

**BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM**  
**DIVISION OF MONETARY AFFAIRS**  
**FOMC SECRETARIAT**

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**Date:** March 13, 2018  
**To:** Federal Open Market Committee  
**From:** Matthew M. Luecke  
**Subject:** DSGE Models Update

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The attached memo provides an update on the projections of the DSGE models.

## **System DSGE Project Forecasts**

March 13, 2018

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<sup>1</sup>We thank Cole Dreier and Keith Sill, Abhi Gupta, Michael Cai, and Pearl Li for their contributions.

This memo describes the economic forecasts of the four models that are currently part of the System project on dynamic stochastic general equilibrium (DSGE) models. These are the EDO (Board), PRISM (FRB Philadelphia), Chicago Fed and New York Fed models. We first provide a summary of the forecasts and then describe each of them in greater detail.

### **Summary of Model Forecasts**

The current forecasts for real GDP growth, core PCE inflation, and the federal funds rate are displayed in the table and figures at the end of this summary section. The DSGE model forecasts were obtained using actual data through 2017Q4 and conditioning assumptions or “nowcasts” for 2018Q1 where the sources of the nowcasts are principally the respective staff forecasts. For the NY Fed, PRISM, and EDO models the federal funds rate path is determined by the respective estimated policy reaction functions. The Chicago Fed model uses the Federal Funds rate from the Survey of Market Participants to pin down the funds rate for the next ten quarters. After that, the funds rate is determined by the model’s estimated rule. For the sake of comparison, the tables include the December and March Tealbook forecasts, as well as the model forecasts prepared for the December and March FOMC meeting. The memo also presents model-based estimates and forecasts of the real natural rate of interest, defined in each model as the equilibrium real rate of interest that would prevail in the absence of sluggish adjustment of nominal prices and wages. In addition, the memo reports estimates and forecasts of model-based output gaps. These are computed as percent deviations of actual output from the natural level of output, the latter again defined as the level of output that would prevail if prices and wages were fully flexible.

Turning first to GDP growth, the median forecast has growth equal to 2.3 percent in both 2018 and 2019, and 2.4 percent for 2020. While PRISM continues to have the strongest forecast with annual growth averaging about 2.9 percent over the forecast horizon, the Chicago Fed model has the weakest forecast predicting an average annual growth rate of about 1.5 percent. The EDO and the NY Fed growth forecasts lie between the PRISM and Chicago Fed forecasts, at, respectively, 2.6 percent and 2.1 percent over the next three years. While the projections from the EDO, NY Fed and Chicago Fed models were relatively unchanged at all horizons from December, PRISM’s projection for 2018 was revised downwards. Disagreement across output growth forecasts, defined as the difference between the highest and lowest forecast, has fallen somewhat relative to December, mainly due to the lower forecast path from PRISM. The

Tealbook forecast is higher than all the DSGE models for 2018 but is in line with the intermediate forecasts of the DSGE models for 2019 and 2020.

Turning to inflation, the projections do not show marked differences from recent memos. The NY Fed model continues to predict that inflation will remain below the Committee's longer-run objective throughout the forecast horizon, gliding from 1.8 percent in 2018, to 1.5 percent in 2019 and 2020. The Chicago Fed model also has inflation below target at a steady 1.7 percent over the last two years of the forecast horizon, falling from 1.9 percent in 2018. PRISM and EDO continue to predict inflation will achieve 2 percent by 2020: inflation gradually increases from 1.9 percent (EDO) and 1.8 percent (PRISM) in 2018. The Tealbook forecast for inflation is similar to all four DSGE models for 2018 but is higher than the projections of all DSGE models for 2019 and 2020.

The forecasts of the real natural rate of interest are overall a little higher in 2018, but remain unchanged over the following two years. EDO continues to have the strongest forecast with the real natural rate of interest at 1.5 percent in the last quarters of 2018 and 2019, reaching 1.6 percent by the end of 2020. Chicago Fed remains the weakest medium term forecast with the natural rate of interest projected to decline from 1.5 percent in 2018 to 0.5 percent in 2020. The PRISM and the NY Fed growth forecasts are intermediate with projected natural rates of interest increasing from 0 and 1 percent in 2018, to reach 1.5 and 1.4 percent in 2020, respectively. Note though that the range of uncertainty in the natural rate projections is large enough that all of the forecasts lie within each other's 68 percent confidence bands at the end of 2020.

As for the output gap, EDO, NY Fed, and PRISM continue to predict a negative but contracting output gap all the way till 2020. In contrast, the Chicago Fed model estimates a positive output gap for 2018 (1.0 percent) but expects output to fall below potential by 2020 with an output gap of -0.6 percent. The Tealbook forecast is even stronger than the Chicago Fed model in terms of the size of the output gap for 2018. Going forward, the Tealbook continues predicting that output stays above potential for 2019 and 2020 which is in contrast to the four DSGE models.

EDO, the NY Fed, and PRISM tend to attribute negative output gaps to past shocks to financial conditions – so-called headwinds – which have a lasting effect on the economy and

continue to restrain aggregate demand. These headwinds have continued to abate, as evidenced by the higher estimated real natural rate of interest path over the forecast horizon. Negative productivity shocks have also contributed to depressing economic activity over the course of the recovery, and continue to impede growth in the medium term. In contrast, the Chicago Fed model attributes slower growth over the forecast horizon to the removal of monetary policy accommodation and tighter financial conditions.

The expected speed of normalization in the federal funds rate varies across models, consistent with their assessments of the speed at which economic activity and especially inflation rebound. PRISM and EDO forecasts display a relatively steeper path for the federal funds rate, starting at 2.6 and 2.4 percent in the last quarter of 2018 and gradually reaching 3.6 and 3.5 percent in 2020Q4, respectively. NY Fed and Chicago Fed project a shallower path with the federal funds rate at 2.3 in 2018Q4 and increasing to 2.9 and 2.8 percent at the end of 2020. The Tealbook predicts a steeper path than any of the DSGE models, rising to 5 percent by the end of 2020.

## Forecasts

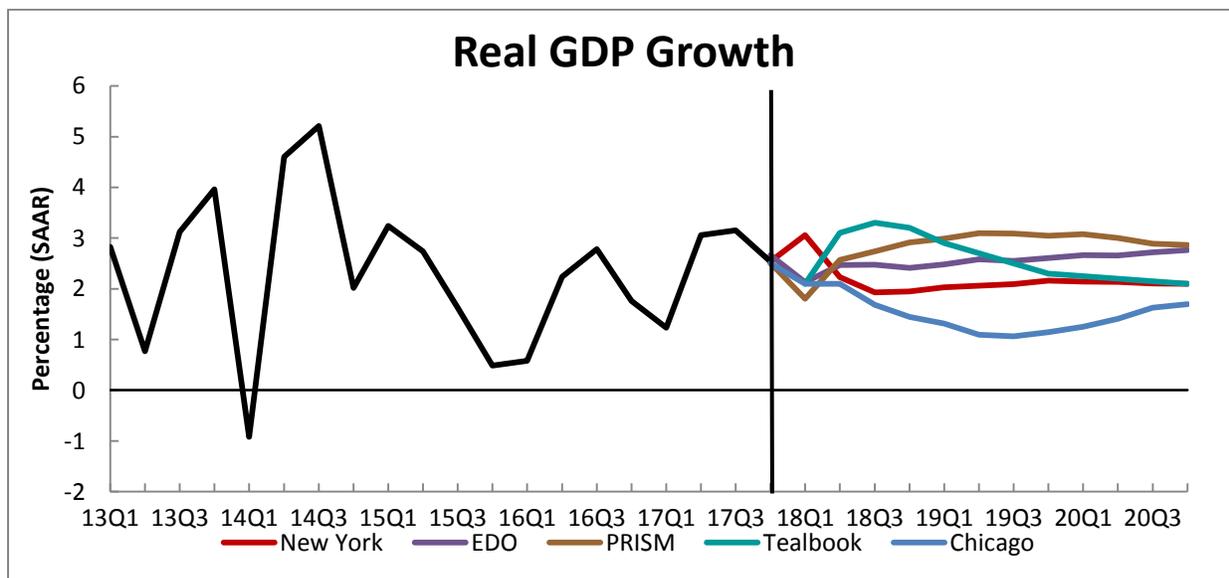
Model	Output Growth (Q4/Q4)					
	2018		2019		2020	
	March	December	March	December	March	December
EDO - Board of Governors	<b>2.4</b> (0.8, 3.9)	2.6 (0.7, 4.5)	<b>2.6</b> (0.5, 4.7)	2.5 (0.4, 4.6)	<b>2.7</b> (0.6, 4.8)	2.6 (0.5, 4.9)
New York Fed	<b>2.3</b> (0.2, 4.2)	2.0 (-0.6,4.4)	<b>2.0</b> (-0.8, 4.7)	2.2 (-0.6,4.8)	<b>2.1</b> (-0.8, 4.8)	2.2 (-0.6,4.9)
PRISM - Philadelphia Fed	<b>2.5</b> (0.4, 4.7)	3.2 (0.4, 6.5)	<b>3.1</b> (-0.1, 6.7)	3.4 (-0.1, 6.9)	<b>3.0</b> (-0.5, 6.6)	3.2 (-0.2, 7.0)
Chicago Fed	<b>1.8</b> (-0.7, 4.3)	2.0 (-1.4, 5.4)	<b>1.2</b> (-2.6, 4.9)	1.1 (-2.6, 4.9)	<b>1.5</b> (-2.3, 5.3)	1.5 (-2.3, 5.4)
Median Forecast*	<b>2.3</b>	<b>2.3</b>	<b>2.3</b>	<b>2.3</b>	<b>2.4</b>	<b>2.4</b>
March Tealbook	<b>2.9</b>		<b>2.6</b>		<b>2.1</b>	

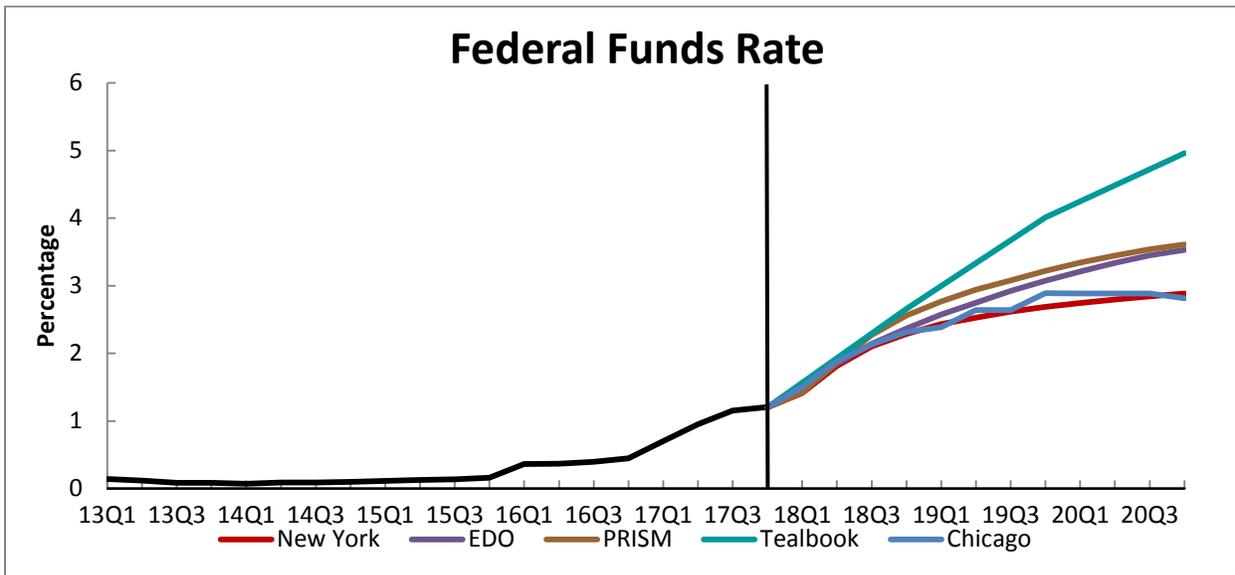
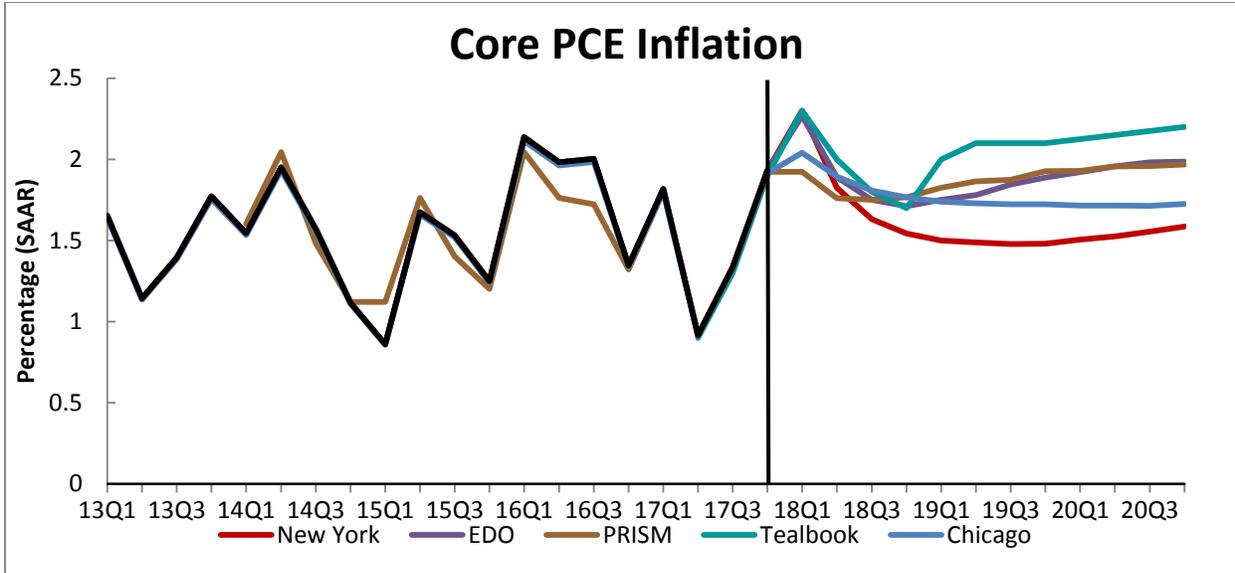
Model	Core PCE Inflation (Q4/Q4)					
	2018		2019		2020	
	March	December	March	December	March	December
EDO - Board of Governors	<b>1.9</b> (1.4, 2.4)	1.7 (1.1, 2.3)	<b>1.8</b> (1.0, 2.7)	1.9 (1.1, 2.8)	<b>2.0</b> (1.0, 2.9)	2.1 (1.1, 3.1)
New York Fed	<b>1.8</b> (1.3, 2.4)	1.5 (0.7,2.2)	<b>1.5</b> (0.5, 2.5)	1.5 (0.4,2.5)	<b>1.5</b> (0.4, 2.7)	1.6 (0.4,2.8)
PRISM - Philadelphia Fed	<b>1.8</b> (1.0, 2.7)	1.7 (0.6, 3.0)	<b>1.9</b> (0.4, 3.4)	1.9 (0.4, 3.4)	<b>2.0</b> (0.3, 3.6)	2.0 (0.4, 3.8)
Chicago Fed	<b>1.9</b> (1.0, 2.6)	1.7 (0.9, 2.5)	<b>1.7</b> (0.9, 2.6)	1.7 (0.9, 2.6)	<b>1.7</b> (0.8, 2.6)	1.7 (0.9, 2.6)
Median Forecast*	<b>1.9</b>	<b>1.7</b>	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>	<b>1.9</b>
March Tealbook	<b>1.9</b>		<b>2.1</b>		<b>2.2</b>	

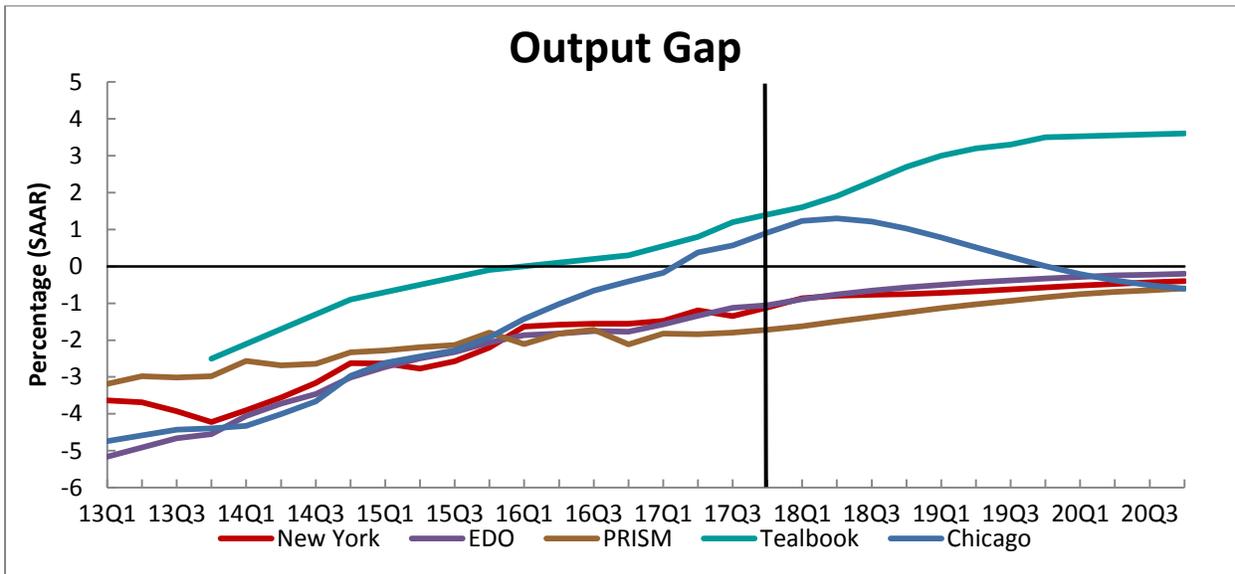
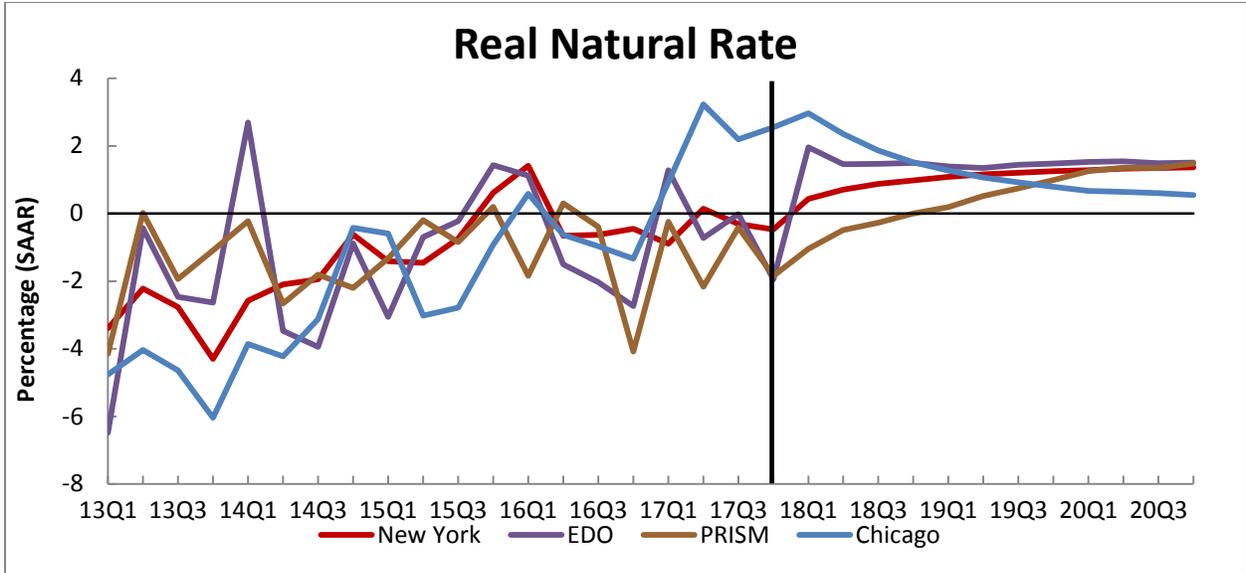
Model	Federal Funds Rate (Q4)					
	2018		2019		2020	
	March	December	March	December	March	December
EDO - Board of Governors	<b>2.4</b> <b>(1.4, 3.4)</b>	2.4 (1.2, 3.6)	<b>3.1</b> <b>(1.5, 4.7)</b>	3.1 (1.4, 4.8)	<b>3.5</b> <b>(1.7, 5.4)</b>	3.6 (1.7, 5.5)
New York Fed	<b>2.3</b> <b>(0.9, 3.7)</b>	2.2 (0.7, 3.7)	<b>2.7</b> <b>(1.0, 4.4)</b>	2.6 (0.9, 4.5)	<b>2.9</b> <b>(1.1, 4.8)</b>	2.9 (1.1, 4.9)
PRISM - Philadelphia Fed	<b>2.6</b> <b>(1.4, 3.7)</b>	2.2 (0.8, 3.6)	<b>3.2</b> <b>(0.8, 5.2)</b>	3.1 (0.7, 5.3)	<b>3.6</b> <b>(1.1, 6.4)</b>	3.6 (0.8, 6.3)
Chicago Fed	<b>2.3</b> <b>(1.8, 2.9)</b>	2.0 (1.2, 2.8)	<b>2.9</b> <b>(1.4, 4.3)</b>	2.6 (1.0, 4.3)	<b>2.8</b> <b>(0.8, 4.9)</b>	2.6 (0.4, 4.8)
Median Forecast*	<b>2.3</b>	<b>2.2</b>	<b>3.0</b>	<b>2.9</b>	<b>3.2</b>	<b>3.2</b>
March Tealbook	<b>2.66</b>		<b>4.01</b>		<b>4.96</b>	

Model	Real Natural Rate of Interest r* (Q4)					
	2018		2019		2020	
	March	December	March	December	March	December
EDO - Board of Governors	<b>1.5</b> <b>(-3.4, 6.4)</b>	1.4 (-3.5, 6.3)	<b>1.5</b> <b>(-3.4, 6.5)</b>	1.4 (-3.4, 6.5)	<b>1.6</b> <b>(-3.5, 6.4)</b>	1.6 (-3.5, 6.6)
New York Fed	<b>1.0</b> <b>(-0.7, 2.6)</b>	0.8 (-0.9, 2.5)	<b>1.3</b> <b>(-0.6, 3.1)</b>	1.1 (-0.8, 2.9)	<b>1.4</b> <b>(-0.6, 3.3)</b>	1.3 (-0.6, 3.2)
PRISM - Philadelphia Fed	<b>0.0</b> <b>(-3.1, 2.8)</b>	0.2 (-2.7, 3.5)	<b>1.0</b> <b>(-2.0, 4.2)</b>	0.9 (-2.2, 4.5)	<b>1.5</b> <b>(-2.4, 4.2)</b>	1.7 (-2.0, 4.6)
Chicago Fed	<b>1.5</b> <b>(-1.1, 4.2)</b>	0.7 (-2.1, 3.5)	<b>0.8</b> <b>(-2.3, 3.9)</b>	0.4 (-2.7, 3.7)	<b>0.5</b> <b>(-2.7, 3.8)</b>	0.5 (-2.7, 3.7)
Median Forecast*	<b>1.2</b>	<b>0.8</b>	<b>1.1</b>	<b>1.0</b>	<b>1.4</b>	<b>1.5</b>
March Tealbook						

Model	Output Gap (Q4)					
	2018		2019		2020	
	March	December	March	December	March	December
EDO - Board of Governors	<b>-0.6</b> (-1.6, 0.5)	-0.6 (-1.8, 0.7)	<b>-0.4</b> (-2.0, 1.4)	-0.4 (-2.2, 1.4)	<b>-0.2</b> (-2.2, 1.8)	-0.3 (-2.3, 1.7)
New York Fed	<b>-0.7</b> (-2.6, 1.0)	-1.0 (-3.1, 1.0)	<b>-0.6</b> (-3.3, 1.9)	-0.8 (-3.8, 1.9)	<b>-0.4</b> (-3.8, 2.6)	-0.6 (-4.2, 2.5)
PRISM - Philadelphia Fed	<b>-1.3</b> (-2.3, 0.0)	-1.5 (-2.8, -0.3)	<b>-0.8</b> (-2.3, 0.4)	-1.3 (-2.4, 0.5)	<b>-0.6</b> (-2.0, 1.0)	-1.0 (-2.3, 0.7)
Chicago Fed	<b>1.0</b> (-0.1, 2.2)	1.1 (-0.5, 2.6)	<b>0.0</b> (-2.3, 2.4)	0.0 (-2.6, 2.6)	<b>-0.6</b> (-3.6, 2.4)	-0.5 (-3.6, 2.5)
Median Forecast*	<b>-0.7</b>	<b>-0.8</b>	<b>-0.5</b>	<b>-0.6</b>	<b>-0.5</b>	<b>-0.6</b>
March Tealbook	<b>2.7</b>		<b>3.5</b>		<b>3.6</b>	







## Detailed Descriptions of Individual Model Forecasts

### The EDO Model

The EDO model's forecast is conditional on data through the fourth quarter of 2017 and on a preliminary Tealbook forecast for the first quarter of 2018.

Real GDP growth is about 2½ percent, on average, over the projection horizon, somewhat below its long-run value of 3 percent. Inflation reaches the Committee's 2 percent objective in the second half of 2020. Below-trend real GDP growth is driven by the slow fading of risk premium shocks and accommodative monetary policy. For inflation, the EDO model interprets the weakness in inflation over the past few years as driven by negative wage markup shocks and expects them to dissipate only gradually over the projection horizon. The temporary high inflation at the beginning of the forecast horizon is due to positive price markup shocks, which dissipate by the end of 2018.

The output gap is currently estimated to be negative 0.9 percent. The output gap closes very slowly and remains at negative 0.2 percent by the end of 2020. The real natural rate of interest is estimated to be around 2 percent in the first quarter of 2018 and hovers around 1.5 percent thereafter until the end of 2020, 0.6 percentage point below its steady-state value of 2.1 percent. According to the EDO model, capital-specific risk premium shocks—inferred from a combination of weaker-than-expected investment and output data with stronger-than-expected consumption data over the past several years—have been holding down the output gap and the real natural rate. As these shocks slowly dissipate, the output gap closes and the real natural rate rises.

Consistent with the gradual return of inflation and the output gap to their long-run values, the federal funds rate is projected to increase gradually over the forecast horizon, reaching 3½ percent by the end of 2020. At the end of the projection horizon, the federal funds rate is still below its long-run value of 4.1 percent, reflecting the inertia in the policy rule and the persistently negative output gap.

The EDO model's projection of real GDP growth in this round is slower for the first half of 2018 than it was in December 2017 because of various transitory factors; thereafter, real GDP growth is only a touch stronger relative to December. In the near term, core PCE inflation is about 20 basis points higher than last December, resulting from positive price markup shocks

inferred from stronger-than-expected price growth data. However, in the medium term, core PCE inflation is 10 basis points lower than in the December round, owing to the fading of the positive price markup shocks and the negative wage markup shocks inferred from weaker-than-expected wage growth. In the near term, the output gap has been revised down slightly since December, but it is higher in the medium term, mainly because of a downward revision to the level of potential output. The projection of the real natural rate of interest in 2018 has been revised up 25 basis points, on average, since December, but it is almost unchanged for the rest of the forecast horizon. The path of the federal funds rate is lower this round than in December following a lower trajectory for inflation. This is consistent with small changes in the output gap over the forecast horizon and the fact that the estimated monetary policy rule in EDO is mostly sensitive to changes in the output gap rather than its level.

### **The NY Fed Model**

The New York Fed model forecasts are obtained using data released through 2017Q4, augmented for 2018Q1 with the New York Fed staff forecasts (as of March 2) for real GDP growth and core PCE inflation, and with values of the federal funds rate, the 10-year Treasury yield and the spread between Baa corporate bonds and 10-year Treasury yields based on 2018Q1 averages up to March 2.

Based on this information, we project real GDP growth of 2.3 percent in 2018 on a Q4/Q4 basis, somewhat stronger than the forecasts of 2 percent reported both in December and September. This projection reflects the current New York Fed staff judgmental forecast, which is somewhat less optimistic than the model's unconditional assessment of a 2.6 percent growth rate for this year. In 2019 and 2020, GDP growth is anticipated to decline to 2 percent and 2.1 percent respectively. Consistent with this somewhat more solid growth prospects in the current year; inflation is also forecast to be slightly higher in the short term, at 1.8 percent relative to 1.5 percent in the December projection. However, its progress towards the FOMC's longer-run goal of 2 percent remains slow with core PCE inflation projected to be 1.5 percent in both 2019 and 2020 respectively. In fact, the March projection is 0.1 percentage point lower for 2020 relative to December.

The output gap is currently estimated to be about 0.2 percentage points smaller throughout the forecasting horizon than projected in December. Similarly to December, it narrows to -0.7

percent in 2018 and gradually shrinks to -0.4 percent in 2020. The natural rate of interest is also estimated to be about 0.2 percentage points higher through the forecasting horizon, reaching 1.4 percent at the end of 2020. The federal funds rate is closer to its December projection, reaching 2.9 percent by the end of 2020. This path translates into approximately four rate hikes in 2018, two more in 2019 and only one more in 2020.

The projections for all the variables are surrounded by significant uncertainty. For instance, the 68 percent posterior probability interval for GDP growth includes negative readings for the years between 2019 and 2020. In comparison, the posterior probability intervals for inflation are tighter, with their upper bound never exceeding 3 percent throughout the forecast horizon.

As in December, the model explains the above long-run average real GDP growth rate in 2018 with continued improvement in financial conditions, as captured by positive contributions of both the financial and marginal efficiency of investment shocks. The same factors are behind the higher path for the natural rate of interest relative to December. These positive forces are partly offset by lower TFP growth through the forecast horizon. This factor can, at least in part, explain the shallower output gap relative to the December forecast. As for inflation, the model attributes its recent weakness to a confluence of several factors, which continue to hold it below target over the forecast horizon. These factors include the lingering effects of the financial headwinds that have hampered the recovery, whose impact on inflation is estimated to be very persistent, as well as negative shocks to wage and price markups, which in the model capture some of the more transitory influences on inflation dynamics.

### **The PRISM Model**

The Philadelphia Research Intertemporal Stochastic Model (PRISM) forecast is constructed using data through 2017Q4 that are then supplemented with a 2018Q1 nowcast based on the most recent Macroeconomic Advisors model forecast.

PRISM forecasts that output will grow at a 2.5 percent pace in 2018, about the same pace as in 2017. Output growth then accelerates slightly to a 3 percent pace in 2019 and 2020. PRISM does not take account of the recent tax reform except to the extent that reform is affecting the underlying data on which the model is estimated. The nowcast pins down real output growth in 2018Q1 at 1.8 percent and core inflation at 1.9 percent. Core inflation stays about flat over the

forecast horizon, reaching 2 percent in 2020Q2. The PRISM projection has the funds rate following an estimated policy rule through the forecast horizon: the federal funds rate averages 2.6 percent in 2018Q4 and advances steadily to reach 3.6 percent in 2020Q4.

We also forecast the natural rate of interest and the output gap as determined from the model. The natural rate of interest – the rate of interest that would prevail if wages and prices were fully flexible – is estimated at -1 percent in 2018Q1. As output growth strengthens and the economy normalizes to trend, the natural rate rises over the forecast horizon to reach about 1.5 percent at the end of 2020. Our estimate of the output gap is derived from the log deviation of real output from its flexible-price counterfactual level. The estimated output gap is at -1.6 percent in 2018Q1 and shrinks slowly over the next three years to reach -0.6 percent at the end of 2020.

According to PRISM, output growth in 2018Q1 is being held down by negative shocks to TFP, financial conditions, and monetary policy. Partially offsetting those negative effects are positive shocks to labor and investment. Going forward, TFP, financial and monetary policy shocks exert a drag on output growth while government spending, investment, and labor supply make positive contributions to growth. Output growth is largely projected to run at a slightly-above-trend pace through the forecast horizon. Consumption growth (nondurables plus services) is running at a below trend pace in 2018Q1, held down by shocks to TFP, investment and monetary policy. Going forward, consumption growth accelerates as those shocks wane and as the labor and financial markets continue to rebound. However, consumption growth runs at a pace that is slightly below trend over the forecast horizon. Negative financial shocks are holding down investment in 2018Q1. As these shocks wane, investment growth settles to around a 3 percent pace over the next few quarters and then gradually eases to about 2.5 percent by the end of 2020. On balance, the model continues to imply a de-trended level of output that is below its steady state and an important factor in accounting for this output gap is the low level of aggregate hours worked, which the model generates through a combination of labor supply shocks and government spending shocks. These shocks are gradually unwinding, providing the aforementioned positive contribution to output growth.

The 2018Q1 nowcast for core PCE inflation is 1.9 percent. The model predicts that inflation hovers around that level over the next three years. With inflation running close to target over the forecast horizon, PRISM has upward pressure on prices from investment growth and the

renormalization of the labor market being largely offset by the slow unwinding of past financial shocks.

The forecast is implemented with a rule-based federal funds rate path. In 2018Q4 the funds rate averages 2.6 percent, rising to 3.2 percent in 2019Q4 and 3.6 percent in 2020Q4 -- a similar pace of normalization compared to the December forecast. The model puts relatively little weight on output dynamics in the estimated policy rule. Consequently, the shocks that account for the dynamics of the federal funds rate are largely the same as those that account for the dynamics of inflation.

### **The Chicago Fed Model**

The Chicago Fed's DSGE model forecast is constructed using data through 2017Q4 supplemented by judgmental assumptions for 2018Q1 GDP, core CPI inflation, and expected core PCE inflation one-quarter ahead and over the next 10 years. Data on expected future funds rates from survey data pin down the federal funds rate path for the next 10 quarters. Therefore, our forecasts encompass the expectations of tighter future monetary policy which have developed since the December 2017 meeting. The model rationalizes these expectations with forward guidance shocks. In 2020Q4, the model's estimated policy rule takes over.

The model projects GDP growth for 2018 of 1.8 percent, which is slightly below its potential, and 1.1 percent in 2019 before rebounding somewhat to 1.5 percent in 2020. The model attributes growth slightly above potential since 2016Q2 to positive and permanent innovations to neutral technology, relatively loose financial conditions, and a high degree of monetary accommodation from forward guidance. The tightening of financial conditions and gradual removal of monetary accommodations decrease expected GDP growth throughout the forecast horizon. This relatively low forecasted GDP growth and the model's relatively wide 68 percent coverage intervals at two and three year horizons mean that we cannot rule out a recession during those years.

The model's projection for Core PCE inflation in 2018 equals 1.9 percent. This embodies the very strong month over month growth of core CPI from December 2017 to January 2018, 4.5 percent. Since this upward revision from our December forecast of 1.7 percent reflects a transitory shock to producers' desired markups, our inflation forecasts remain unchanged at 1.7

percent for 2019 and 2020. The model explains the weakness in inflation over the past five years with measurement error and shocks to producers' desired markups. Additionally, the model attributes some of the inflation weakness in 2017 to downward pressure from past technology shocks. That undercurrent's continuation dominates our inflation forecasts for 2019 and 2020 and holds them below the committee's 2 percent target. Nevertheless, the model's 68 percent coverage intervals reveal little chance of deflation over the forecast horizon.

We also forecast the natural rate of interest and the output gap. The natural rate is the contemporaneous spot rate on 3-month government bonds that would prevail if wages and prices were fully flexible. We measure the output gap as the log deviation of output from its flexible wage and price counterfactual. The model sees a positive output gap over the previous year peaking at 0.9 percent in 2017Q4. The output gap continues to rise for two quarters, peaking at 1.3 percent in 2018Q2. It ends the year at 1.0 percent. We project a steady 25 basis point per quarter decline throughout 2019, so the economy reaches potential output at the beginning of 2020. However, we forecast that this output gap deterioration continues throughout 2020, albeit at a slower pace. The output gap ends that year at -0.6 percent. This output gap path is associated with an above steady-state natural rate at the end of 2017, 2.5 percent which substantially declines thereafter. Its values at the end of 2018, 2019, and 2020 equal 1.5 percent, 0.8 percent, and 0.5 percent.