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 economic activity has weakened. The first half of the year has experienced negative growth, and most forecasters project that activity will grow at below-trend rates over the second half of the year. On net, growth in 2022 should be flat, and most are not expecting a strong bounce back in 2023. Improving supply chains and continued consumption growth are expected to support a positive second half, but there

[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.

are noticeable signs of economic weakness. Residential real estate markets may very well be in recession, with new construction waning. Increases in mortgage rates and high home prices are weighing on this sector. Mortgage rates are likely to go higher as the FOMC continues to tighten monetary policy. As well, industrial production has slowed and high inflation continues to erode household spending power. The war in Ukraine continues to affect the supply of key materials, with the greatest negative impact being felt in Europe. It is not out of the question that the economy could enter a mild recessionary period. The bright spot continues to be the labor market, where job growth continues at an extremely healthy pace. As long as the labor market remains healthy, the economy will likely avoid a recession.

After declining by 1.6 percent in the first quarter, the economy declined by 0.6 percent in the second quarter and is only expected to grow slowly over the remainder of the year, implying that GDP will remain largely flat for 2022. However, gross domestic income (GDI), which also measures the aggregate state of the economy, has been growing positively, increasing by 1.75 percent in the first quarter and 1.34 percent in the second quarter. Theoretically, both of these measures should be identical, but they are calculated from different surveys and there is usually some statistical discrepancy. That discrepancy happens to be rather large at the moment, so a better gauge would be to optimally statistically combine the information in both series to evaluate the economy's underlying strength. Such a measure is computed in the Philadelphia Fed's Real-Time Data Center and is referred to as GDPplus. Over the first two quarters of the year, it has grown by 2.0 percent and 1.8 percent, respectively, indicating that the economy is in somewhat better shape than implied by readings on GDP alone.

As mentioned, consumption activity is lending modest economic support. Retail sales grew tepidly in August and are on a downward trend. Motor vehicle sales grew by a healthy 2.8 percent in August, but vehicle sales remain well below pre-pandemic levels as supply shortages continue to plague the automotive industry. Goods sales also remain healthy, but going forward, rising interest rates could weigh heavily on that category of consumption. Other factors contributing to the gradual weakening in consumption are falling asset prices and the waning effect of past government stimulus payments. Nevertheless, future consumption growth is expected to be positive, and we are seeing some modest improvement in consumer sentiment. In September, the preliminary reading of the index from the University of Michigan was up almost 10 points from its record low of 50.0 in June. The improvement is in part due to falling prices at the pump. Additionally, consumer balance sheets remain healthy, with default rates remaining low.

Residential real estate also looks to be weakening and may be in recession, and that is especially true of the single-family sector of the market. Single-family permits fell for the sixth straight month in August, and although single-family housing starts rebounded a bit in August, this segment of the housing market has cooled noticeably since the spring. The multi-family portion, which is a relatively small portion of the market, continues to boom. High single-family home prices and continuing supply constraints partially explain the strength in the multi-family part of the market as the affordability of single-family homes is pushing some households out of that market. House prices have also begun to cool, with 24 percent of builders surveyed by the National Association of Home Builders reporting that they had lowered home prices over the last month.

Weakness is also apparent in the manufacturing sector. In the Philadelphia Fed's Manufacturing Business Outlook Survey, the current conditions index indicates that regional manufacturing is in recession. The September survey showed significant weakening in both new orders and shipments, and the index for future activity showed marked pessimism by industry contacts. Many firms continue to wrestle with supply chain problems and are having trouble finding enough skilled workers. Nationally, the ISM index continues on a downward trend, but at 52.8 in August it remains in expansionary territory. That the sector remains weakly expansionary was indicated by August's 0.1 percent increase in production activity.

On the bright side, the labor market remains robust and very tight by historical standards despite the decline in GDP. The economy has added roughly 3.5 million net new jobs through August this year, and August's employment growth of 315,000 net new jobs exceeded most forecasters' expectations. Thus, employment growth remains extraordinarily healthy at this point in the recovery. Other labor market indicators also point to strength. Job-opening rates have retreated somewhat from the record high in March, but they are still at a remarkably high level, with approximately two openings for each unemployed worker. Quit rates have also fallen but remain above pre-pandemic levels, indicating that job-to-job movements are still healthy and the rate at which workers are laid off is also below what it was pre-pandemic. Taken together, the various readings point to a tight labor market. Nominal compensation, as measured by average hourly earnings, is up 5.2 percent over the last 12 months, also pointing to a healthy labor market. However, nominal wage gains are not quite keeping up with inflation, implying that earning power has decreased somewhat over the past year.

Turning to inflation, it shows little sign of easing. Largely due to lower energy prices, the headline CPI's rise of 8.3 percent over the last 12 months to August is down from its four-decade high of 9.1 percent in June. However, the core index, which takes out volatile food and energy prices, increased by 6.3 percent over the last year, not far from its four-decade high of 6.4 percent in March. Other indicators, like the various trimmed means produced at both the Dallas and Cleveland Feds, remain elevated, and inflationary pressures are broad based, affecting much of the consumption basket. Fortunately, survey measures of inflation seem to be improving, and market-based measures continue to indicate that inflation expectations are well anchored at the Fed's 2 percent target. The FOMC has indicated that getting inflation under control is a priority, and its resolve appears to be credible.

To conclude, the pace of economic activity is weak, and 2022 looks likely to experience little or no growth. There is evidence that supply bottlenecks are slowly unwinding, but supply chains have not returned to pre-pandemic efficiency. Past and prospective monetary tightening will weigh negatively on economic prospects, especially in interest-sensitive sectors. However, the labor market remains historically healthy, and the consumer may be able to weather the upcoming economic headwinds. At present, risks are to the upside for inflation and on the downside for growth. The view that future economic activity is weakening is reflected in FOMC members' projections of economic activity, which have been significantly downgraded since the June FOMC meeting. Next year's expected real GDP growth has been downgraded by half a percentage point to 1.2 percent, while the forecasted unemployment rate also increased by 0.5 percentage point to 4.4 percent. Expectations of inflation were also raised, and the median path for appropriate policy was also significantly tightened. The only significant bright spot continues to be the labor market, with rapid gains in employment and a plentitude 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	$\boldsymbol{\rho}$	$\boldsymbol{\Psi_\pi}$	$\boldsymbol{\Psi_y}$
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.

Model Forecasts Under the Baseline

The forecast is generated using observed data through the second quarter of 2022, together with an assumption of how output growth and unemployment will fare in the third quarter of 2022. The forecast then begins in the fourth quarter of 2022 and extends through the fourth quarter of 2025. 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 be flat in 2022, 1.1 percent in 2023, 1.5 percent in 2024, and 1.9 percent in 2025. This represents a downward revision in the forecast compared to June.
- Core PCE inflation runs at a 4.8 percent pace in 2022, falling to 3.8 percent in 2023, 2.9 percent in 2024, and 2.4 percent in 2025.
- The unemployment rate is at 3.9 percent at the end of 2022 and then rises to reach 5.6 percent at the end of 2023, 6.4 percent at the end of 2024, and 6.5 percent at the end of 2025.

[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.
[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 federal funds rate averages 2.4 percent in 2022Q4, rising to 3.3 percent in 2023Q4 and then falling to 2.6 percent at the end of 2024 and 2 percent at the end of 2025. Note that these forecasts were generated prior to the September FOMC meeting.

The forecast for output growth is weaker compared to the June forecast as the economic data on output has generally come in on the weak side since early summer. Our forecast was made prior to the most recent FOMC meeting; we no longer impose a path for the funds rate on the model but rather let monetary policy be completely data determined according to the model's policy reaction function. As of the September FOMC meeting, the funds rate in the fourth quarter is likely to be higher than what is projected in the model baseline forecast. Note as well that the model path for the funds rate is below the market expectation and the modal forecast from the September SEP. 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. Consumer confidence has deteriorated, and inflation remains well above the FOMC's target.

The model now anticipates that output growth will be flat in 2023 and then rebound to only a bit above 1 percent in 2024. The model's current-quarter forecast of 1.4 percent is significantly above the Federal Reserve Bank of Atlanta's GDPNow forecast of 0.3 percent for the third quarter of 2022.

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 rises gradually over the forecast horizon to reach 6.5 percent at the end of 2025. This is somewhat above 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 4.8 percent pace in 2022. With tightening monetary policy and modest output growth, inflation then moves down, albeit slowly, over the forecast horizon to average 3.8 percent in 2023 before dropping to 2.4 percent in 2025. Thus, the model anticipates that inflation will run above the FOMC target of 2 percent average inflation over the forecast horizon.

[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 baseline forecast is weaker on growth than the median projections from the third-quarter 2022 Survey of Professional Forecasters (SPF) over the forecast horizon. The median respondent expects real output growth of 1.6 percent in 2022, 1.3 percent in 2023, 2.3 percent in 2024, and 2.1 percent in 2025. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 4.5 percent (Q4/Q4) for 2022, edging down to 2.8 percent in 2023 and 2.2 percent in 2024. Thus, the SPF is similar on inflation in 2022 but then expects less inflation over the following two years compared to the model. The forecasters' path for the unemployment rate is lower over the forecast horizon compared to the baseline: The median SPF forecast for the unemployment rate is 3.7 percent in 2022, rising to 3.9 percent over the period from 2023 to 2025.

The September 2022 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 0.2 percent in 2022, 1.2 percent in 2023, 1.7 percent in 2024, and 1.8 percent in 2025. The median forecast of the unemployment rate is 3.8 percent at the end of 2022, 4.4 percent at the end of 2023, 4.4 percent at the end of 2024, and 4.3 percent at the end of 2025. Core PCE inflation is projected at 4.5 percent in 2022, moving down to 3.1 percent in 2023, 2.3 percent in 2024, and 2.1 percent in 2025. The median Committee member forecast now anticipates that the federal funds rate will reach 4.4 percent at the end of 2022, rising to 4.6 percent at the end of 2023 and then falling to 3.9 percent at the end of 2024 and 2.9 percent at the end of 2025.

Summary

The baseline NKDSGE model uses historical correlations in the data to generate its forecasts and does not incorporate significant judgmental adjustment. The NKDSGE model also does not explicitly account for any structural changes to the economy that may be induced by 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 flat output growth in 2022 and only modest growth over the next three years. Inflation eases slowly and runs above the FOMC target of 2 percent on average through 2025. Forecast uncertainty remains very high as the economy recovers 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. On balance, the forecast now calls for a weaker real economy and higher inflation over the next few years compared to the June projection.

Figure 1: Real GDP Growth

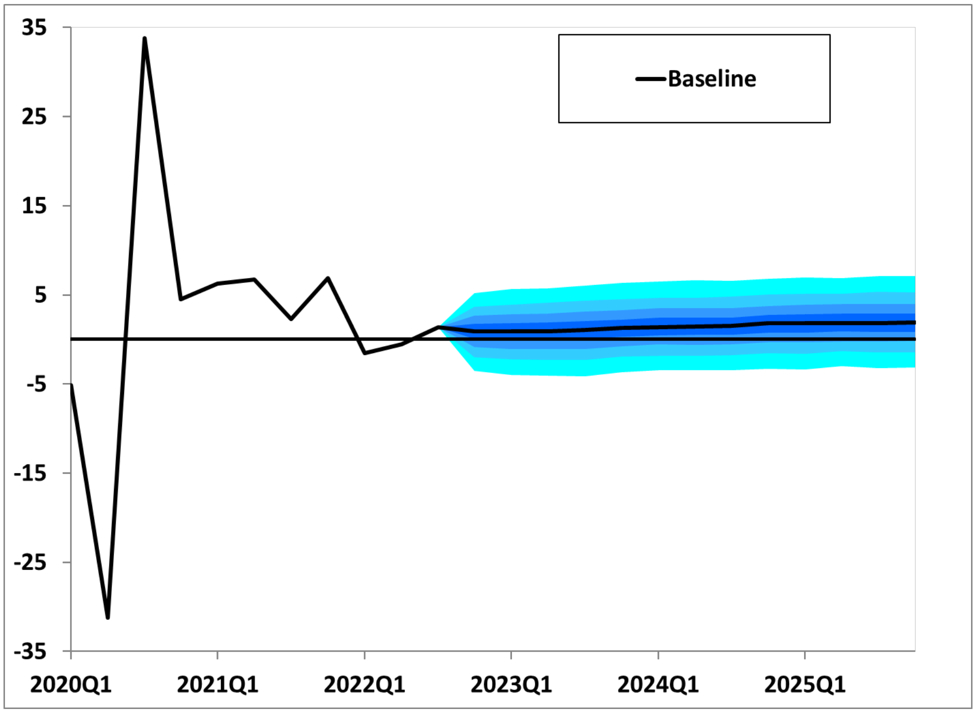


Figure 2: Core PCE Inflation

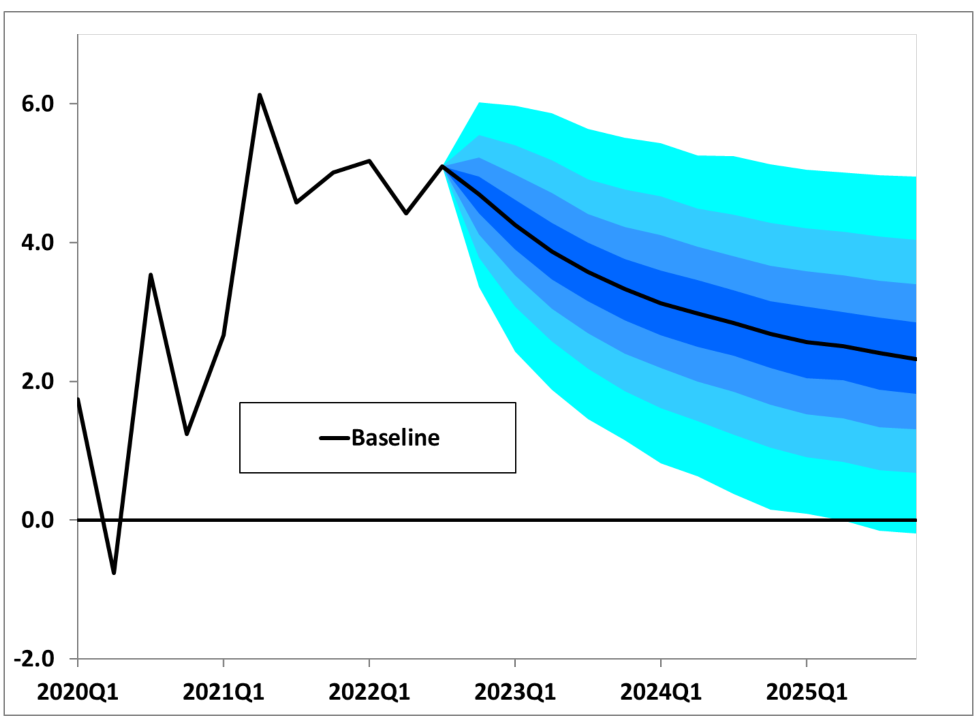


Figure 3: Unemployment Rate

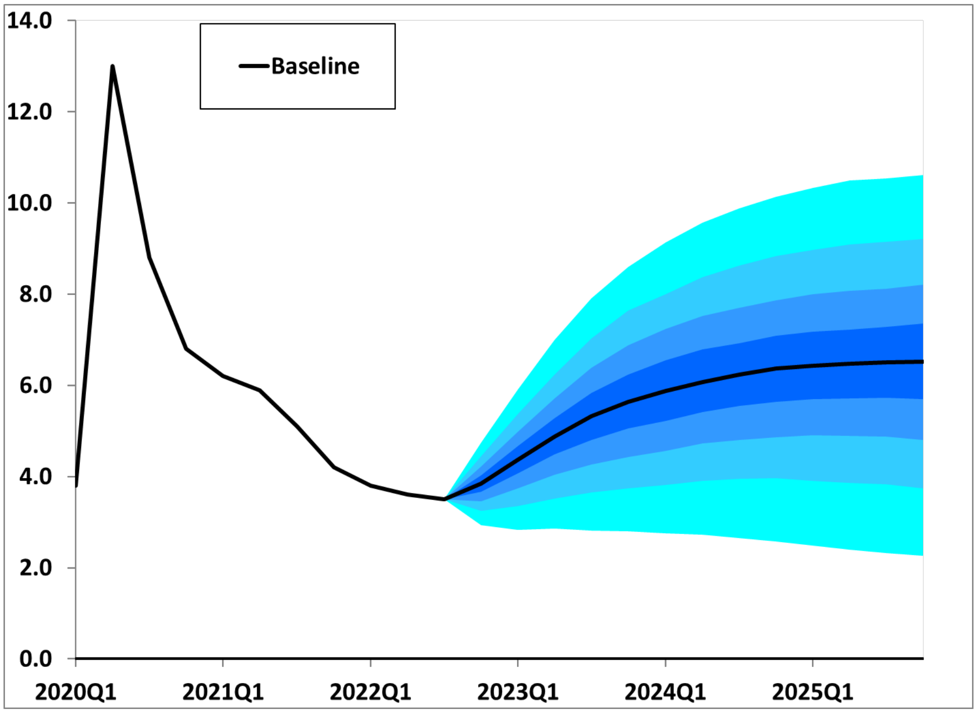


Figure 4: Federal Funds Rate

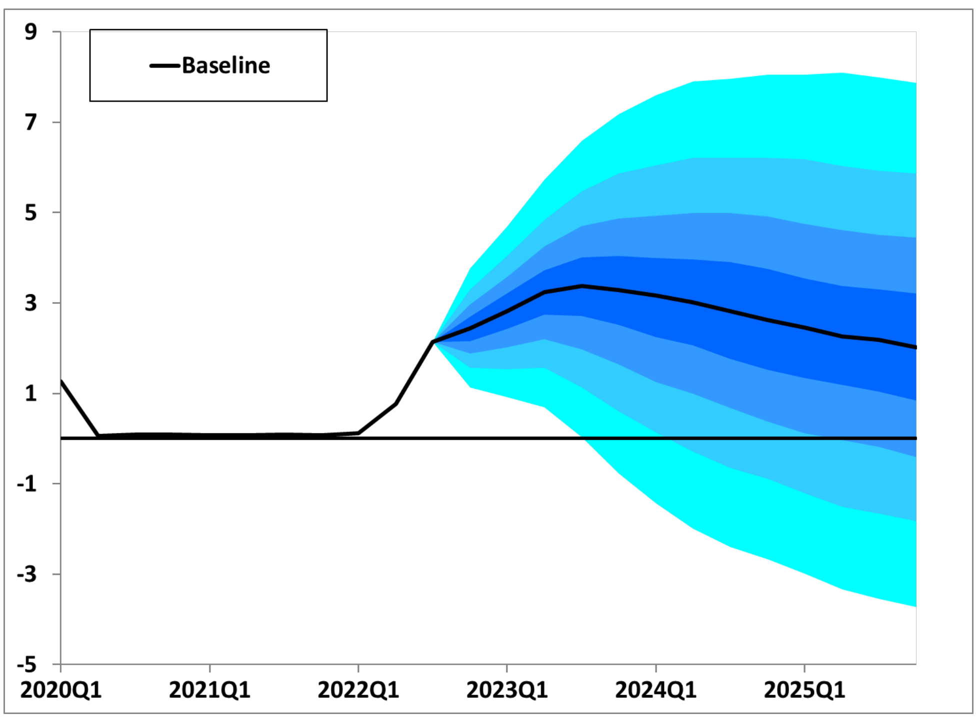


Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

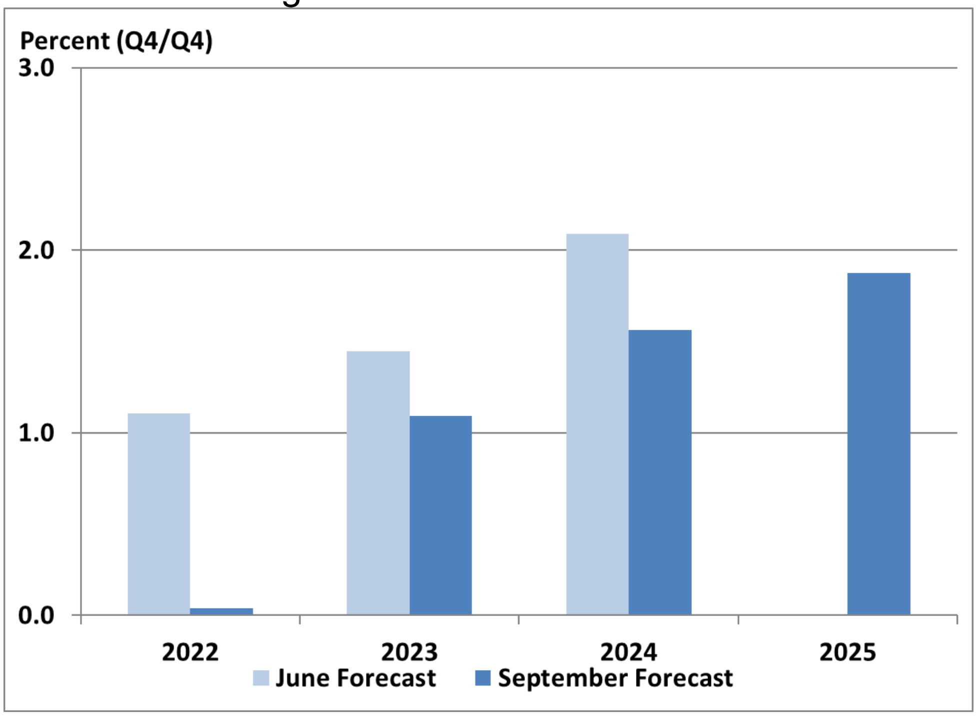


Figure 5b: Core PCE Inflation Growth

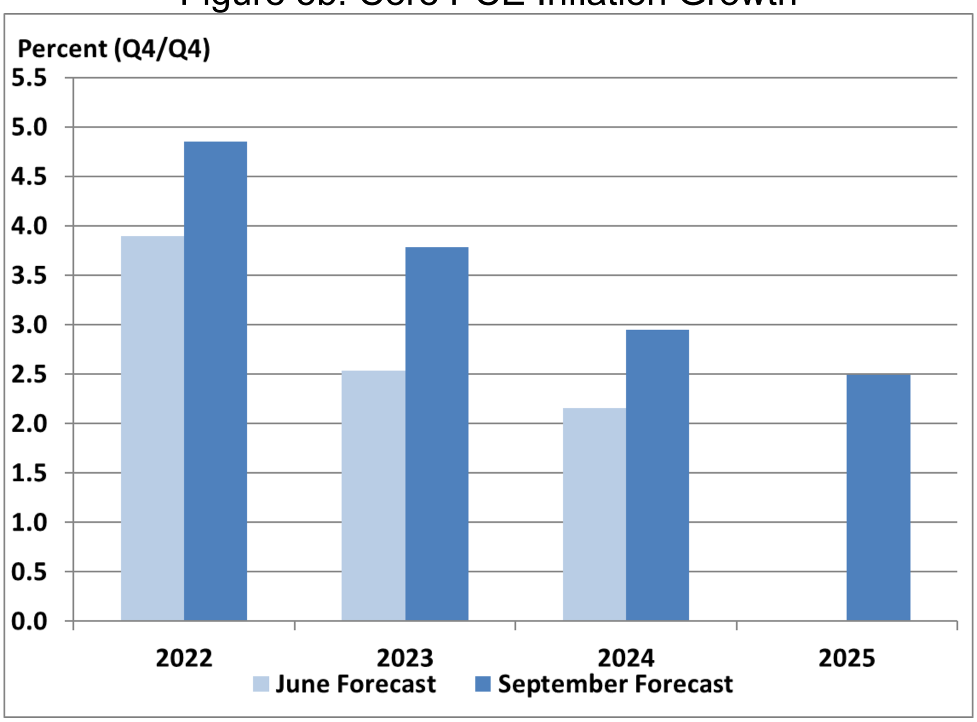


Figure 5c: Unemployment Rate

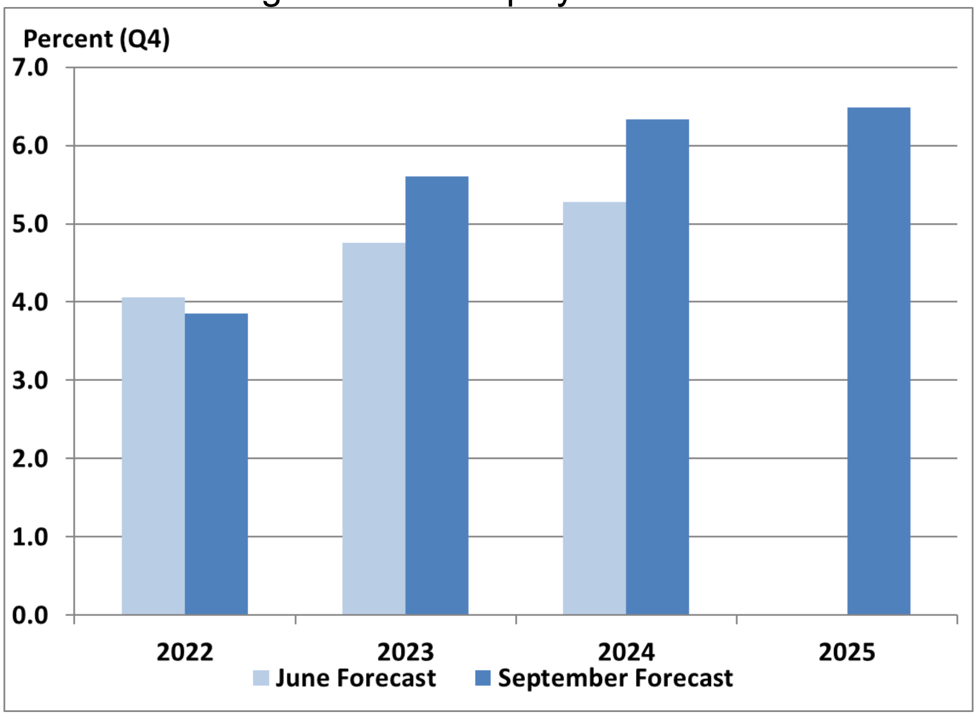
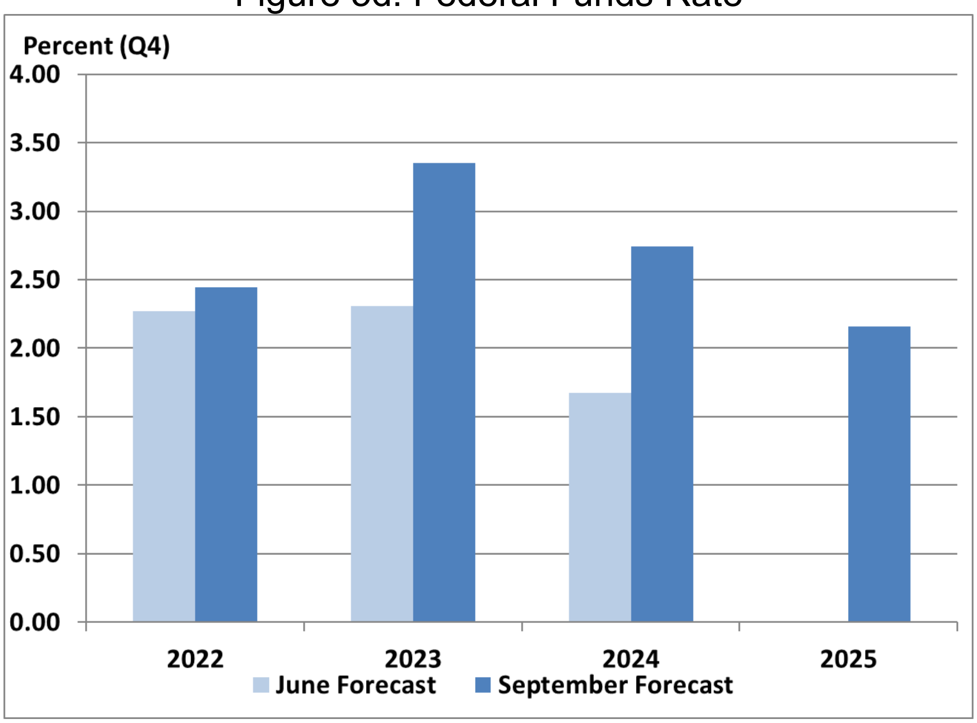


Figure 5d: Federal Funds Rate



Note: Historical data have been retrieved from Haver Analytics.