

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.

Economic Overview

Since the September 2022 Monetary Policy Report, incoming data has largely confirmed that the economy is slowing to a pace of growth well below its long-term trend. Although gross domestic product (GDP) growth came in at a strong 3.2 percent in the third quarter of 2022, much of that growth was accounted for by net exports, and that large contribution is not expected to continue going forward. Tightening financial market conditions are leading to slower investment and spending growth by households and firms. The housing market is in a severe contraction in the face of sharply higher mortgage rates. House prices and rents are

¹ The views expressed in this report are those of the author and do not necessarily reflect those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. The author thanks Veronika Konovalova and Riley Thompson for their assistance.

showing signs of outright declines in some markets. The labor market remains tight but is showing signs of softening. Employment growth over the last three months is down significantly compared to earlier this year. The ratio of job openings to unemployed workers, while still at historically high levels, continues to fall. On balance, real GDP growth for 2022 is expected to come in at below 1 percent. Inflation remains elevated and much higher than the Federal Open Market Committee (FOMC) is comfortable with. However, the price data over the last few months have shown some encouraging signs and suggest that inflation may indeed have peaked. Financial market expectations are that the FOMC will continue its tightening cycle until the second quarter of 2023, though at a reduced pace of increase.

Real GDP increased 3.2 percent in the third quarter. Real consumption expenditures held steady, adding a solid 1.5 percentage points to growth, while net exports added an additional 2.9 percentage points. However, gross private investment was weak and subtracted 1.8 percentage points from third-quarter growth.

Turning to the more recent data, real disposable income growth was positive in October, a welcome rebound after several months of being flat. Personal savings reached new lows, suggesting that consumers are willing to tap into their savings to sustain consumption growth. Over the 12-month period ending in October, real disposable personal income was down 3 percent. In October, real personal consumption was up 0.5 percent while nominal retail sales rose 1.3 percent, but nominal retail sales then declined 0.8 percent in November. Over the past few months, consumer confidence has been about flat but at low levels, indicating wariness about economic conditions.

The Federal Reserve Bank of Philadelphia's December Manufacturing Business Outlook Survey weakened further, showing that current activity remained negative and fell to -13.8 in December. This represents the index's fourth consecutive negative reading and its fifth negative reading in the last six months. The current employment index dipped into negative territory in December after a positive reading in November. Some 19 percent of firms reported declines in employment against 17 percent reporting increases. The prices received index continued to trend above its long-run average, while the prices paid index is at about its long-run average.

The housing market recession continues, with activity continuing to cool and prices falling. Both starts and permits for single-family homes fell in November. The value of new construction put in place edged down further in October compared to September but was 9.2 percent above its October 2021 level. Existing home sales fell 5.9 percent in October and were down 28 percent from a year ago. Sales of new, single-family homes rebounded 7.5 percent in October, with sales surging in the Northeast but plummeting in the Midwest and sliding a bit in the West. The CoreLogic Home Price index was up 11.5 percent year over year.

in September, while the Case-Shiller Home Price index showed a 10.6 percent gain year over year in September. Both indexes posted monthly declines in September compared to August.

Inflation has slowed over the last two months but remains at a high level. The November consumer price index (CPI) came in at a 0.1 percent increase, compared to 0.4 percent in October, and was up 7.1 percent year over year. Excluding food and energy, core CPI inflation ran at a 6 percent year-over-year pace in November, down from 6.3 percent in October and 6.6 percent in September. The headline personal consumption expenditure (PCE) price index was up 0.3 percent in October for the third straight month and was up 6 percent on a year-over-year basis. Core PCE inflation rose 0.2 percent in October and was up 5 percent versus one year ago. Core goods prices are disinflating, and housing services inflation is likely to wane in the coming months as the effects of current price and rent declines become fully reflected in the sample. Services inflation remains a cause for concern as wages represent an important cost component, and wage inflation remains elevated and at a level above what is thought to be consistent with 2 percent average inflation. Inflation expectations remain high at the short horizon but seem anchored close to 2 percent at long horizons. The Federal Reserve Bank of New York's Survey of Consumer Expectations increased at both the one-year and three-year horizons in November to, respectively, 5.2 percent and 3 percent. The Conference Board's Consumer Confidence Index consumer inflation expectations for the next 12 months ticked up to 7.2 percent in November. Looking further ahead, the Survey of Professional Forecasters' five-year-ahead annual average for the CPI remains near 2 percent, indicating that longer-term expectations remain relatively stable.

To conclude, the pace of economic activity is weak, and 2022 looks likely to experience very modest growth at best. 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 seems 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 likely to remain weak is reflected in FOMC members' projections of economic activity, which have been slightly downgraded since the September FOMC meeting. Next year's expected real GDP growth has been downgraded by 0.7 percentage point to 0.5 percent, while the forecasted unemployment rate increased by 0.2 percentage point to 4.6 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 healthy 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 prepandemic 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 author 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. We run forecast simulations under four different versions of the basic rule shown here:

Table 1

Rule	ρ	Ψ_π	Ψ_y
Baseline	0.85	2.62	0.53
Taylor (1993)	0.0	1.50	0.50
Taylor (1999)	0.0	1.50	1.0
Inertial Taylor (1999)	0.85	1.50	1.0

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.

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 third quarter of 2022, together with an assumption of how output growth and unemployment will fare in the fourth quarter of 2022. The forecast then begins in the first quarter of 2023 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 growth is forecast to be zero in 2022, 0.6 percent in 2023, 1.3 percent in 2024, and 1.8 percent in 2025. This represents a downward revision in the forecast compared to September.
- Core PCE inflation runs at a 4.9 percent pace in 2022, falling to 3.7 percent in 2023, 2.6 percent in 2024, and 2 percent in 2025. This path is revised down slightly compared to September.
- The unemployment rate is at 3.7 percent at the end of 2022 and then rises to reach 5.4 percent at the end of 2023, 6.2 percent at the end of 2024, and 6.4 percent at the end of 2025.
- The federal funds rate averages 4 percent in the fourth quarter of 2023, falling to 3.1 percent in the fourth quarter of 2024 and 2.3 percent in the fourth quarter of 2025. Note that these forecasts were generated prior to the December FOMC meeting.

The forecast for output growth is slightly weaker compared to the September forecast, as the economic data on output has softened since September. 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. The model path for the funds rate is below the financial market expectation and the modal forecast from the December Survey of Economic Projections (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, the war in Europe and China's exit from zero-

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

COVID suggest continued uncertainty about the resolution of supply shocks and supply chain disruptions. Longer-term interest rates have been edging down recently, and 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, though, and inflation remains well above the FOMC's target.

The model now anticipates that output growth will be below 1 percent in 2023 and then rebound to only a bit above 1 percent in 2024. The model's current-quarter forecast of -0.4 percent is significantly below the Federal Reserve Bank of Atlanta's GDPNow forecast of 2.8 percent for the fourth quarter of 2022.

The baseline model shows output growth running at a pace that, on average, is about 1.2 percentage points below its long-run average over the next three years.⁴ The unemployment rate rises gradually over the forecast horizon to reach 6.4 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 been somewhat encouraging, although inflation remains at an uncomfortably high level. The model anticipates that core PCE inflation will run at a 4.9 percent pace in 2022. With tightening monetary policy and modest output growth, inflation then moves down, albeit slowly, over the forecast horizon to average 3.7 percent in 2023 before dropping to 2 percent only in 2025. Thus, the model anticipates that inflation will run above the FOMC target of 2 percent average inflation over most of the forecast horizon.

The baseline forecast is weaker on growth than the median projections from the fourth-quarter 2022 Survey of Professional Forecasters (SPF) over the forecast horizon. The median respondent expects real output growth of 1.9 percent in 2022, 0.7 percent in 2023, 1.8 percent in 2024, and 2.2 percent in 2025. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 4.8 percent (Q4/Q4) for 2022, edging down to 3 percent in 2023 and 2.4 percent in 2024. Thus, the SPF is similar on inflation compared to the baseline 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 approximately 4.2 percent over the period from 2023 to 2025.

The December 2022 SEP by FOMC participants shows the median projection for output growth at 0.5 percent in 2022, 0.5 percent in 2023, 1.6 percent in 2024, and 1.8 percent in 2025. The median forecast of the unemployment rate is 3.7 percent at the end of 2022, 4.6

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.

percent at the end of 2023, 4.6 percent at the end of 2024, and 4.5 percent at the end of 2025. Core PCE inflation is projected at 4.8 percent in 2022, moving down to 3.5 percent in 2023, 2.5 percent in 2024, and 2.1 percent in 2025. The median Committee member forecast now anticipates that the federal funds rate will reach 5.1 percent at the end of 2023 and then move down to 4.1 percent at the end of 2024 and 3.1 percent at the end of 2025.

Alternative Policy Rules

With this edition of the Monetary Policy Report we return to the addition of alternative policy rules as prescriptions for the course of monetary policy over the next few years. As indicated in Table 1, the alternative rules are forms of the Taylor Rule that have differing weights on the inflation gap, the output gap, and the lagged interest rate. The alternative rules generally lead to lower core inflation, lower real output growth (indeed, negative output growth over the near term), and a higher unemployment rate over the forecast horizon. Thus, the alternative rules suggest policy should slow the real economy more than in the baseline in order to bring down inflation more quickly. This is indicated in Figure 4, where the funds rate paths, especially for the Taylor 1999 and Taylor 1992 rules, suggest sharp spikes in the funds rate in the near term in order to slow the economy. The inertial Taylor Rule, while having a funds rate path that is more similar to the baseline, is able to quash the output gap quickly, which is manifested in slower near-term output growth and a higher path for the unemployment rate. Consequently, inflation comes down more quickly under that specification. This works through the expectations channel as households act on the expectation that monetary policymakers will respond more aggressively to the output gap compared to the baseline. All else equal, the inertial Taylor Rule implies that interest rates would remain high even after inflation and the output gap have been brought down. Instead, forward-looking households and firms adjust their demand and prices immediately, lowering the output gap and inflation, which allows the monetary authority not to have to follow through on the threat of persistently higher rates.

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. 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 over the next two years. Forecast uncertainty remains very high as the economy recovers from supply side disruptions, the war in Europe, and China's exit from 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 slightly lower inflation over the next few years compared to the September projection.

Figure 1: Real GDP Growth

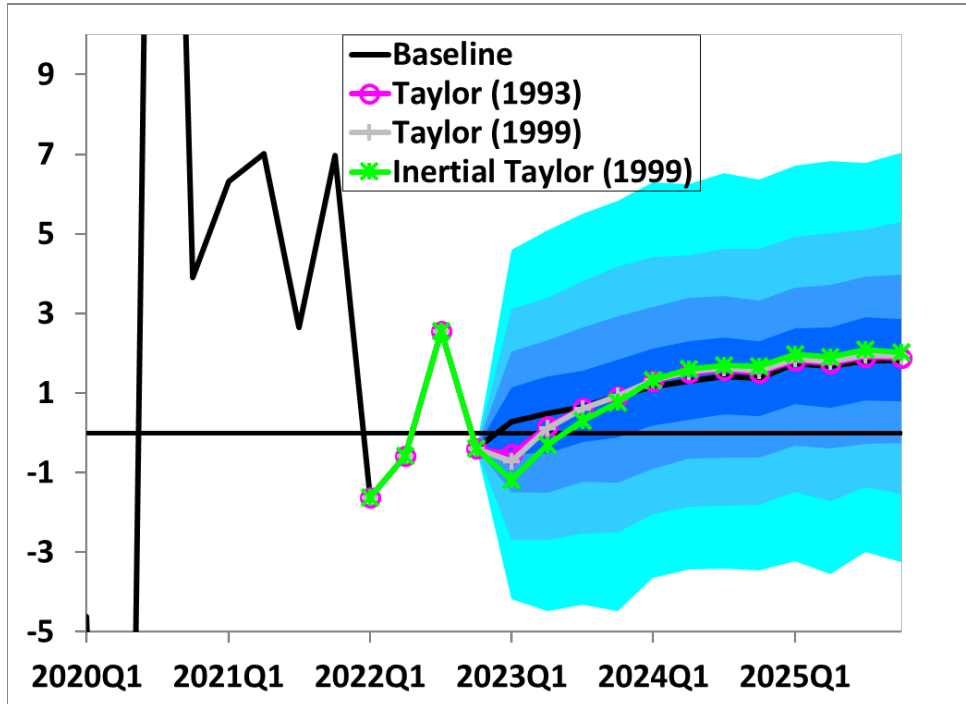


Figure 2: Core PCE Inflation

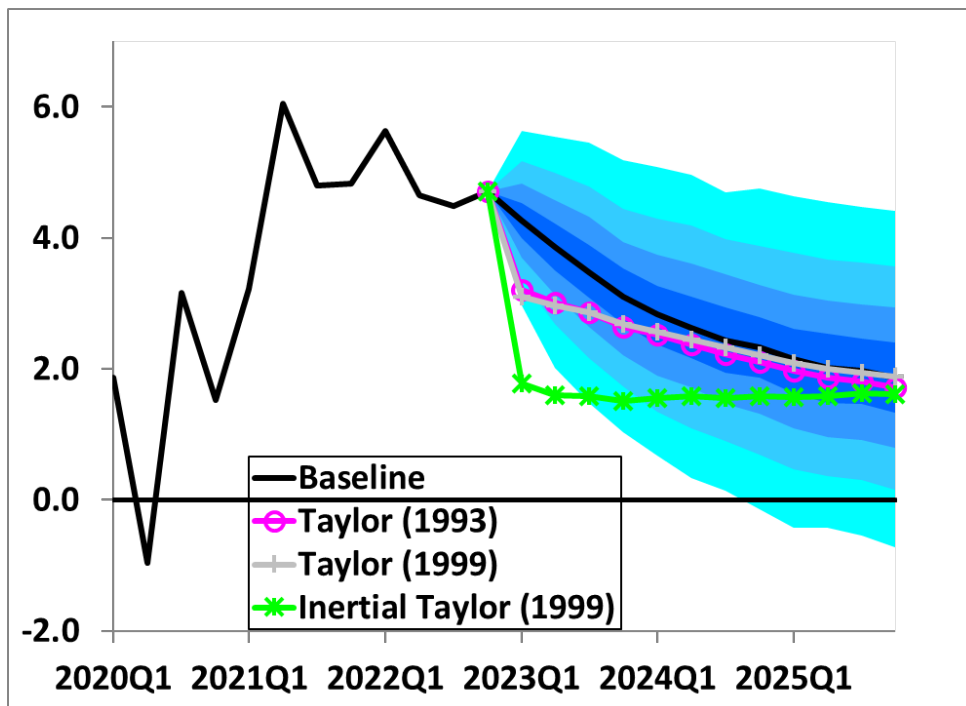


Figure 3: Unemployment Rate

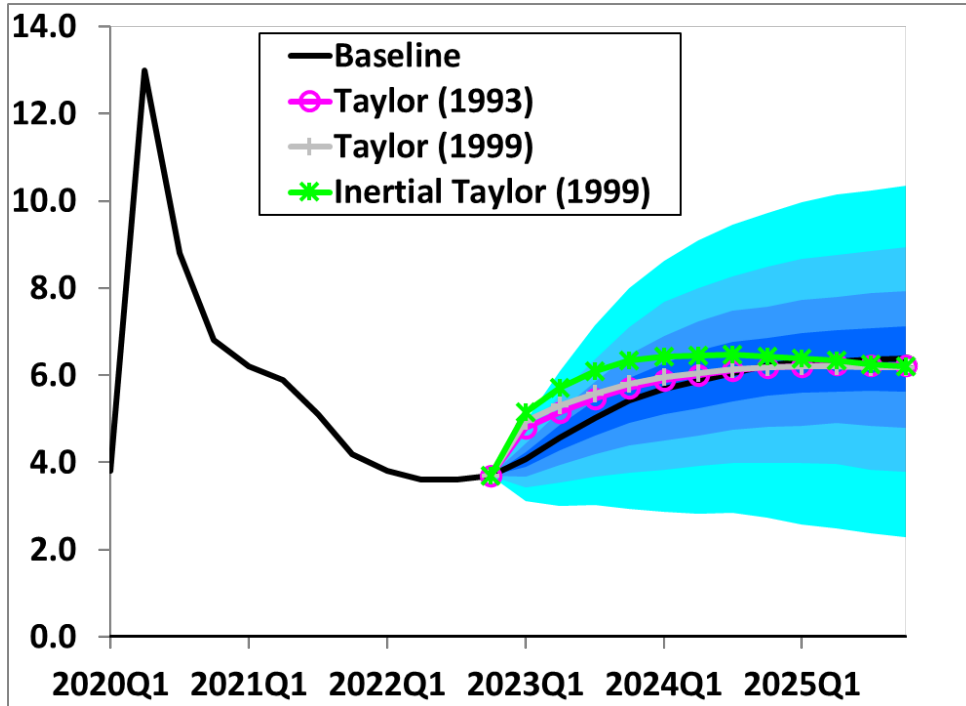


Figure 4: Federal Funds Rate

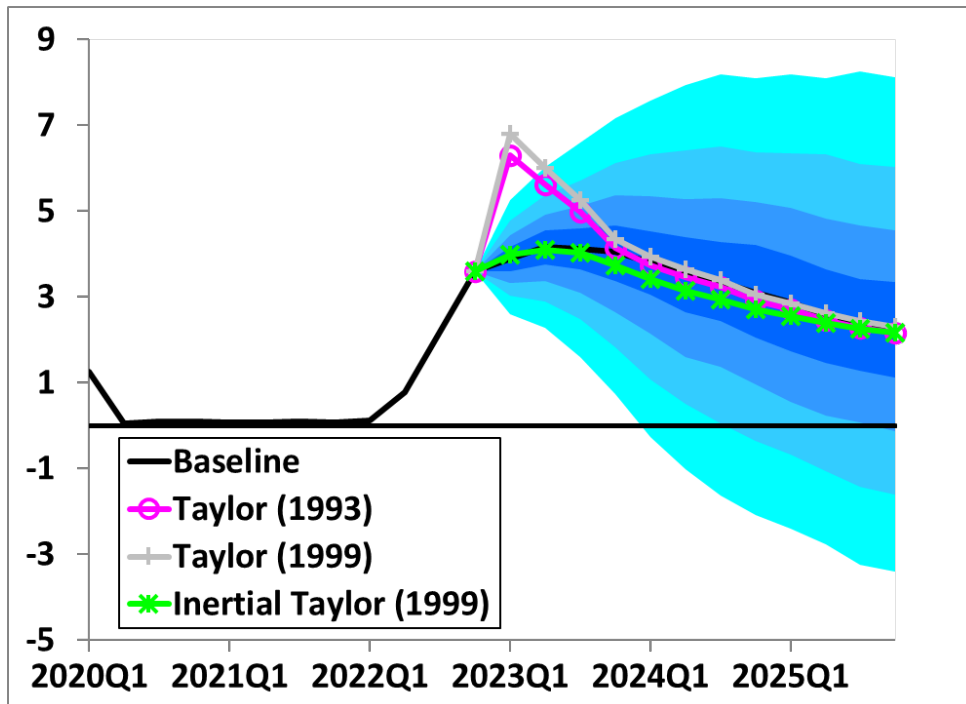


Figure 5: Baseline Forecast Comparisons

Figure 5a: Real GDP Growth

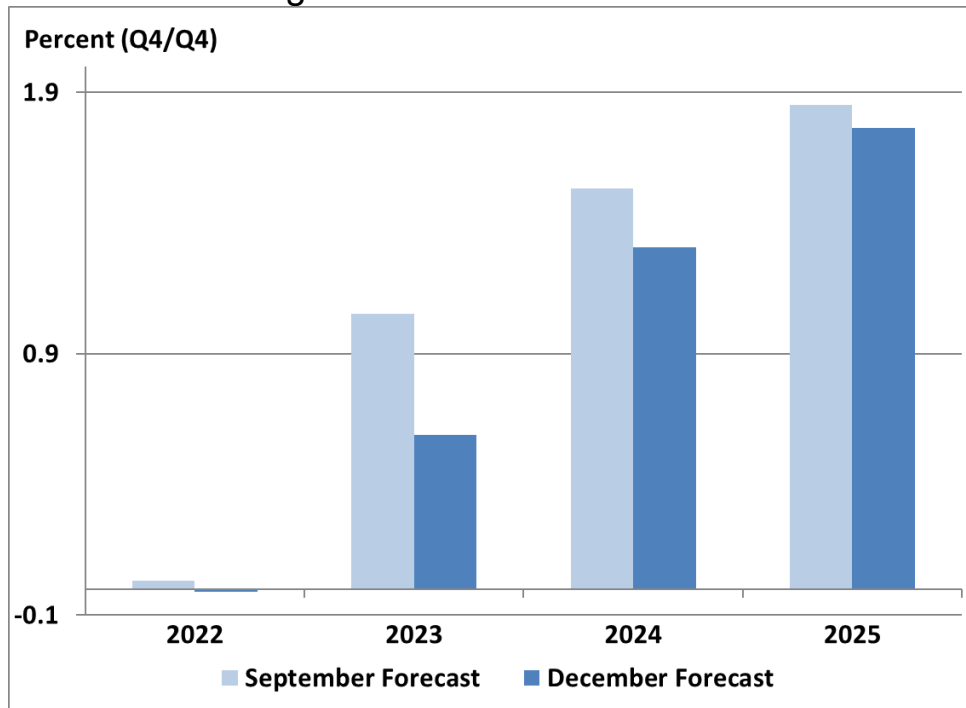


Figure 5b: Core PCE Inflation Growth

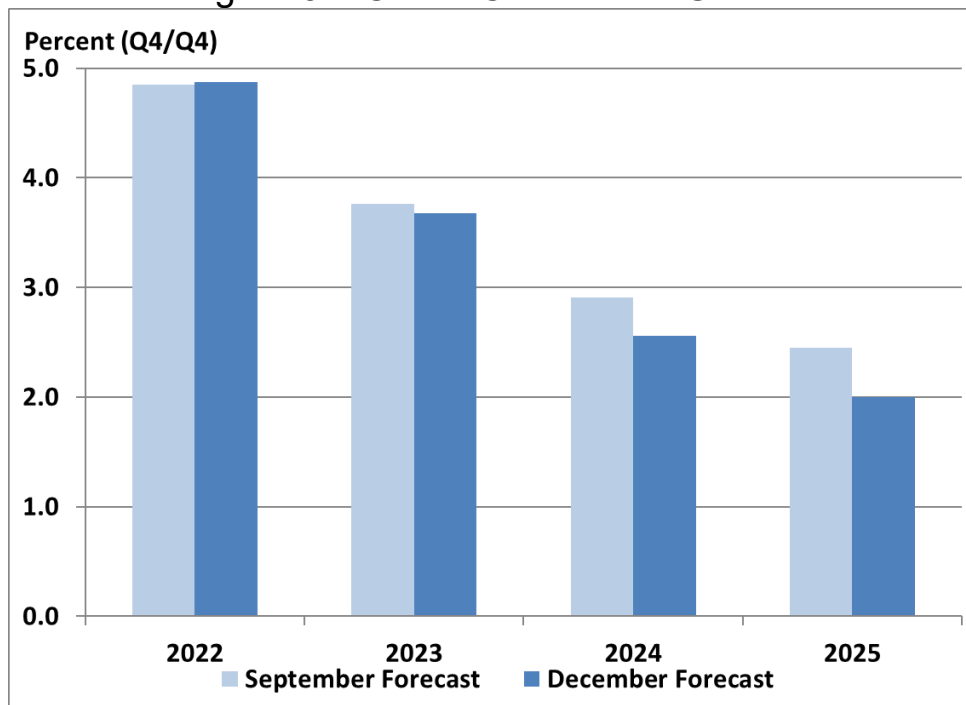


Figure 5c: Unemployment Rate

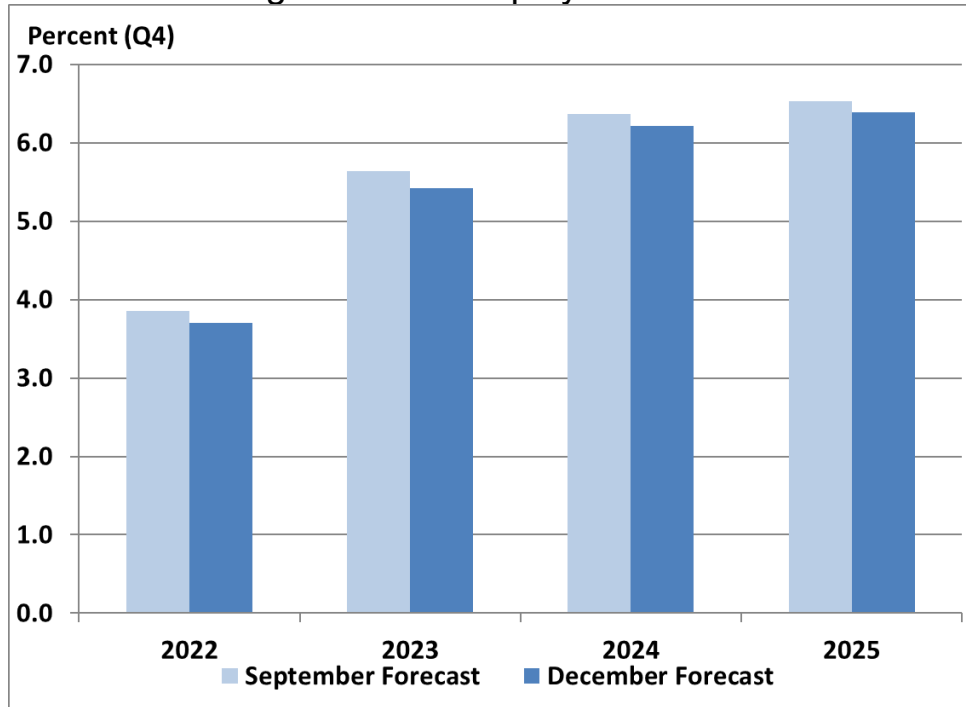
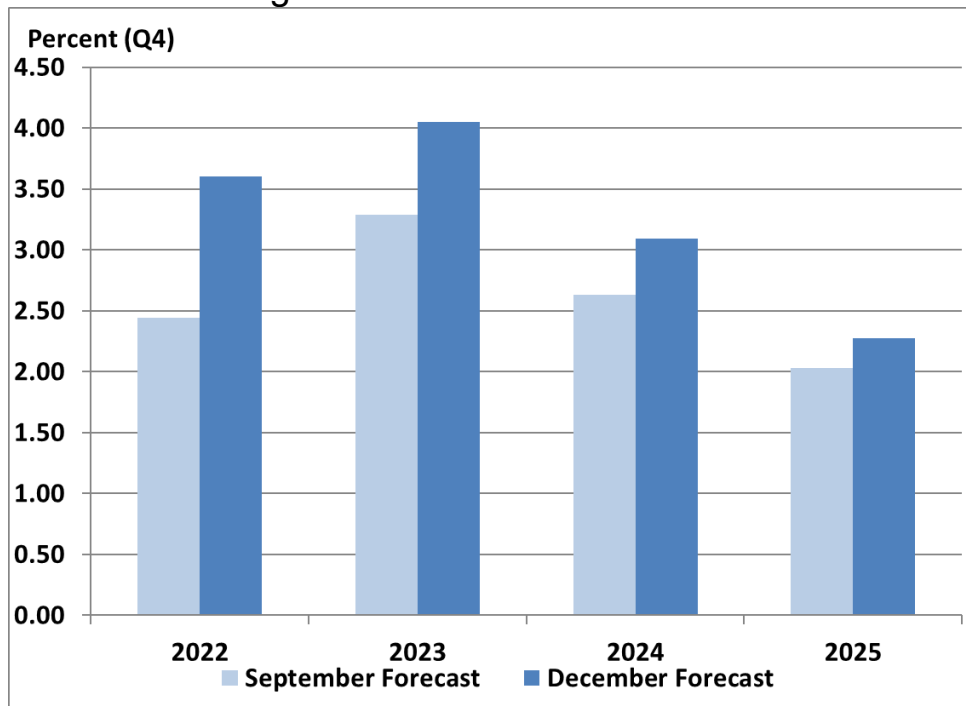


Figure 5d: Federal Funds Rate



Note: Historical data have been retrieved from Haver Analytics.