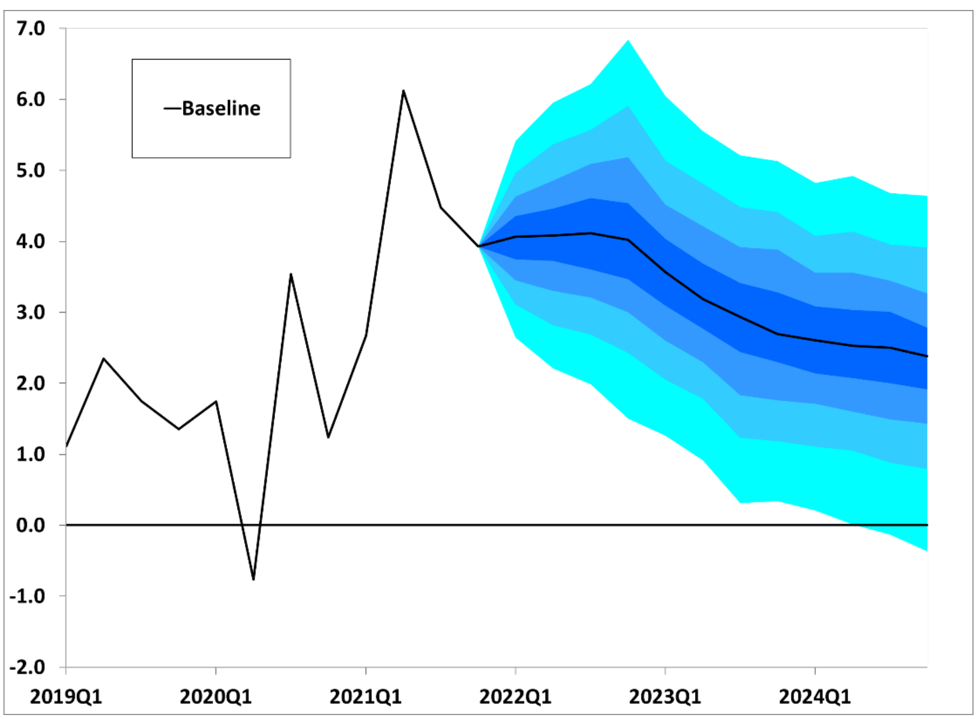


Figure 3: Unemployment Rate

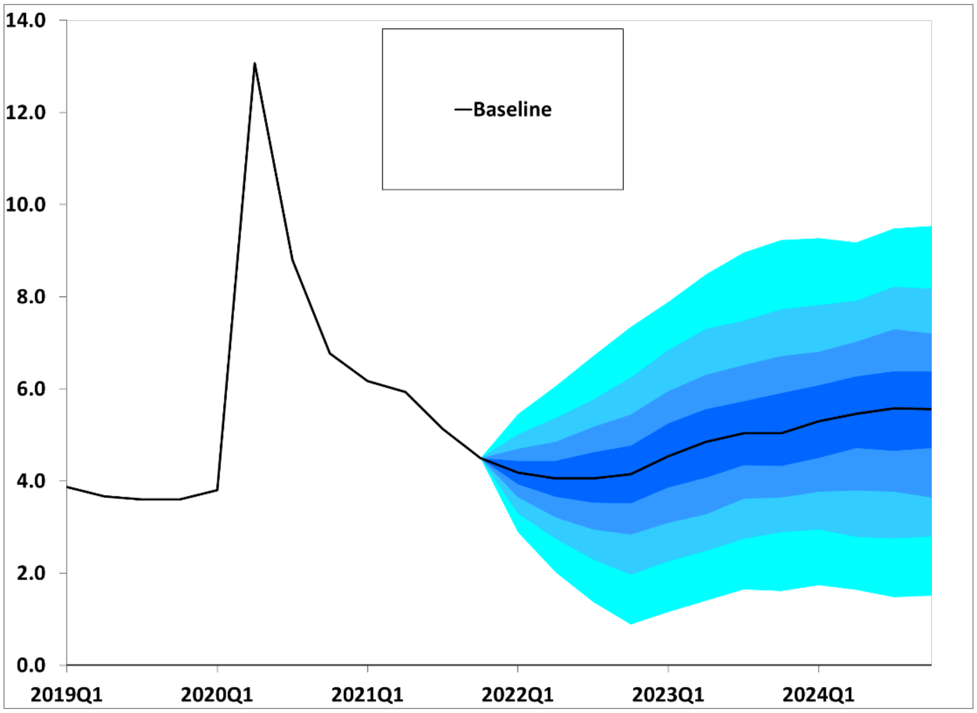


Figure 4: Federal Funds Rate

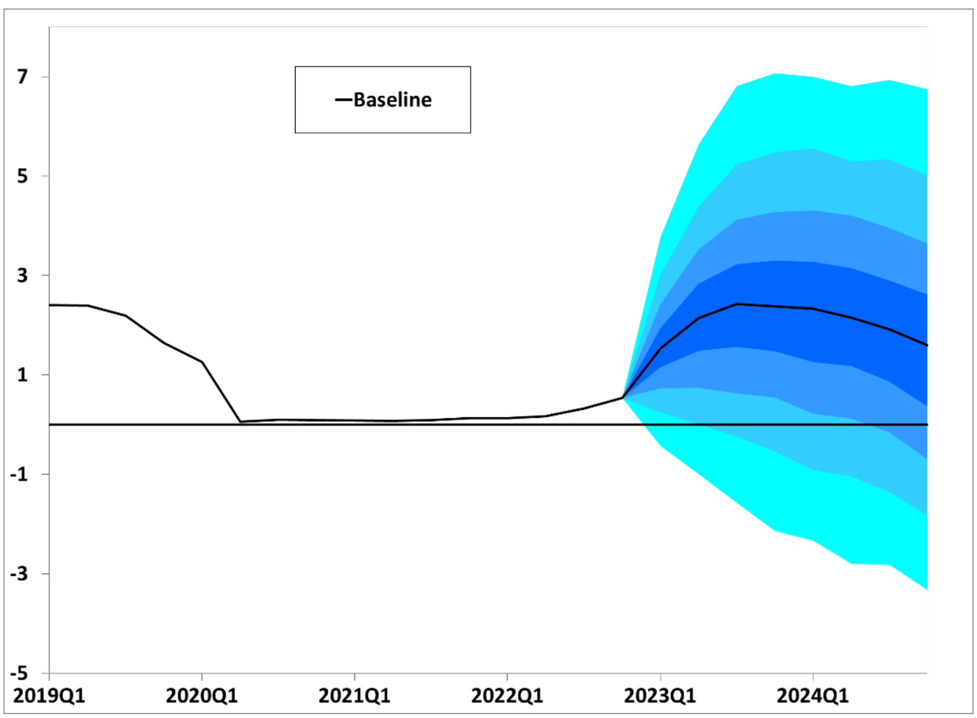


Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

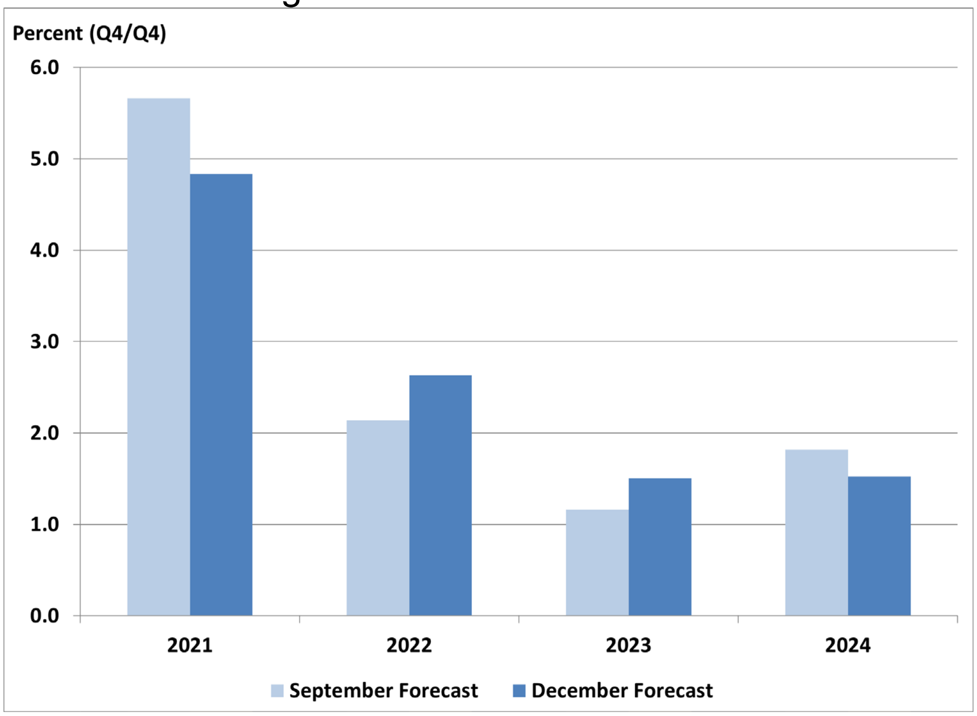


Figure 5b: Core PCE Inflation Growth

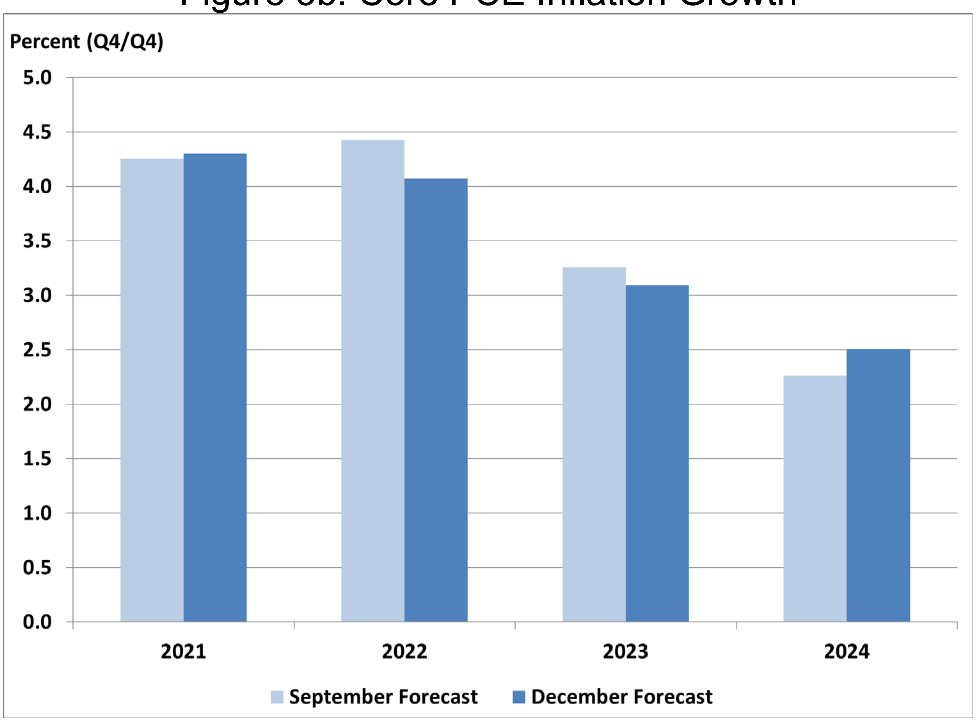


Figure 5c: Unemployment Rate

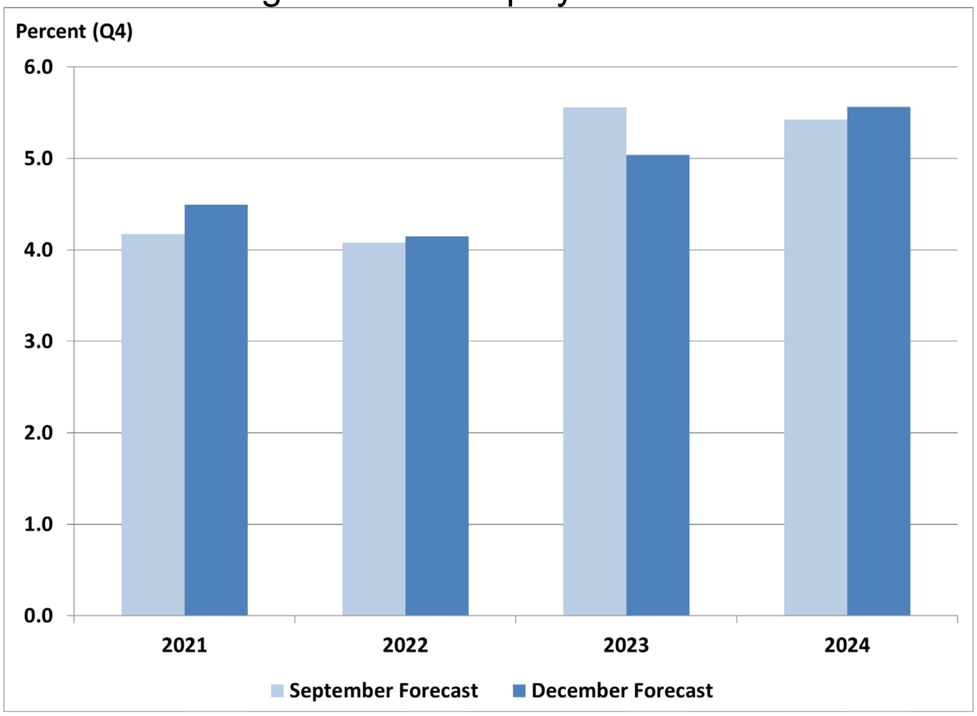
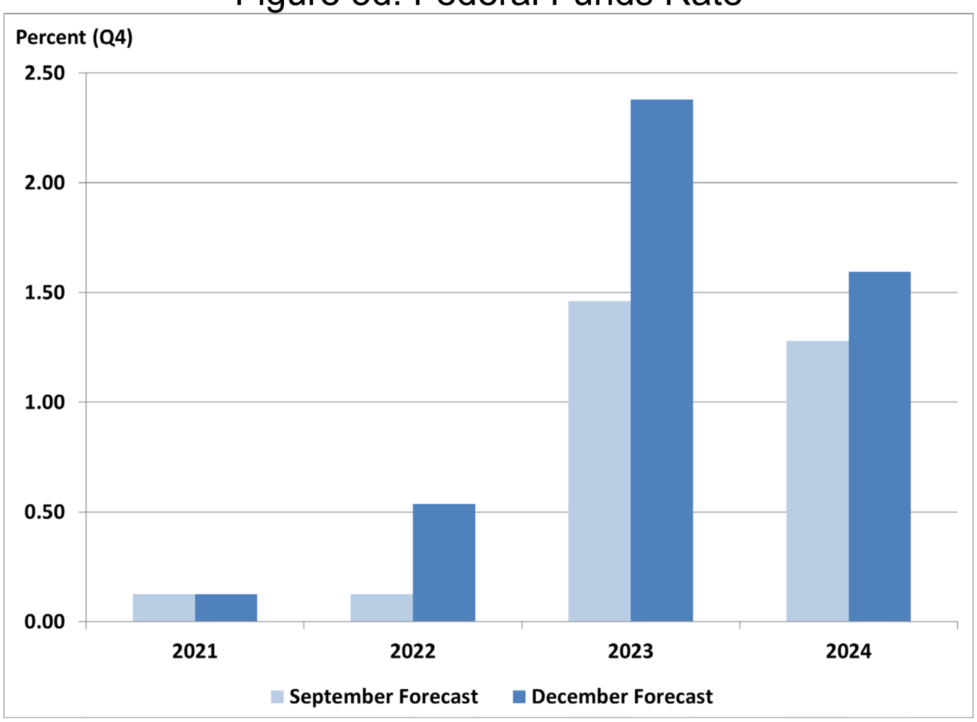


Figure 5d: Federal Funds Rate



Note: Historical data have been retrieved from Haver Analytics.