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The FOMC's New Individual Economic Projections and Macroeconomic Theories*

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Abstract

This paper examines whether the individual economic projections made by the Federal Open Market Committee's (FOMC) policymakers are consistent with macroeconomic theories: Okun's law, the Phillips curve, and the Taylor rule. By analyzing the FOMC's individual economic projections between 2007 and 2014, I find that they are consistent with Okun's law, revealing a significantly negative relationship between unemployment and output growth projections. On the other hand, the relationship between inflation and unemployment projections associated with the Phillips curve is much weaker and more dispersed. The results on the FOMC's reaction function, the Taylor rule, are mixed: The response of the projections of the federal funds rate against the inflation gap projections—the deviation of inflation projections from the target—is significantly positive, whereas the response against the corresponding output gap projections varies depending on the specification.

Keywords: FOMC, Individual Economic Projections, Okun's law, Phillips Curve, Taylor rule

J.E.L. codes: C32, C53, E58

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1 Introduction

Recently, central banks' communications concerning judgments on the current state of the economy and the future path of monetary policy have become increasingly important in the conduct of monetary policy. This is especially the case when many advanced economies have experienced the effective lower bound (ELB) after the financial crisis of 2008-2009 and the COVID-19 crisis in 2020. Since 2007, the Federal Open Market Committee's (FOMC) has been publishing the Summary of Economic Projections (SEP) made by individual policymakers, which has become one of the most important communication tools for the Federal Reserve. According to the survey conducted by Olson and Wessel (2016), nearly half of the Fed watchers from both academia and private sectors regard the SEP as useful. However, there is one caveat to the SEP: Only a "summary" of the projections, such as the range and central tendency, is available at the time of the meeting, from which only the variable-by-variable summaries of the projection are observed.[1] As a result, it is impossible for the public to associate the projections of different macroeconomic variables or to associate the macroeconomic projections with the appropriate paths of monetary policy.

In this paper, I overcome this shortcoming by using a novel data set of the FOMC participants' anonymous individual economic projections between 2007 and 2014 and examine two research questions. First, I investigate the empirical properties of the FOMC's individual economic projections and assess whether they are consistent with standard macroeconomic facts and theories, such as Okun's law and the Phillips curve. Because the FOMC policymakers are highly experienced macroeconomists who have access to a vast array of staff and resources to direct economic research at the Federal Reserve, it is crucial to evaluate whether their individual projections are consistent with the textbook macroeconomic relationships.

Second, this paper estimates the reaction function of the FOMC, which characterizes the FOMC's monetary policy decisions in response to changing economic conditions, as discussed in Bernanke (2016). More specifically, I estimate a Taylor rule based on the inflation and output gaps—deviations of inflation and output growth from their natural levels—using the FOMC's individual economic projections. There are two advantages to use the FOMC's individual projections. First, the FOMC publishes all the relevant projections for the estimation of the

[1]For the assessment based on the aggregate summary of economic projections, see Arai (2016) and Kalfa and Marquez (2019).

reaction function, including the projections of the federal funds rate, inflation, and output gaps. Therefore, the reaction functions could be directly estimated without using any state-space models. Second, there are substantial variations in the FOMC's individual projections, even though the actual federal funds rate remained at the ELB during the sample period, because the projections cover relatively long horizons up to three years.[2]

The empirical results based on the panel regression indicate that the FOMC's individual projections are consistent with Okun's law, and the association between the output growth and the unemployment rate is strongly negative and statistically significant. On the other hand, the negative relationship between unemployment and inflation (i.e., the Phillips curve) is weak and dispersed, although the relationship is statistically significant, perhaps reflecting the recent flattening of the Phillips curve documented in the literature. The analysis using the Survey of Professional Forecasters (SPF) during the same sample period leads to similar results—a robust Okun's law relationship and a weak Phillips curve relationship—which suggests that these tendencies are likely driven by the sample period rather than the factors specific to the forecasters.

The estimates of the reaction function are mixed, and the FOMC's individual economic projections are partially consistent with the Taylor rule. The natural rate of real interest and the response to the inflation gap are estimated to be positive and statistically significant. In particular, the magnitude of the response to the inflation gap is larger than one for most cases, which is consistent with the Taylor principle claiming that the central bank should be sufficiently aggressive against inflation to maintain stability. On the other hand, the response to the output gap varies depending on the specifications and becomes significantly negative once the effects of the forecast horizons are controlled. These results may reflect the diverse views among the FOMC policymakers on the inflation outlook and the appropriate path of monetary policy.

This paper is related to the series of papers in the literature that analyzed the FOMC's individual economic projections to understand the FOMC's decision making and the conduct of US monetary policy, including those by Meade and Sheets (2005), Nakazono (2013), Romer (2010), Sheng (2015), and Tillmann (2011). The FOMC's economic projections have attracted renewed interest since 2007, when the FOMC started to use their projections as one of the primary communication tools, and this paper is one of the first attempt to analyze the empirical

[2] Bundick (2015), Pierdzioch et al. (2016), and Kim and Pruitt (2017) also exploited this advantage and used the forecasts to estimate the central bank's reaction function.

properties of these new projections. By conducting a simple panel regression analysis, this paper confirms that the FOMC's individual economic projections are largely consistent with standard macroeconomic theories, except that heterogeneous views on the appropriate path of monetary policy may play a crucial role on the FOMC's reaction function.

The remainder of the paper is organized as follows: Section 2 describes the data and methods used in the paper. Section 3 presents the main empirical results and Section 4 provides the exension and discussion. Section 5 offers concluding remarks.

2 Methodology

In this section, I first explain the details of the FOMC's individual economic projections. Second, I describe how I calculate the annual changes of the unemployment projections used in the analysis. Third, I describe the test to see whether the FOMC's individual economic projections are consistent with Okun's law. Fourth, I describe a similar test for the Phillips curve. Finally, I describe the estimation of the FOMC's reaction function.

2.1 Data

The FOMC's economic projections are the numerical projections of several macroeconomic series over the next two to three years and the longer run[3]: real GDP growth, the unemployment rate, PCE inflation, Core PCE inflation. Since 2011, the FOMC has started publish the projected path of the future federal funds rates associated with these macroeconomic projections. The FOMC's economic projections are the annual projections that target the level or the growth rate at the fourth quarter of a given year. Although each member of the FOMC submits his or her own projections at the meeting, only a set of summary statistics are released immediately after the meeting, such as the ranges, central tendency, and median.[4] The FOMC releases these projections four times a year, typically in March, June, September, and December.

Recently, individual FOMC policymakers' economic projections have become available for the public with a five-year lag, and the projections from 2007 to 2014 are currently published. These individual projections are anonymous, and the policymakers are identified by randomly assigned numbers, which are reshuffled at every meeting. Therefore, the researchers can analyze

[3]The projections at the longer run were added in 2009.

[4]The FOMC has began releasing the median projections in September 2015.

the variations in the projections across different economic variables made at each meeting.

2.2 Calculation of Annual Changes

The FOMC's economic projections are in the form of growth rates for real GDP growth, PCE inflation, and Core PCE inflation whereas they are based on the levels for the unemployment rate. For the regression analysis, it is convenient to compute the annual changes in the unemployment rate.

Denote the forecast of the unemployment rate made by the forecaster i at the qth quarters of the year t forecasting h years ahead ($h = 0, \ldots, 3$), as $\hat{U}^i_{t+h|t,q}$. Then I compute the forecasts of the annual change relative to the previous year as follows:

$$\Delta\hat{U}^i_{t+h|t,q} \equiv \begin{cases} \hat{U}^i_{t|t,q} - U_{t-1|t,q} & \text{for } h = 0 \\ \hat{U}^i_{t+h|t,q} - \hat{U}^i_{t+h-1|t,q} & \text{for } h = 1, 2, 3 \end{cases} \tag{1}$$

where $U_{t-1|t,q}$ is the real-time realized value of year $t-1$ observed at the qth quarters of the year t. In other words, I calculate the annual changes by taking the difference between the real-time realized value and the projections for the nowcasts and by taking the annual changes in the projections for the subsequent forecasts.

Figure 1 depicts the calculation of annual changes. To illustrate, suppose that the forecasts are made at the second quarter of the year t. Then, the forecasts for the fourth quarter of year ($h = 0$) and for the fourth quarter of the next year ($h = 1$) by forecaster i are denoted as $\hat{U}^i_{t|t,2}$ and $\hat{U}^i_{t+1|t,2}$, respectively. By taking the difference between them, I effectively compute the forecast of the annual changes between year t and year $t+1$ made at the second quarter, $\Delta\hat{U}^i_{t+1|t,2} = \hat{U}^i_{t+1|t,2} - \hat{U}^i_{t|t,2}$. For the forecast at the fourth quarter of the same year, the annual change is computed by taking the difference between the forecast and the real-time realized value of the previous year, $\Delta\hat{U}^i_{t|t,2} = \hat{U}^i_{t|t,2} - U_{t-1|t,2}$.

2.3 Test for Okun's Law

Okun's law is a negative relationship between the changes in the unemployment rate and output growth, which characterizes a short-run fluctuation of the economy:

$$\Delta U_t = \alpha - \beta\Delta Y_t, \tag{2}$$

where ΔU_t is the changes in the level of the unemployment rate and ΔY_t is the growth rate of output. Typically, we assume that the $\alpha = 1.5\%$ and $\beta = 0.5$ for the US economy.[5]

It is straightforward to test whether the FOMC policymaker's individual projections are consistent with Okun's law using the following regression:

$$\Delta \hat{U}^i_{t+h|t,q} = \alpha_{h,q} - \beta_{h,q} \Delta \hat{Y}^i_{t+h|t,q} + \varepsilon^i_{t+h|t,q}, \tag{3}$$

where $\Delta \hat{U}^i_{t+h|t,q}$ is the forecasts of the changes in the unemployment rate made by the forecaster i at the qth quarters of the year t forecasting h years ahead, and $\Delta \hat{Y}^i_{t+h|t,q}$ is the corresponding forecasts for GDP growth.

Using this specification, I first run separate regressions for each combination of quarters in which forecasts are made and their forecast horizons, which ranges from nowcast ($h = 0$ and $q = 4$: forecasting the fourth quarter of the year at the same quarter) to fourteen quarters ahead ($h = 3$ and $q = 3$: forecasting the fourth quarter three years ahead at the third quarter of a year).

Second, I pool the forecasts across all horizons to estimate the coefficients by controlling the effects at specific horizons:

$$\Delta \hat{U}^i_{t+h|t,q} = \alpha - \beta \Delta \hat{Y}^i_{t+h|t,q} + \sum_{h=0}^{H} \sum_{q=1}^{Q} \delta_{h,q} D_{h,q} + \varepsilon^i_{t+h|t,q}, \tag{4}$$

where $D_{h,q}$ is the dummy variable for a particular forecast horizon, and H and Q denote the maximum number of horizons and quarters, respectively.

2.4 Test for the Phillips Curve

The test for the Phillips curve, which describes a tradeoff between inflation and unemployment, is constructed in a similar manner. A typical Phillips curve is defined in a gap form as follows:

$$\pi_{t+h} = E_t[\pi_{t+h}] - \theta(U_{t+h} - U^n_{t+h}) + v_t, \tag{5}$$

where π, U^n, and v denote the rate of inflation, the natural rate of unemployment, and the supply shock, respectively.[6] To describe the test for the Phillips curve, I introduce new notations.

[5] For example, see Mankiw (2016).
[6] For example, see Mankiw (2016).

Denote $E^i_{t,q}[\pi_{t+h}] = \int f^i(\pi_{t+h}|\Omega_{t,q})\pi_{t+h}d\pi_{t+h}$ as the expected inflation rate h years ahead by the policymaker i, where $f^i(\pi_{t+h}|\Omega_{t,q})$ is the probability density assigned by the policymaker i about the inflation h years ahead conditional on the information set $\Omega_{t,q}$.

This specification of the Philips curve could be tested by taking the first order differences of the projections as follows:

$$\Delta\hat{\pi}^i_{t+h|t,q} = \Delta E^i_{t,q}[\pi_{t+h}] - \theta_{h,q}\left(\Delta\hat{U}^i_{t+h|t,q} - \Delta\hat{U}^{n,i}_{t+h|t,q}\right) + \nu^i_{t+h|t,q}, \tag{6}$$

$$= \gamma_{h,q} - \theta_{h,q}\Delta\hat{U}^i_{t+h|t,q} + \nu^i_{t+h|t,q}, \tag{7}$$

where $\Delta\hat{\pi}^i_{t+h|t,q}$, $\Delta E^i_{t,q}[\pi_{t+h}]$, and $\Delta\hat{U}^{n,i}_{t+h|t,q}$ are defined in the same way as in Equation (1). The intercept in Equation (7), $\gamma_{h,q} \equiv \Delta E^i_{t,q}[\pi_{t+h}] + \theta_{h,q}\Delta\hat{U}^{n,i}_{t+h|t,q}$, captures the differences of the projections of inflation expectation and the natural rate of unemployment at different horizons. In other words, if $E^i_{t,q}[\pi_{t+h}] = E^i_{t,q}[\pi_{t+h-1}]$ and $\hat{U}^{n,i}_{t+h|t,q} = \hat{U}^{n,i}_{t+h-1|t,q}$ for given t, q, h and i—which implies that the policymaker i does not change his or her inflation expectation or the forecasts of the natural rate of unemployment at horizon h in the same FOMC meeting—then $\gamma_{h,q}$ should be zero. This implication could be tested in the empirical analysis.

Following the same method outlined in the regression testing for Okun's law, I pool the forecasts across all horizons by adding the fixed effects for each horizon,

$$\Delta\hat{\pi}^i_{t+h|t,q} = \gamma - \theta\Delta\hat{U}^i_{t+h|t,q} + \sum_{h=0}^{H}\sum_{q=1}^{Q}\delta_{h,q}D_{h,q} + \nu^i_{t+h|t,q}, \tag{8}$$

where $D_{h,q}$ is the dummy variable for a particular forecast horizon.

2.5 Estimating the FOMC's Reaction Function

The reaction function of the FOMC policymakers characterizes their monetary policy decisions in response to changing economic conditions by taking the tradeoffs in their policy objectives into account. The new dataset of individual FOMC policymakers' projections has a couple of advantages in estimating the reaction function. First, the researchers can measure the output and inflation gaps without any state-space models because the FOMC policymakers publish their inflation and unemployment rate projections in the longer run along with their fixed-target forecast. Second, the estimation will not be constrained by the ELB because the forecasts of future interest rates could be positive at sufficiently long forecast horizons, even though the short-term federal funds rate was stuck at ELB between 2012 and 2014. Therefore, the individual FOMC policymakers' projections will give the researchers substantial variation for the estimation.

Typically, the FOMC's reaction function is described by the Taylor rule, in which the optimal interest rate depends on the output and inflation gaps:

$$i_{t+h} = \rho + \phi^{\pi}(\pi_{t+h} - \pi^{*}) + \phi^{Y}(\Delta Y_{t+h} - \Delta Y^{n}_{t+h}), \tag{9}$$

where i_t is the nominal interest rate, π^* is the target inflation rate, and ΔY^{n}_{t+h} is the natural level of output growth.[7] Using the FOMC policymakers' inflation and unemployment rate projections in the longer run, this equation could be directly estimated in the following regression:

$$\hat{i}^{i}_{t+h|t,q} = \rho_{h,q} + \phi^{\pi}_{h,q}(\hat{\pi}^{i}_{t+h|t,q} - \hat{\pi}^{i}_{LR|t,q}) + \phi^{Y}_{h,q}(\Delta\hat{Y}^{i}_{t+h|t,q} - \Delta\hat{Y}^{i}_{LR|t,q}) + \varepsilon^{i}_{t+h|t,q}, \tag{10}$$

where superscript i denotes the forecasts made by individual policymaker i. The constant, $\rho_{h,q}$ could be interpreted as the natural rate of interest, which would prevail when the economy is in a state of long-run equilibrium.

Following the same method outlined in the tests for Okun's law and the Phillips curve, this regression could be estimated by pooling the forecasts across all horizons and adding the fixed effects for each horizon.

$$\hat{i}^{i}_{t+h|t,q} = \rho + \phi^{\pi}(\hat{\pi}^{i}_{t+h|t,q} - \hat{\pi}^{i}_{LR|t,q}) + \phi^{Y}(\Delta\hat{Y}^{i}_{t+h|t,q} - \Delta\hat{Y}^{i}_{LR|t,q}) + \sum_{h=0}^{H}\sum_{q=1}^{Q}\delta_{h,q}D_{h,q} + \varepsilon^{i}_{t+h|t,q}, \tag{11}$$

where $D_{h,q}$ is the dummy variable for a particular forecast horizon.

3 Results

3.1 Okun's Law

Figure 2 shows the scatter plot of the changes in the unemployment rate and GDP growth with the corresponding fitted line. It is evident from the figure that there is a strong negative correlation between the forecasts of output growth and the changes in unemployment rate, which implies that the FOMC's economic projections are consistent with Okun's law. The

[7] For example, see Chapter 3 of Galí (2015).

estimates of the regression analysis are summarized in Table 1, which confirms this observation. The estimates of the constant and coefficient are 1.21 and -0.58 for the pooled regression and 1.13 and -0.66 for the regression with the fixed effects for the forecast horizons described in Equation (4), all of which are statistically significant. The horizon fixed effects are positive and statistically significant at longer horizons, which implies that the FOMC policymakers tend to be more pessimistic about unemployment projections than those predicted by corresponding output growth projections. Given that the sample period covers the Great Recession, during which the unemployment rate rose quickly, these results are not particularly surprising. The Wald test strongly rejects the null hypothesis that the values of the coefficients are all zero. The adjusted R^2 are quite high, and more than seventy percent of the variation is explained by the Okun's law regression.

Figure 3 shows the estimated coefficients of Okun's law at each quarterly horizon described in Equation (3) with the corresponding standard errors. Although the magnitudes of the estimates at the horizons within a year tend to be significantly larger than the conventional value of 0.5, the estimates converge around 0.5 at the longer horizons, which suggests that the FOMC's individual projections are broadly consistent with the conventional Okun's law. The larger estimates at the shorter horizons likely to reflect the rapid increase in the unemployment at the onset of the Great Recession.

3.2 Phillips Curve

Figure 4 shows the scatter plot of the changes in inflation and the unemployment rate with the corresponding fitted line, in which inflation is measured by PCE or Core PCE. Unlike the test for Okun's law, the association between inflation and unemployment projections is much weaker, with many observations substantially deviating from the fitted line in both measures of inflation. Table 2 summarizes the results of the regression analysis, and they are consistent with this observation. The estimated slope of the Phillips curve is -0.25 with PCE inflation and -0.19 with Core PCE inflation, which are unchanged even if the horizon fixed effects are included as in Equation (8). The estimates of the constant are -0.14 with PCE inflation and -0.05 with Core PCE inflation and they are statistically significant, rejecting the implication that expected rate of inflation and natural rate of unemployment are unchanged across horizons. However, the magnitude of estimates is very close to zero and the estimates become insignificant once I include the horizon fixed effects. Although the Wald test significantly rejects the null hypothesis that the values of the coefficients are all zero, the adjusted R^2 are much lower than the Okun's law regression, and only ten to twenty percent of the variation is explained by the Phillips curve regression.

Figure 5 shows the estimated slope of the Phillips curve at each quarterly horizons described in Equation (7), with the corresponding standard errors. The figure shows that the slope of the Phillips curve is approximately -0.1 at most horizons, whereas the magnitude of the estimates between three and seven quarters ahead is substantially larger than the other horizons, although the standard deviation is also quite large. Although the magnitude of the estimates depends on the measure of inflation, the general pattern of the results is similar. The large estimated coefficients at the medium term likely reflect the fact that inflation was subdued during the Great Recession and the following period of recovery. At the onset of the Great Recession, the FOMC policymakers expected inflation to fall dramatically, perhaps reaching close to zero, given the severity of the macroeconomic shock, and they thus predicted a large magnitude of increases in the unemployment rate and reductions in inflation.[8] On the other hand, the FOMC policymakers predicted that inflation would increase as the unemployment rate gradually declined during the recovery, which did not happen as much as anticipated. Both predictions will steepen the slope of the Phillips curve suggested by the medium-term projections. However, the FOMC policymakers modify their inflation projections as the target period approaches, which makes the slope suggested by short-term projections smaller.

3.3 Reaction Function

Figure 6 shows the scatter plot of the federal funds rate, output gap and inflation gap measured by PCE, with different quarterly horizons. As the figure clearly shows, the FOMC policymakers expect the federal funds rate to rise at longer horizons, although it has been stuck at zero in the short term. Table 3 presents the estimates of the reaction function using the whole sample. Regression analysis shows that the estimated constant and response to the inflation gap is 1.58 and 1.91 with PCE inflation and 1.67 and 2.64 with Core PCE inflation; both of these estimates are statistically significant, whereas the response to the output gap is negative and

[8] However, inflation did not fall as much as predicted by the Phillips curve in reality, which is called "missing disinflation." For a detailed discussion, see Ball and Mazumder (2011), Christiano et al. (2015), Coibion and Gorodnichenko (2015), and Gilchrist et al. (2017).

insignificant. These estimates of the response to the inflation gap are consistent with the Taylor principle, which claims that the central banks should be sufficiently aggressive against inflation to maintain stability of the economy.[9]

However, these estimates dramatically changes once the horizon fixed effects are considered, as in Equation (11). The horizon fixed effects are statistically significant at most horizons, and the magnitude becomes quite large as the horizon becomes longer. For example, the horizon fixed effect is 3.01 with PCE inflation and 2.89 with Core PCE inflation at the horizon of fourteen quarters ahead. At the same time, the estimated response to the inflation gap becomes substantially smaller, at 0.66 with PCE inflation and 1.07 with Core PCE inflation, and the response to the output gap becomes significantly negative, at -0.82 with PCE inflation and -0.80 with Core PCE inflation.

Figure 7 shows the estimated responses to inflation and output gaps at each quarterly horizon described in Equation (10), with the corresponding standard errors. The results shows two tendencies: First, the responses to the inflation gap are close to zero at the short horizons within a year, and they reach above one at most long-term horizons, although the estimates are volatile. Second, the response to the output gap is close to zero at the short horizons within a year and becomes significantly negative at the longer horizons. Given that the short-term interest rate was stuck at zero between 2012 and 2014, it is not surprising that the responses to inflation and output gaps are estimated to be zero at the short horizons.

4 Extensions

4.1 Comparison with the SPF forecasts

As a robustness check, I conducted the same analysis using the individual forecasts of SPF during the same period. One thing to note is that the FOMC's projections and SPF are not fully comparable due to their designs, and there are a couple of minor differences. First, the SPF's unemployment forecasts target the annual average of the unemployment rate, instead of the value at the fourth quarter targeted by the FOMC. Therefore, the calculation of annual changes in the unemployment rate is based on the annual average of the real-time data observed at the time of the forecasts. Second, the maximum horizon of the SPF for real economic variables

[9]For details, see Galí (2015).

is four years, whereas the maximum horizon for the price levels is three years, which is shorter than the FOMC's forecasts.

Tables 4 and 5 present the empirical results of Okun's law and the Phillips curve based on the SPF forecasts. The results are generally similar to the results obtained using the FOMC's individual projections. For Okun's law, both constant and slope are significant, with magnitudes close to the conventional values: The constants and slopes are 1.18 and -0.58 for the pooled regression and 1.09 and -0.60 with the horizon fixed effects. Adjusted R^2 are relatively high, with the magnitudes of 0.64 and 0.65, respectively. On the other hand, the Phillips curves found in SPF's forecasts are much weaker and more dispersed than Okun's law: The slopes are -0.33 and -0.32 with PCE inflation and -0.19 and -0.23 with Core PCE inflation. Although the null hypothesis that all the coefficients are zero is strongly rejected, the explanatory power of the regression is relatively low, with R^2 of 0.15 and 0.17 with PCE inflation and 0.28 and 0.29 with Core PCE inflation. These results suggest that empirical pattern found in the FOMC's individual projections—robust Okun's law relationship and the weak Phillips curve relationship—are likely driven by the sample period rather than the factors specific to the forecasters.[10]

4.2 Macroeconomic Implications

This paper found a relatively robust Okun's law and weak Phillips curve relationships in the FOMC's economic projections and the SPF forecasts, which are generally consistent with the findings in the literature. A number of papers, such as those by Ball et al. (2015), Pierdzioch et al. (2011), and Mitchell and Pearce (2010), found that Okun's law served as a useful guide for the forecasters. In fact, Jordà et al. (2020) show that a simple model incorporating Okun's law can help refine the advance data release of the real GDP, even during the COVID-19 pandemic. Given the significance of Okun's law in terms of forecasting, it is natural to find this robust relationship between output growth and the unemployment rate projections.

On the other hand, a number of papers in the literature have documented that the forecasting performance of the models based on the Phillips curve has substantially deteriorated over the years, as discussed in Stock and Watson (2008) and Faust and Wright (2013). In particular, many recent papers—including those of Del Negro et al. (2020), Gagnon and Collins (2019), Hooper et al. (2020), Jorgensen and Lansing (2019), Kuttner and Robinson (2010), Matheson and Stavrev

[10] For more detailed comparison of FOMC and other private forecasts, see Bespalova (2020), Ellison and Sargent (2012), Gamber and Smith (2009), and Romer and Romer (2000).

(2013), and Simon et al. (2013)—examine whether the Phillips curve has flattened in recent decades or not and discuss possible policy implications. Therefore, it is not surprising that the observed correlation between inflation and unemployment projections made by both FOMC policymakers and private forecasters becomes weaker. By studying the professional survey forecasts in the US, the UK, and Europe, Casey (2020) reached the same conclusion that the forecasts are broadly consistent with Okun's law and to some extent consistent with some form of the Phillips curve.

For the reaction function, the implication of econometric results is mixed. This paper found a positive constant and positive responses to inflation gaps, the magnitudes of which are often larger than those presented by the Taylor principle. Although these results on the constant and inflation gaps are consistent with a standard macroeconomic theory and earlier analysis by Morris (2017) based on the aggregate projections, the significantly negative response on the output cap is unfortunately not consistent.

My conjecture about the interpretation is that the results likely reflect the diverse views about the future paths of appropriate monetary policy in the long term. Although the hawkish and dovish FOMC policymakers may have similar views on the paths of output gaps, their predicted paths for the federal funds rate could be substantially different due to their diverse, often conflicting, views on inflation. For example, Faust (2016) criticized that "SEP provides a partial and disjoint summary of the remarkable dispersion of FOMC members' views about the outlook for the economy and policy. (Page 3, Line 11–12) " and Vissing-Jorgensen (2019) proposed several reforms on the FOMC's communications because the FOMC policymakers strategically use their communications to influence the consensus, which eventually confuses the investors. Because the regression analysis cannot control these individual fixed effects for the federal funds rate due to the anonymity of the economic projections, the response of output gaps could be substantially volatile once we control the constant at each horizon either by adding horizon fixed effects or splitting the samples at each horizon.

5 Conclusion

This paper analyzes the properties of the panel of individual economic projections made by the FOMC policymakers. By analyzing their anonymous projections between 2007 and 2014, this paper finds that they are consistent with Okun's law, whereas the relationship between inflation and unemployment projections, associated with the Phillips curve, is much weaker and more dispersed. This paper also estimates the Fed's reaction function to obtain the mixed results.

The investigation of the FOMC's individual economic projections suggests that they provide researchers with substantially richer variations compared to aggregate SEPs. Further research on the FOMC's individual economic projections, especially using their identities once they becomes public in the future, would yield a much better understanding of the FOMC's collective decision making and their conduct of US monetary policy.

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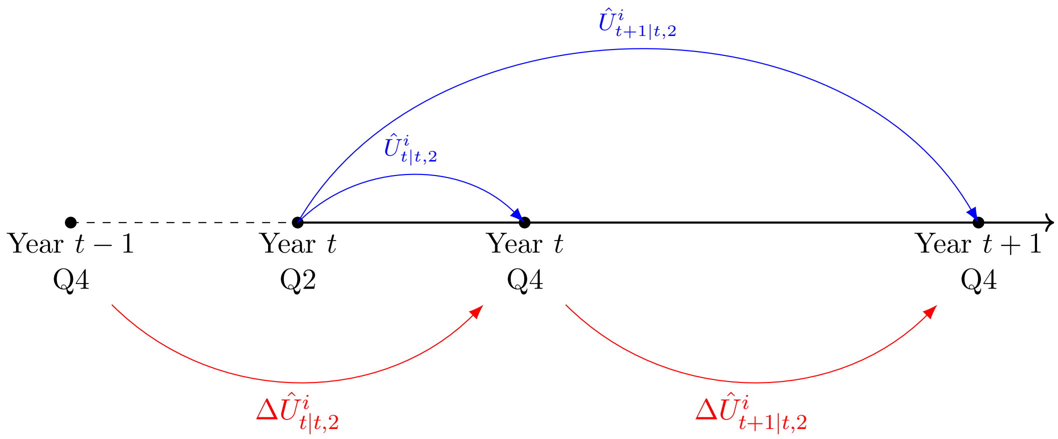


Note: This table illustrates the calculation of annual changes in the unemployment rate based on the projections released at Q2 by the policymaker i. Blue lines describe the projections published at Q2 of the year and red lines describe the computed annual changes.

Figure 1: Illustration of Computing Annual Changes

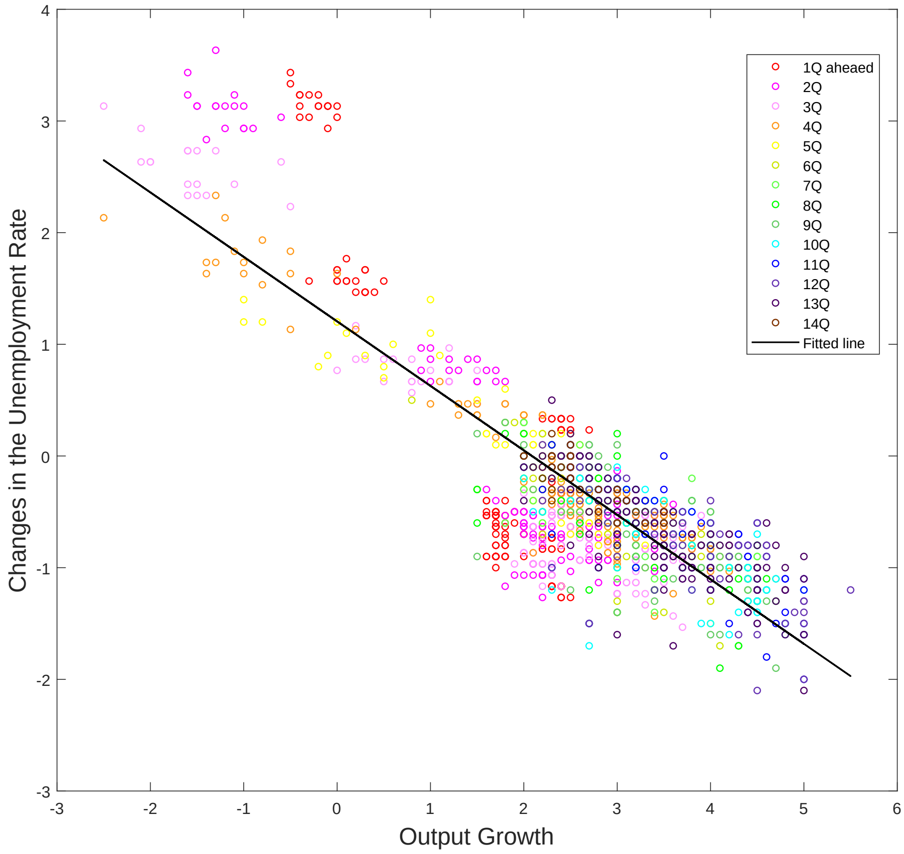
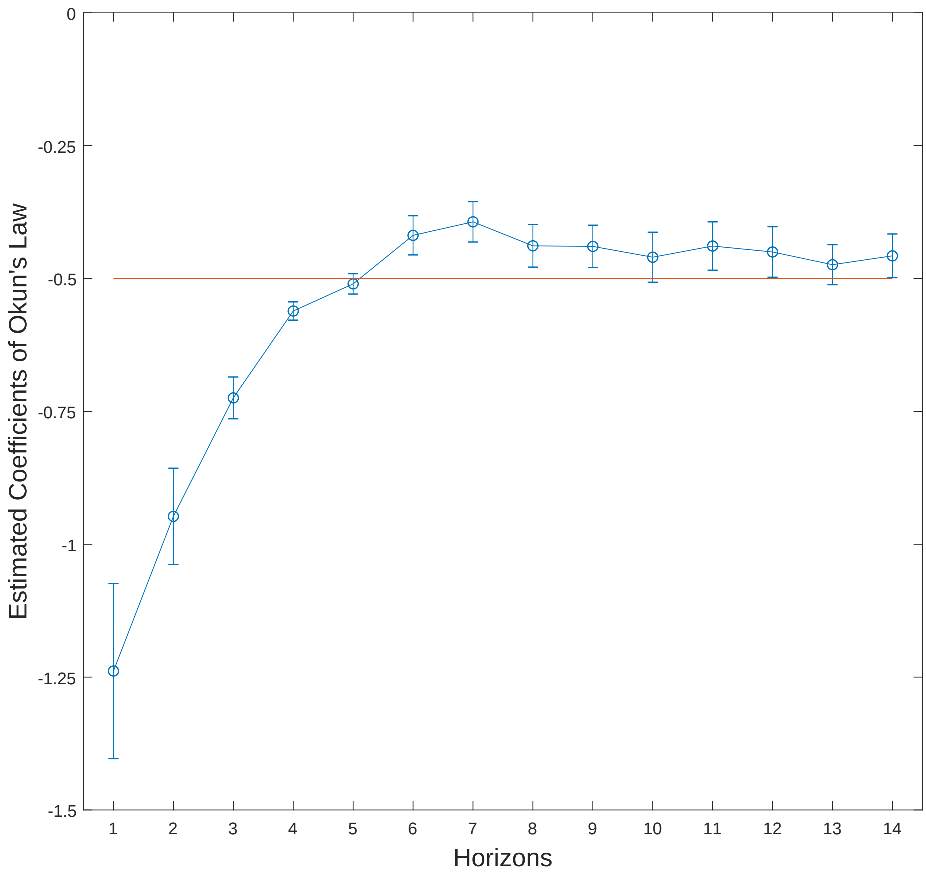


Figure 2: FOMC's Output Growth and Unemployment Projections



Note: This figure shows the estimated slope of the Okun's law using the samples of individual horizons. The estimates are shown in the circle with the bands of standard deviation based on HAC standard errors.

Figure 3: Estimated Slope of the Okun's Law at Individual Horizons

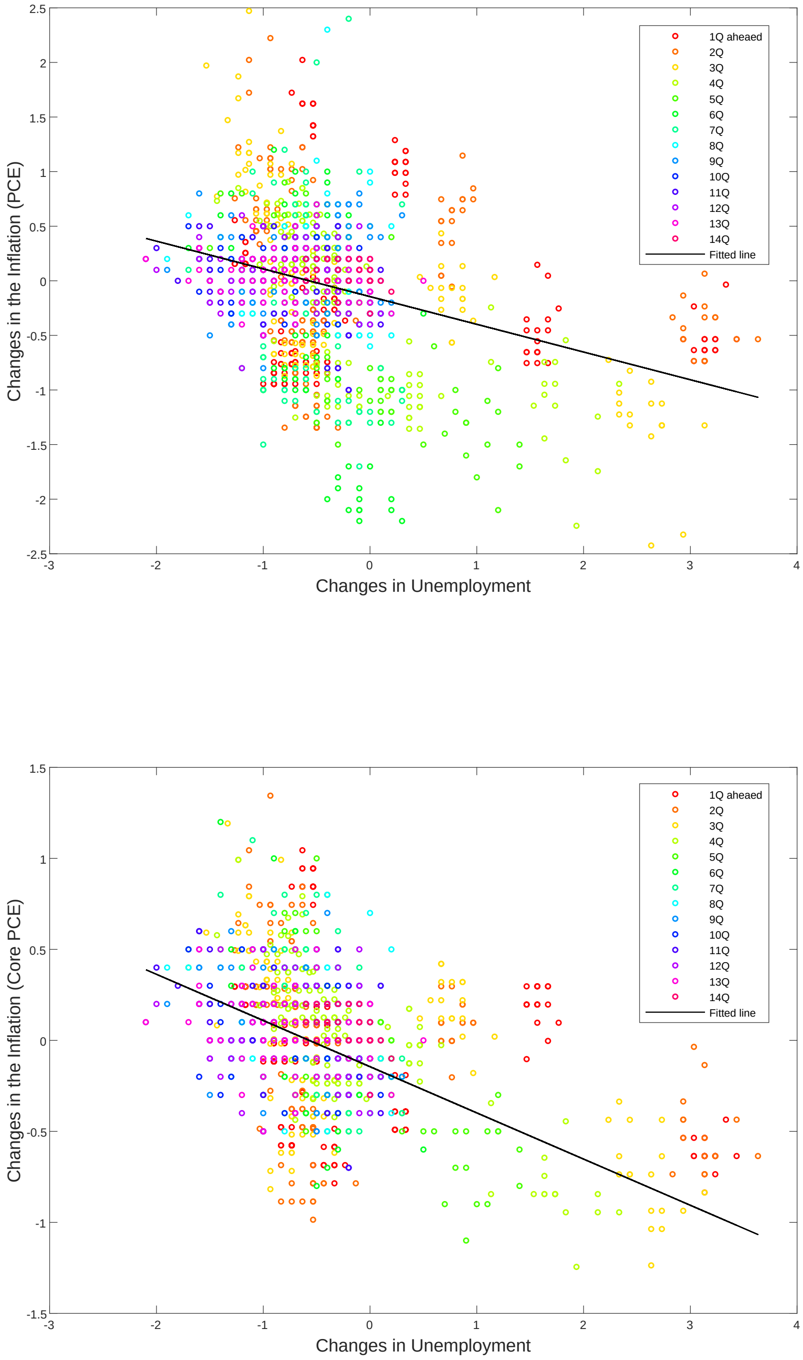
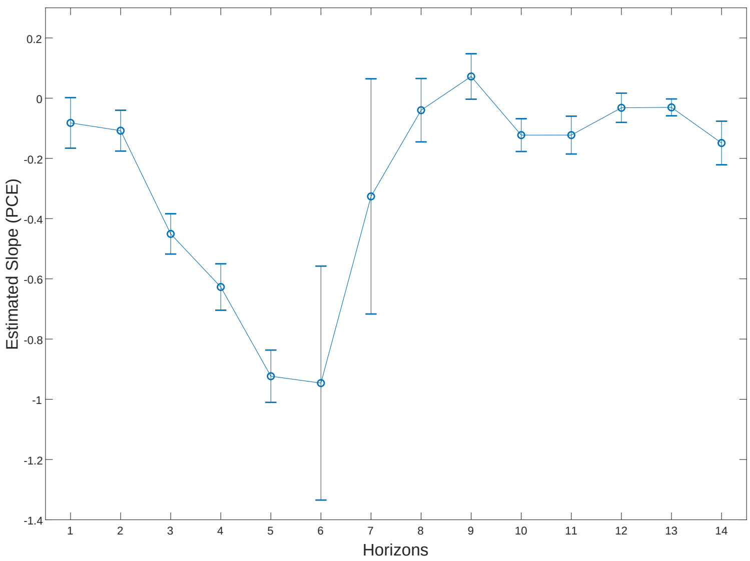
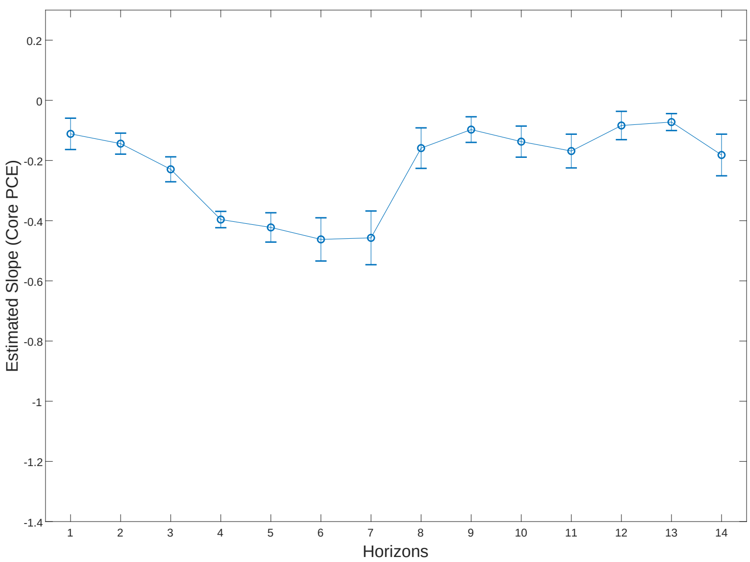


Figure 4: FOMC's Inflation and Unemployment Projections (PCE and Core PCE)





Note: This figure shows the estimated slope of the Phillips curve based on PCE and Core PCE using the samples of individual horizons. The estimates are shown in the circle with the bands of standard deviation based on HAC standard errors.

Figure 5: Estimated Coefficients of the Phillips Curve at Quarterly Horizons

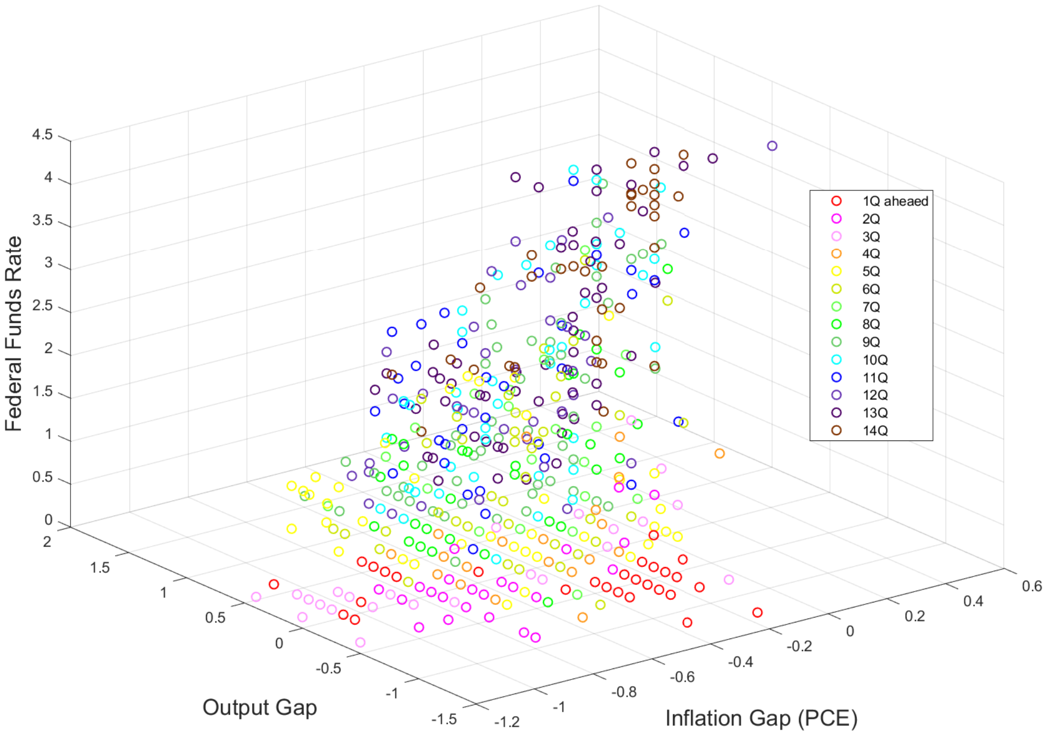


Figure 6: FOMC's Projections for Inflation Gap (PCE), Output Gap, and Federal Funds Rates

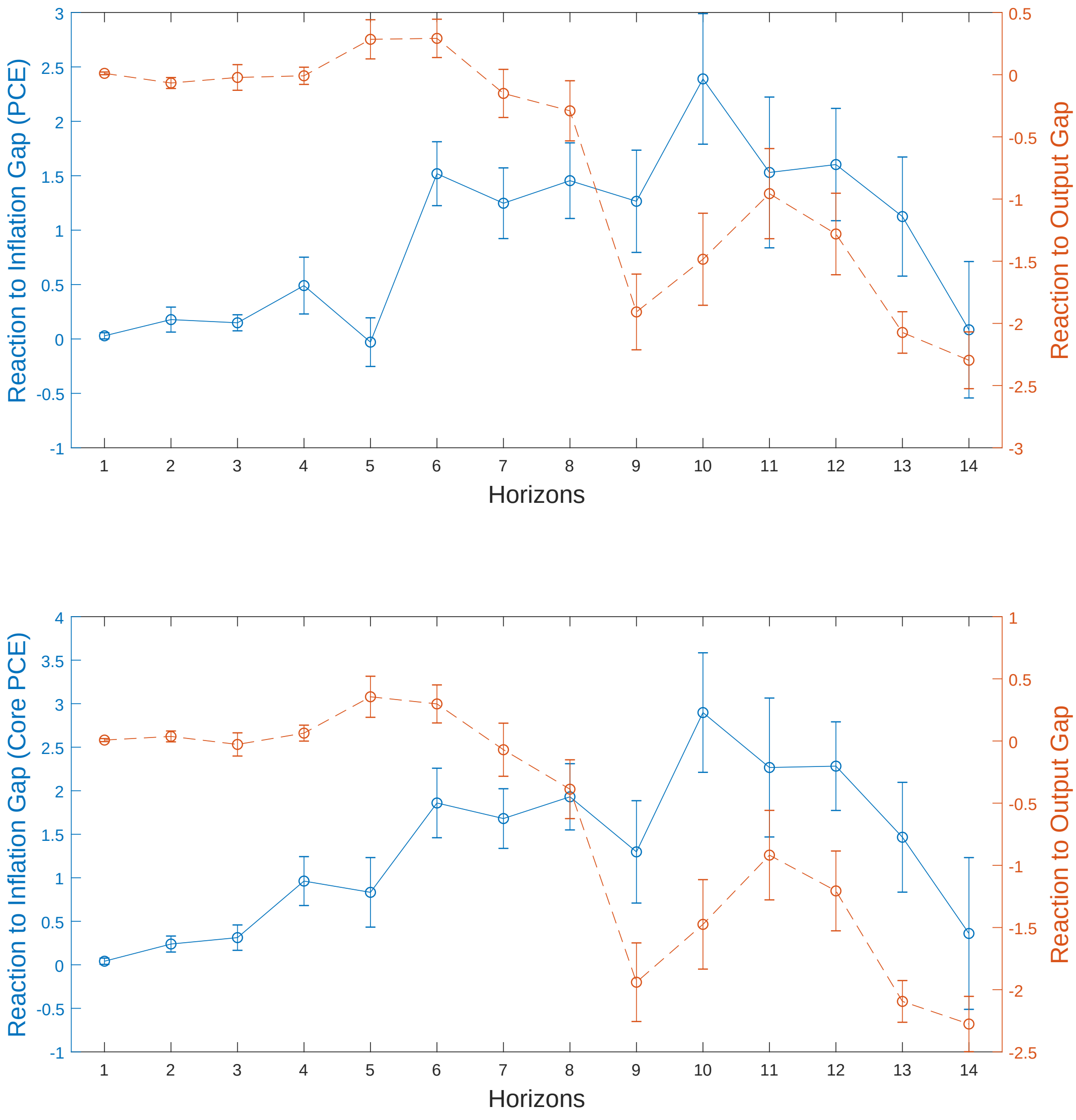


Figure 7: Reactions to Inflation and Output gaps at Individual Horizons

	(1)	(2)
Constant	1.21^{***}	1.13^{***}
Slope	-0.58^{***}	-0.66^{***}
Horizon fixed effects:		
2Q		0.06
3Q		0.00
4Q		0.23
5Q		0.27
6Q		0.32
7Q		0.41^{*}
8Q		0.39^{*}
9Q		0.42^{*}
10Q		0.45^{**}
11Q		0.52^{**}
12Q		0.50^{**}
13Q		0.46^{**}
14Q		0.39^{*}
Wald statistics	1213.87^{***}	3064.96^{***}
Adjusted R^2	0.70	0.73
Observations	1749	1749

[a.] This table shows the results of regressions testing the Okun's law with difference specifications.

[b.] Inference is based on heteroscedasticity and autocorrelation robust (HAC) standard errors. *, **, and *** denote the significance level at 10%, 5%, and 1%, respectively.

Table 1: Estimates of the Okun's Law using the Whole Sample

	PCE		Core PCE	
	(1)	(2)	(1)	(2)
Constant	−0.14***	−0.10	−0.05**	−0.09
Slope	−0.25***	−0.25***	−0.19***	−0.19***
Horizon fixed effects:				
2Q		0.06		0.02
3Q		−0.02		0.03
4Q		−0.18		0.04
5Q		−0.22		0.01
6Q		−0.18		0.04
7Q		−0.11		0.08
8Q		0.05		0.07
9Q		0.05		0.04
10Q		−0.03		0.02
11Q		−0.02		0.03
12Q		−0.01		0.02
13Q		0.01		0.03
14Q		0.10		0.10
Wald statistics	27.89***	50.46***	73.98***	104.97***
Adjusted R^2	0.11	0.13	0.21	0.21
Observations	1749	1749	1749	1749

a. This table shows the results of regressions testing the Phillips curve with difference specifications.

b. Inference is based on heteroscedasticity and autocorrelation robust (HAC) standard errors. ** and *** denote the significance level 5% and 1%, respectively.

Table 2: Estimates of the Phillips Curve Using the Whole Sample

	PCE		Core PCE	
	(1)	(2)	(1)	(2)
Constant	1.58***	0.26	1.67**	0.37**
Response to Output Gap	−0.11	−0.82***	−0.13	−0.80***
Response to Inflation Gap	1.91***	0.66***	2.64***	1.07***
Horizon fixed effects:				
2Q		0.13		0.09
3Q		0.31		0.36*
4Q		0.43**		0.47**
5Q		0.82***		0.75***
6Q		0.97***		0.93***
7Q		1.15***		1.09***
8Q		1.16***		1.10***
9Q		1.67***		1.57***
10Q		2.06***		1.97***
11Q		2.19***		2.08***
12Q		2.08***		1.99***
13Q		2.53***		2.41***
14Q		3.01***		2.89***
Wald statistics	212.46***	570.19***	232.11***	563.81***
Adjusted R^2	0.25	0.55	0.30	0.57
Observations	793	793	793	793

a. This table shows the results of regressions testing the Taylor rule with two measures of inflation gap (PCE and Core PCE) and difference specifications.

b. Inference is based on heteroscedasticity and autocorrelation robust (HAC) standard errors. *, **, and *** denote the significance level at 10%, 5%, and 1%, respectively.

Table 3: Estimates of the Taylor Rule Using the Whole Sample

	(1)	(2)
Constant	1.18***	1.09***
Slope	−0.58***	−0.60***
Horizon fixed effects:		
2Q		−0.09
3Q		0.05
4Q		0.19
5Q		0.31
6Q		0.16
7Q		0.20
8Q		0.19
9Q		0.13
10Q		0.15
11Q		0.10
12Q		0.18
13Q		0.12
14Q		0.15
15Q		0.11
16Q		0.11
Wald statistics	484.43***	667.67***
Adjusted R^2	0.64	0.65
Observations	3541	3541

a. This table shows the results of regressions testing the Okun's law with difference specifications.
b. Inference is based on heteroscedasticity and autocorrelation robust (HAC) standard errors. *** denotes the significance level at 1%.

Table 4: Estimates of the Okun's Law (SPF Forecasts)

	PCE		Core PCE	
	(1)	(2)	(1)	(2)
Constant	−0.01	0.10	0.05**	−0.07
Slope	−0.33***	−0.32***	−0.19***	−0.23***
Horizon fixed effects:				
2Q		−0.12		0.08
3Q		−0.09		0.13
4Q		−0.27		0.13
5Q		−0.25		0.14
6Q		−0.17		0.16
7Q		−0.07		0.20
8Q		0.13		0.18
9Q		−0.05		0.12
10Q		−0.08		0.09
11Q		−0.14		0.11
12Q		−0.17		0.10
Wald statistics	83.91***	234.20***	351.61***	556.38***
Adjusted R^2	0.15	0.17	0.28	0.29
Observations	2575	2583	2575	2583

[a.] This table shows the results of regressions testing the Phillips curve with difference specifications.

[b.] Inference is based on heteroscedasticity and autocorrelation robust (HAC) standard errors. ** and *** denote the significance level 5% and 1%, respectively.

Table 5: Estimates of the Phillips Curve (SPF Forecasts)