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 third-quarter economic growth has moderated from its robust second-quarter pace. Some of that moderation is due to the ending of stimulus payments and to the new wave of COVID-19 cases caused by the Delta variant. As well, supply chain disruptions continue to plague many businesses, and labor shortages continue in many sectors. Those sectors that were most affected by COVID-19 continue to

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recover, but that recovery has slowed recently due to the outbreak of the Delta variant of COVID-19. Other sectors such as manufacturing have surpassed their pre-pandemic levels. Consumer activity continues to support the economy and investment is growing strongly, but there has been a waning in spending related to social-distancing-sensitive sectors. As well, the recent rise in COVID cases, hospitalizations, and deaths coupled with the end of stimulus checks has caused consumer optimism to recede, and the persistence of supply chain bottlenecks has resulted in less optimism on the part of businesses as well.

After growing at a robust 6.6 percent pace in the second quarter, the most recent data indicate a moderation in economic activity, with many forecasts for third-quarter GDP growth in the mid-3 percent range. Still, growth for 2021 looks to be well above trend and some of that strength should carry over into 2022. Currently, non-COVID-affected sectors continue to experience solid growth, and manufacturing continues to be a source of economic strength. Regional surveys, including those conducted by this Bank, are consistent with the hard data that indicate strength for this sector. For example, the *Manufacturing Business Outlook Survey's* current activity index jumped up in September and remains solidly in expansionary territory. As well, the employment index indicates continuing strength in hiring. Additionally, firms intend to continue hiring and to make capital investments. Both the prices-paid and prices-received indices remain near historical highs, implying continued price pressures in this sector. However, optimism for future growth has moderated from the historically high levels seen a few months ago. We are hearing of significant and continuing supply chain disruptions and outsized increases in the costs of shipping. As well, employers are having trouble filling vacancies, which for the U.S. as a whole are at their highest levels since the data were first recorded. The report reflects the overall national strength in manufacturing, which has grown by 5.9 percent over the last 12 months.

Residential real estate activity probably peaked early in the year but continues to be a source of economic strength. Residential construction spending grew by an amazing 27 percent over the last 12 months to July, but growth over the last three months has declined to a still robust 11.1 percent. The moderation in residential activity is reflected in August's decline in single-family starts, which have been declining for two straight months. Price pressures, as reflected in the 18.8 percent year-over-year growth in the FHFA House Price Index, may be pushing homebuyers to look at multifamily units, whose permit levels have increased noticeably. Some of the near-term weakness is definitely due to supply constraints, but lofty prices appear to be having an effect as well. Regarding existing home sales, they declined by 2.0 percent in August but remain 12 percent higher than they were in 2019. The recent slowing is due to elevated prices and a low inventory of homes for sale.

Real personal consumption expenditures have notably softened of late. Over the three months to July, expenditures declined by 0.4 percent, with the decline largely due to a major scale-back in spending on durable goods. In turn, some of that weakness is reflected in the decline in the sale of motor vehicles and parts, which is in part driven by supply constraints involving a shortage of computer chips. Some automakers have recently shut down production lines due to a lack of chips. The weakness in consumer activity displayed by the July report may be abating, as the most recent retail sales report for August showed growth in core retail sales of 2.1 percent. The spending was broad-based and supported by recent gains in personal income and the significant amount of savings accumulated during the pandemic. Added confirmation of August's strong retail sales numbers comes from tracking credit and debit card spending on Chase cards, which is now very close to its pre-pandemic trend. However, any spending associated with travel remains well below pre-pandemic norms.

Employment growth moderated significantly in August, averaging only 235,000 net new jobs after averaging approximately 1 million jobs over the previous two months. Roughly a third of the decline was due to a decrease in jobs in the public education sector, and it looks likely that this decline was itself due to mismeasured seasonal adjustment. As well, about half the deceleration from the previous months was in accommodation and food services, which may be reflecting a change in consumer behavior due to the rise of the Delta variant. Thus, as long as new cases remain elevated, we may see continued employment weakness in this sector. The deceleration in job growth has occurred despite the record level of job openings and the fact that there are over 5.3 million fewer people working than pre-pandemic. The labor force appears to be growing slowly, and until participation picks up it will take some time before employment reaches pre-pandemic levels, let alone returns to trend.

Inflation continues to run higher than the long-run average target of 2 percent. Over the last three months, core personal consumption expenditure (PCE) inflation has averaged 5.7 percent at an annual rate. However, much of this strength is reflected in outsized gains in a few goods as neither the Dallas trimmed mean PCE inflation rate nor the Cleveland median inflation rate is displaying such a rapid acceleration. Most forecasters still view the rise in inflation as temporary, but that position is getting more tenuous with each new data point.

As well, market-based measures of inflation expectations indicate that inflation expectations remain well anchored at around 2 percent, but 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. Both surveys indicated expectations of inflation in excess of 5.0 percent.

To conclude, the pace of economic activity has moderated substantially from its robust growth rate in the second 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 some bounce-back in consumption activity, and despite supply constraints the manufacturing sector continues to hum along. The labor market continues to heal, although at a reduced rate, and 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 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.

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[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.

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. 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 through the end of 2022. The forecast is generated using observed data through the second quarter of 2021 together with an assumption on how output growth and unemployment will fare in the third quarter of 2021. The forecast then begins in the fourth quarter of 2021 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 5.7 percent annual rate in 2021, falling to 2.1 percent in 2022, about 1.2 percent in 2023, and 1.8 percent in 2024.

- Core PCE inflation runs near a 4.3 percent pace in 2021 and 2022, moving down to 3.3 percent in 2023 and 2.3 percent in 2024.

- The unemployment rate reaches 4.2 percent at the end of 2021, stays about flat at the end of 2022 at 4.1 percent, and then rises to 5.6 percent at the end of 2023 and 5.4 percent at the end of 2024.

- By assumption, the federal funds rate remains at the ELB through the end of 2022. The funds rate is then allowed to rise and reaches 1.5 percent at the end of 2023 and 1.3 percent at the end of 2024.

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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.

The baseline forecast now calls for output growth to run at a 5.7 percent annual rate in 2021, down from 6.6 percent in the June forecast. Incoming data have been a bit weaker than expected as the spread of the Delta variant of COVID-19 has led to less-robust economic activity. As well, supply-side constraints are impacting growth as labor supply remains below projections and supply chain disruptions remain significant. 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 2.1 percent in 2022 and 1.2 percent in 2023. The model's current-quarter forecast of 5.9 percent is higher than the Federal Reserve Bank of Atlanta's GDPNow forecast of 3.7 percent for the third quarter of 2021 and higher than the Federal Reserve Bank of New York's Staff Nowcast of 3.8 percent. The incoming data since the start of the second quarter have generally pointed to moderating output growth. On balance, the third quarter is expected to come in weaker than the second quarter.

The baseline model shows output growth running at a pace that, on average, exceeds its long-run average over the next three years.[4] The unemployment rate falls from 5.2 percent currently to a low of 3.6 percent in the first quarter of 2022. By the end of the forecast horizon, the unemployment rate is near 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 4.2 percent pace in the third quarter of 2021, rising to a peak of 4.5 percent by mid-2022. Thereafter, inflation moderates to run at a 2.2 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 through the end of 2022.

The baseline forecast is somewhat weaker on growth and stronger on inflation than the median projections from the third-quarter 2021 Survey of Professional Forecasters (SPF) over the forecast horizon. The respondents expected real output growth of 6.1 percent in 2021, 4.4 percent in 2022, and 2.5 percent in 2023. (Note that the SPF reports GDP growth as annual average over annual average.) The SPF's core PCE inflation forecast is 3.7 percent (Q4/Q4) for 2021, edging down to 2.2 percent in 2022 and 2.1 percent in 2023. The forecasters' path for the unemployment rate is similar in the near term compared with the baseline, but it is

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[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.

generally stronger over the medium term: The median SPF forecast for the unemployment rate is 5.6 percent in 2021, falling to 4.3 percent in 2022 and 3.8 percent in 2023.

The September 2021 Summary of Economic Projections (SEP) by FOMC participants shows the median projection for output growth at 5.9 percent in 2021, falling to 3.8 percent in 2022 and 2.5 percent in 2023. The median forecast of the unemployment rate is 4.8 percent at the end of 2021, 3.8 percent at the end of 2022, and 3.5 percent at the end of 2023. Core PCE inflation is projected at 3.7 percent in 2021, moving down to 2.3 percent in 2022 and 2.2 percent in 2023. Headline inflation is projected to run at a slightly stronger pace than core inflation in 2021. The forecast model's baseline forecast for the federal funds rate (Figure 4) is within the range of the September 2021 SEP over the forecast horizon. The baseline forecast is stronger than market expectations, which call for the funds rate to begin edging up at the end of 2022 but remain below 1 percent through the end of 2024.

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 second 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 the fourth quarter, but growth projections have been revised down compared to the June forecast. The growth rate diminishes in the out years of the forecast, which is expected as the boost the economy gets from fiscal stimulus and general reopening diminishes and life returns to a post-pandemic normal. Near-term uncertainty surrounding the evolution of the COVID pandemic remains significant. 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. Congress may well pass additional spending and tax bills in 2021 that have a modest impact on near-term and medium-term growth. On balance, though, the forecast calls for a healthy rebound in economic activity in 2021 and over the next three years.
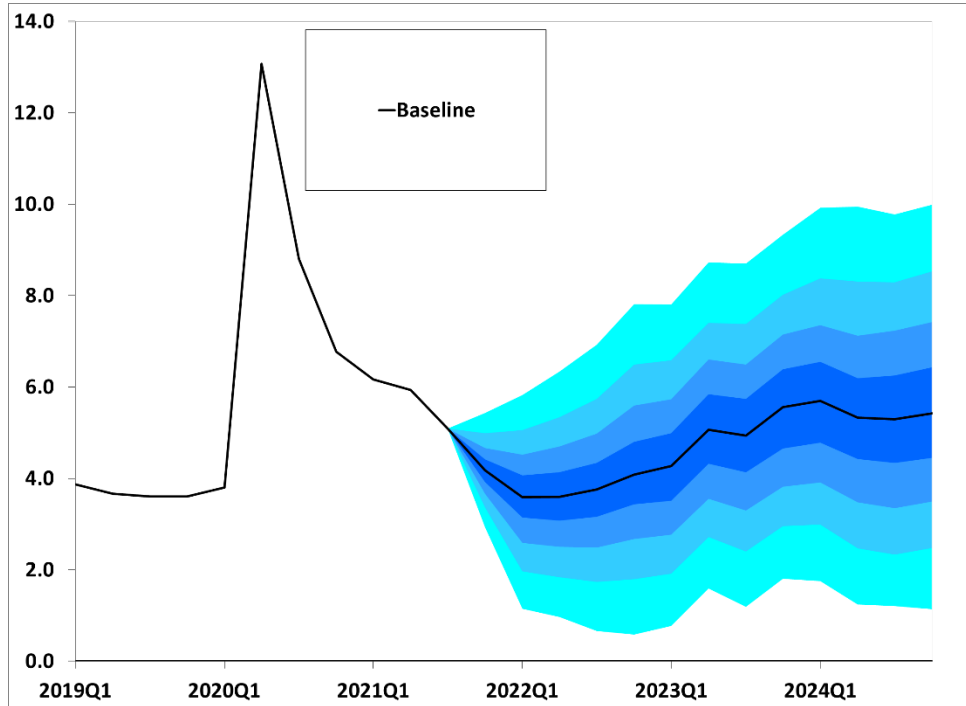
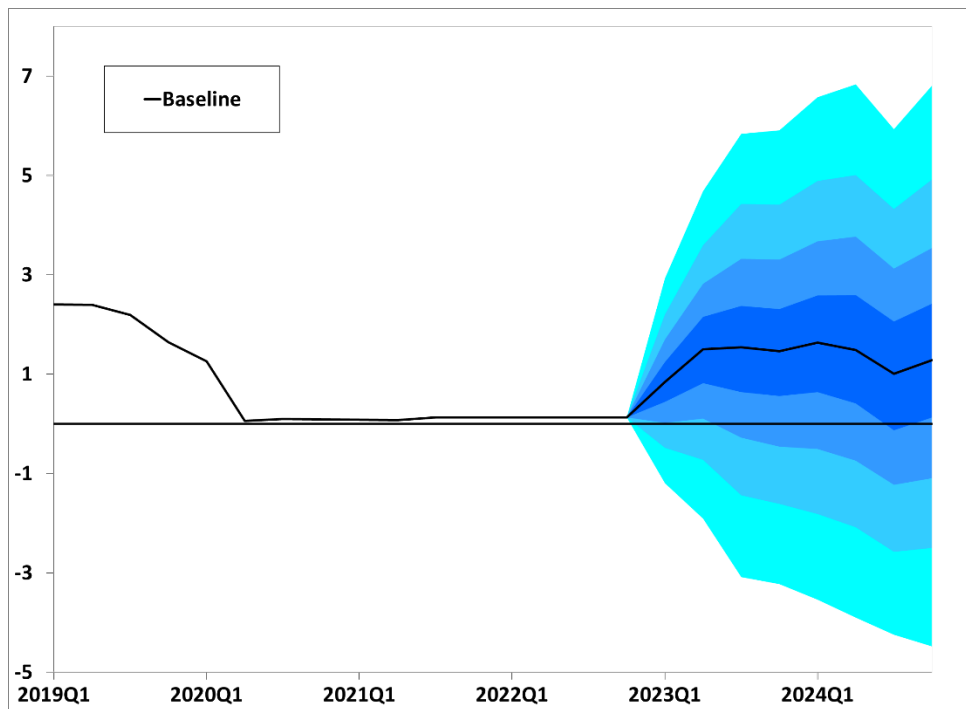# Figure 1: Real GDP Growth
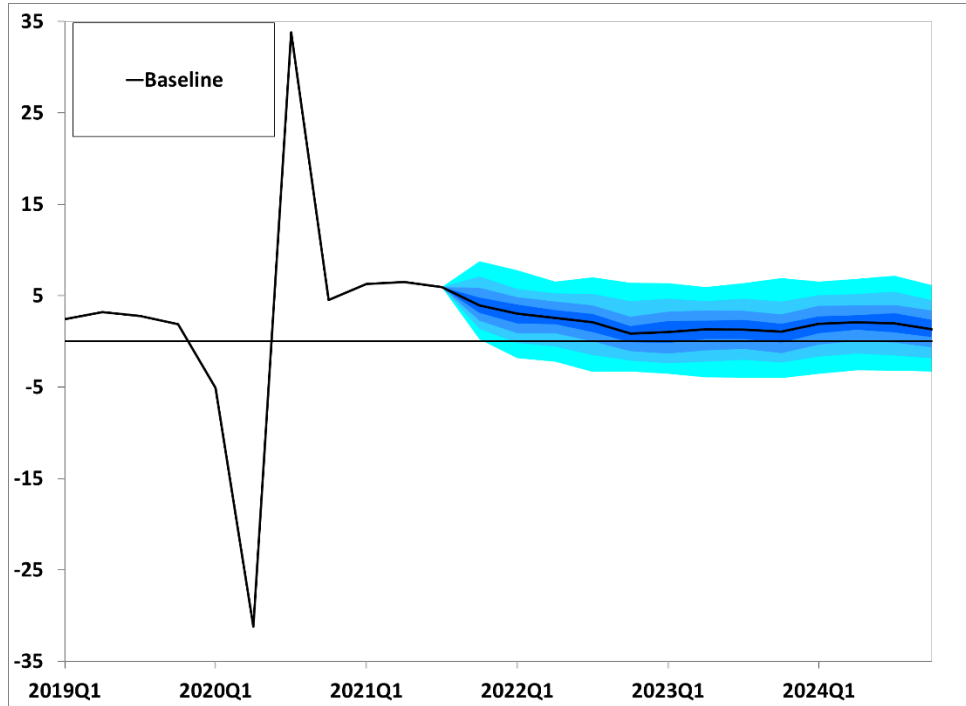
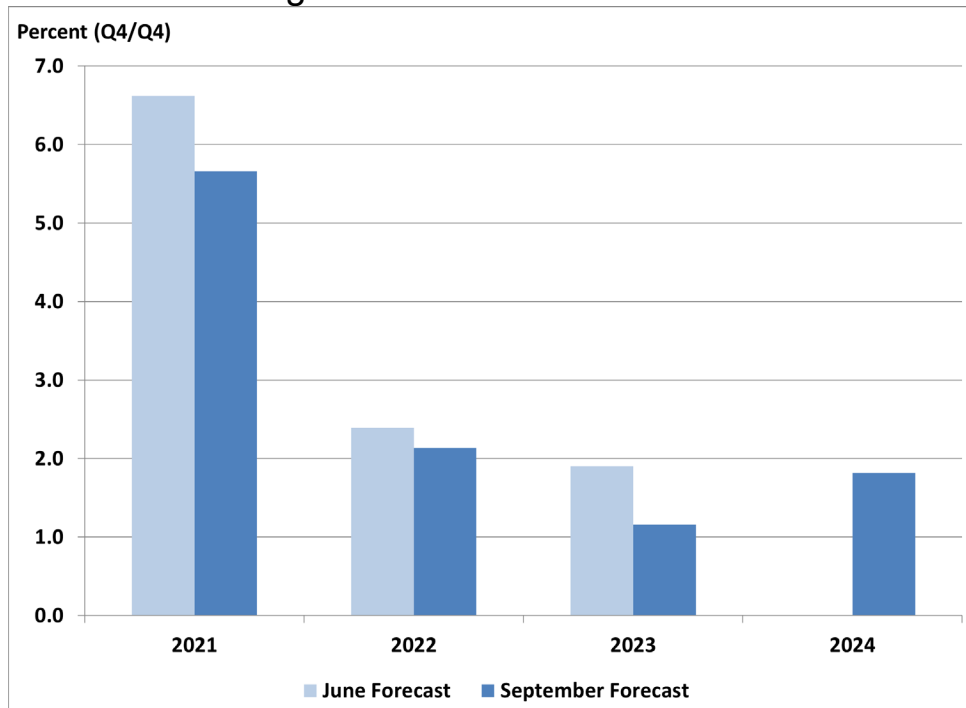# Figure 2: Core PCE Inflation
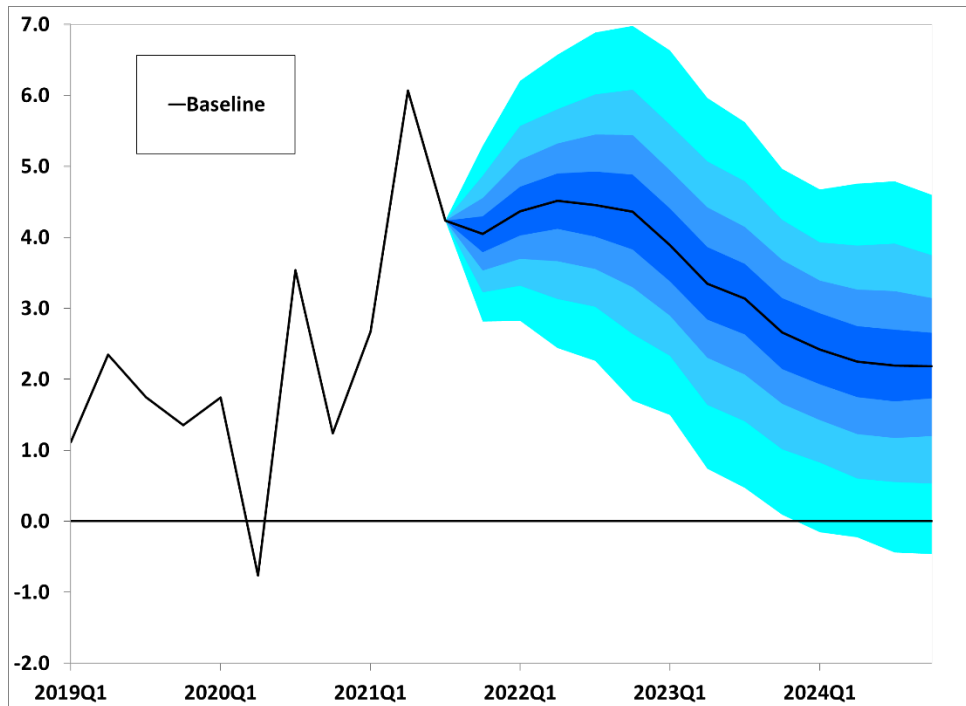
Figure 3: Unemployment Rate

Figure 4: Federal Funds Rate

Figure 5: Baseline Forecast Comparisons

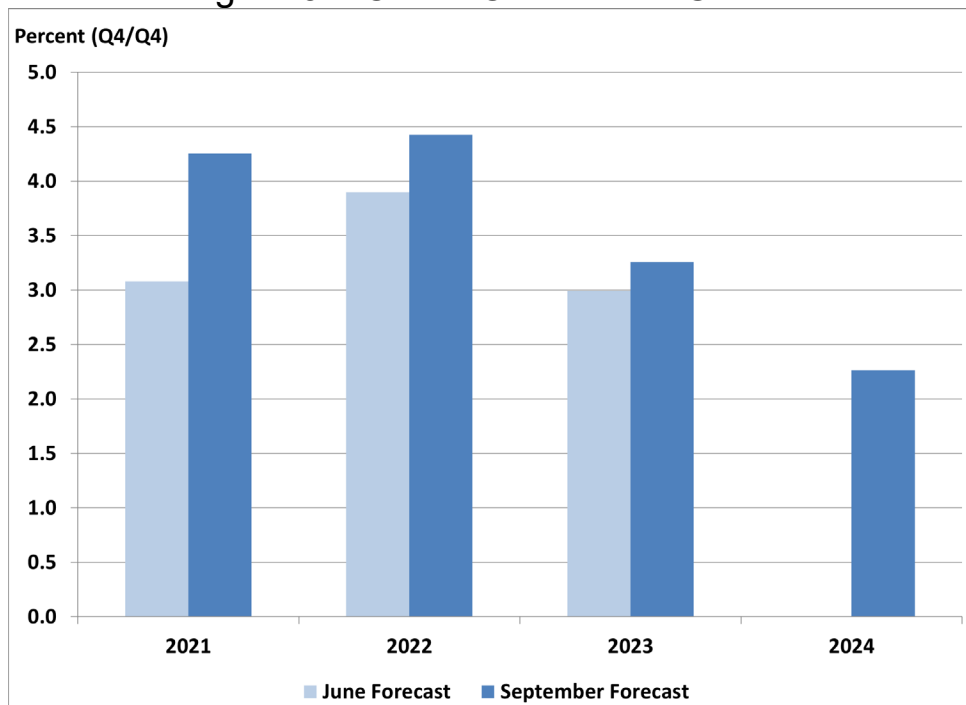## Figure 5a: Real GDP Growth

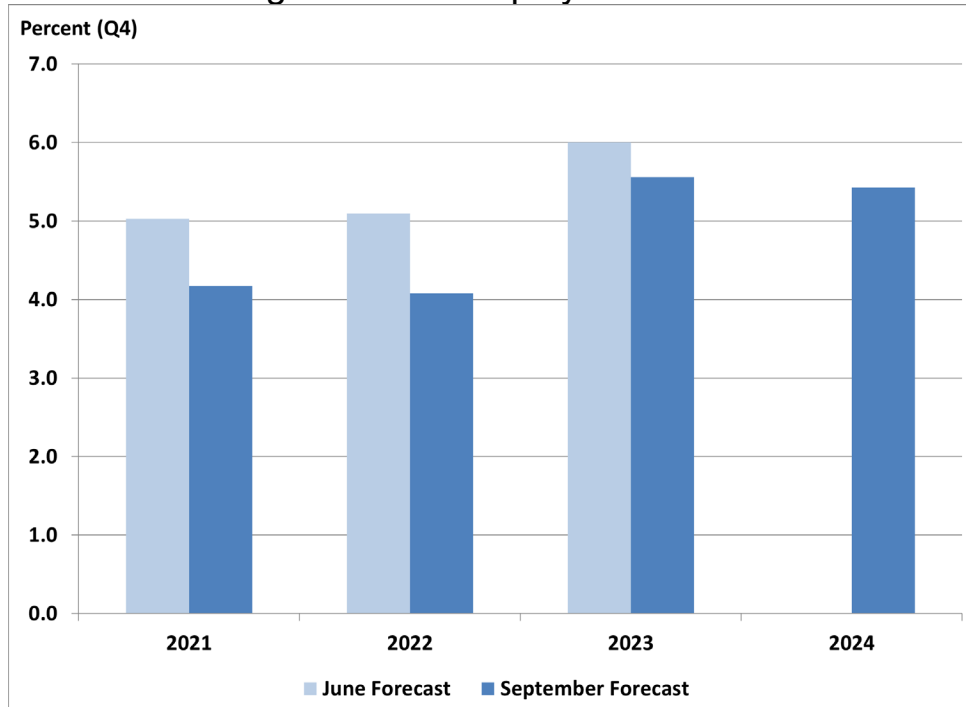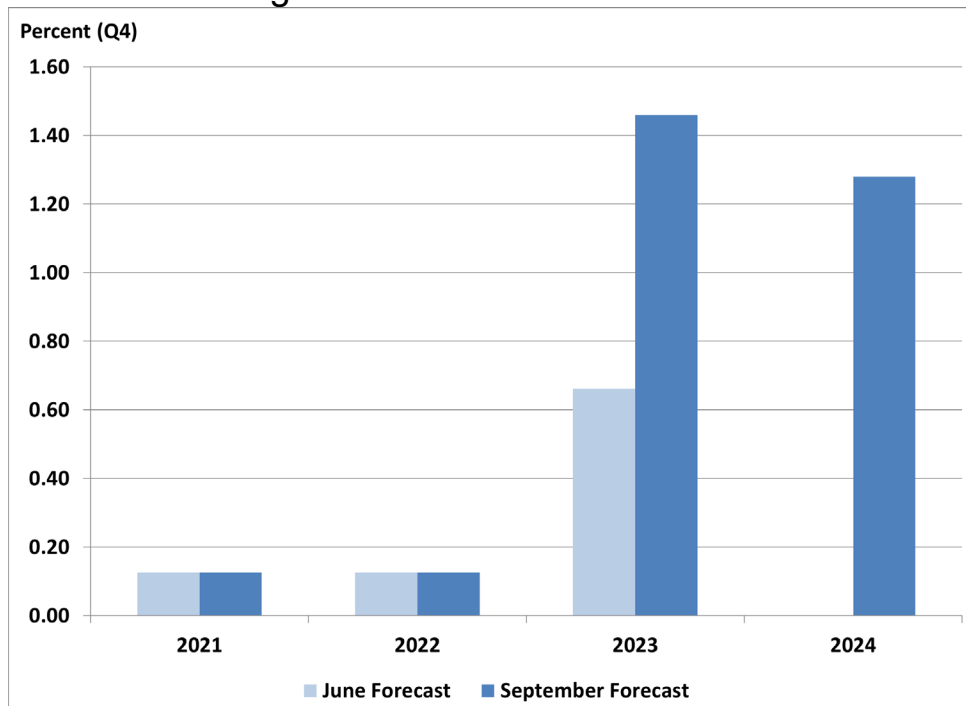## Figure 5b: Core PCE Inflation Growth

Figure 5c: Unemployment Rate

Percent (Q4)

	2021	2022	2023	2024
June Forecast	5.0	5.1	6.0	
September Forecast	4.2	4.1	5.5	5.4

June Forecast   September Forecast

Figure 5d: Federal Funds Rate

Percent (Q4)

	2021	2022	2023	2024
June Forecast	0.13	0.13	0.66	
September Forecast	0.13	0.13	1.46	1.28

June Forecast   September Forecast

Note: Historical data have been retrieved from Haver Analytics.