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

Date: September 17, 2018

To: Federal Open Market Committee

From: Matthew M. Luecke

Subject: DSGE Models Update

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

System DSGE Project Forecasts

September 17th, 2018

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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 2018Q2 and nowcasts for 2018Q3. The New York Fed, PRISM, and EDO models use their estimated policy rules to determine the federal funds rate path. In contrast, 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. Thereafter, that model's estimated interest rate rule governs its policy forecasts. For the sake of comparison, the tables include the September 14 Tealbook forecasts, as well as the model forecasts prepared for the June 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. Finally, 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 defined as the level of output that would prevail if prices and wages were fully flexible.

Beginning with real GDP, the median forecast has growth equal to 3.1 percent in 2018, falling to 2.1 percent for both 2019 and 2020, and then edging up to 2.3 percent in 2021. PRISM continues to have the strongest overall forecast, with growth averaging about 3.3 percent over the medium term. The New York Fed model has the weakest forecast, predicting an average annual growth rate of about 1.7 percent over the next three years. The EDO and Chicago Fed growth forecasts lie in between with averages of between 2 and 2.3 percent over the medium term. PRISM and the Chicago Fed forecasts are a bit stronger than in June, while the New York Fed and EDO forecasts are slightly weaker. Compared to June, disagreement across output growth forecasts, defined as the difference between the highest and lowest forecasts, is about unchanged in 2019 and up slightly in 2020. The Tealbook forecast calls for output growth of 2.5 percent in 2019, falling to 1.5 percent in 2021.

Turning to inflation, all of the forecasts have core PCE inflation near 2 percent in 2018. While the median forecast puts inflation essentially at the committee's target over the next three years, there are some differences across the projections. PRISM has the strongest path among the forecasts with inflation edging up gradually to reach 2.3 percent in 2021. The New York Fed has the weakest path with inflation edging down from 1.9 percent in 2018 to an average of about 1.6 percent over the period 2019 to 2021. EDO and Chicago Fed both expect that inflation will run at about the committee's 2 percent target over the next three years. The Tealbook projects inflation to be essentially at the FOMC target over the forecast horizon.

The forecasted pace of federal funds rate normalization varies across the three models in a manner that is consistent with their differing projections on the future path of output growth and inflation. The PRISM and EDO forecasts are similar in displaying a relatively steeper path for the federal funds rate, starting at 2.3 percent in the last quarter of 2018 and gradually reaching 3.9 percent in 2021Q4. The New York Fed model projects a shallower path with the federal funds rate rising from 2.1 percent in 2018Q4 to 2.8 percent at the end of 2021. (The Chicago Fed model's projections, 2.3 percent at the end of 2018 and 3 percent at the end of 2021, come straight from the Survey of Market Participants, so they contain no new information.) The Tealbook predicts a much steeper path than any of the DSGE models, rising to 5.0 percent by the end of 2021.

Compared to June, the forecasts of the *real* natural rate of interest are flat to lower across the models. PRISM, EDO, and Chicago Fed have shifted down their near-term estimates of the real natural rate of interest by close to 1 percentage point while the New York Fed is about unchanged. Looking further ahead, the strongest real natural rate forecasts over the medium term come from EDO and the New York Fed at, respectively, 1.7 percent and 1.3 percent (both forecasts have the real natural rate path about flat over 2019-2021). PRISM has the natural rate rising from -0.4 percent in 2018Q4 to 1.5 percent in 2021Q4. Chicago Fed has the natural rate declining from 1.3 percent in 2018Q4 to 0.8 percent in 2021Q4. At the end of 2021, the median forecast for the real natural rate is at 1.4 percent.

Estimates of the output gap show considerable dispersion across the models and range from a low of -2.5 percent in PRISM to a high of 1.2 percent in the Chicago Fed model. EDO and the New York Fed see small negative output gaps at the end of 2018Q4. Over the next three years,

PRISM and Chicago Fed expect the output gap to close by about 1 percentage point. EDO and the New York Fed expect the output gap to be about stable over the forecast horizon: from -0.1 in 2018Q4 to -0.4 in 2021Q4 for the New York Fed and from -0.3 percent to -0.2 percent for EDO. The Tealbook has a much stronger output gap over the next three years at 3.2 percent in 2019 and 2020, and 2.7 percent at the end of 2021.

Forecasts

Model	Output Growth (Q4/Q4)						
	2018		**2019**		**2020**		**2021**
	Sept	*June*	**Sept**	*June*	**Sept**	*June*	**Sept**
EDO - Board of Governors	**3.2** **(2.5,3.8)**	2.9 (1.8,4.0)	**2.3** **(0.3,4.2)**	2.6 (0.5,4.7)	**2.2** **(0.2, 4.3)**	2.5 (0.4, 4.7)	**2.5** **(0.3, 4.7)**
New York Fed	**3.0** **(2.1, 3.9)**	2.3 (0.8, 3.8)	**1.7** **(-1.1, 4.2)**	1.9 (-1.0, 4.5)	**1.6** **(-1.2, 4.2)**	1.9 (-0.9, 4.7)	**1.7** **(-1.1, 4.4)**
PRISM - Philadelphia Fed	**3.2** **(2.6, 3.9)**	2.9 (1.5, 4.4)	**3.4** **(0.3, 6.7)**	3.1 (-0.3, 6.4)	**3.4** **(0.1, 6.9)**	2.9 (-0.4, 6.6)	**3.1** **(-0.3, 6.6)**
Chicago Fed	**2.8** **(1.9, 3.8)**	2.4 (0.8, 4.0)	**1.8** **(-2.7, 6.2)**	1.3 (-2.4, 4.9)	**2.0** **(-2.6, 6.7)**	1.5 (-2.4, 5.2)	**2.1** **(-2.7, 6.9)**
Median Forecast*	**3.1**	2.6	**2.1**	2.2	**2.1**	2.2	**2.3**
September Tealbook	3.1		2.5		1.9		1.5

Model	Core PCE Inflation (Q4/Q4)						
	2018		**2019**		**2020**		**2021**
	Sept	*June*	**Sept**	*June*	**Sept**	*June*	**Sept**
EDO - Board of Governors	**2.0** **(1.8, 2.1)**	1.9 (1.6, 2.2)	**1.9** **(1.2, 2.7)**	1.8 (0.9, 2.5)	**2.1** **(1.2, 3.0)**	2.0 (1.0, 2.9)	**2.1** **(1.2, 3.0)**
New York Fed	**1.9** **(1.7, 2.2)**	1.9 (1.5, 2.3)	**1.6** **(0.7, 2.4)**	1.5 (0.5, 2.4)	**1.5** **(0.5, 2.6)**	1.5 (0.4, 2.6)	**1.6** **(0.4, 2.8)**
PRISM - Philadelphia Fed	**2.0** **(1.8, 2.3)**	2.1 (1.5, 2.6)	**2.0** **(0.8, 3.4)**	2.0 (0.5, 3.4)	**2.2** **(0.6, 3.7)**	2.0 (0.5, 3.7)	**2.3** **(0.6, 3.9)**
Chicago Fed	**2.0** **(1.8, 2.2)**	2.1 (1.7, 2.5)	**2.0** **(1.1, 2.8)**	2.0 (1.2, 2.8)	**2.0** **(1.1, 2.8)**	2.0 (1.1, 2.8)	**2.0** **(1.1, 2.9)**
Median Forecast*	**2.0**	2.0	**2.0**	1.9	**2.1**	2.0	**2.1**
September Tealbook	1.9		2.0		2.1		2.1

Model	Federal Funds Rate (Q4)						
	2018		2019		2020		2021
	Sept	*June*	Sept	*June*	Sept	*June*	Sept
EDO - Board of Governors	**2.3** **(1.8, 2.8)**	2.4 (1.6, 3.2)	**3.2** **(1.8, 4.6)**	3.2 (1.6, 4.9)	**3.6** **(1.8, 5.5)**	3.6 (1.8, 5.5)	**3.9** **(1.9, 5.8)**
New York Fed	**2.1** **(1.0, 3.3)**	2.2 (0.7, 3.7)	**2.5** **(0.9, 4.3)**	2.6 (1.0, 4.4)	**2.7** **(0.9, 4.5)**	2.8 (1.1, 4.7)	**2.8** **(1.0, 4.8)**
PRISM - Philadelphia Fed	**2.3** **(1.7, 2.7)**	2.7 (1.8, 3.5)	**3.0** **(1.4, 4.6)**	3.4 (1.4, 5.4)	**3.5** **(1.3, 5.9)**	3.7 (1.1, 6.2)	**3.9** **(1.1, 6.5)**
Chicago Fed	**2.3** **(2.2, 2.4)**	2.4 (2.1, 2.7)	**3.0** **(1.9, 4.0)**	2.9 (1.6, 4.1)	**3.2** **(1.3, 5.1)**	3.1 (1.2, 5.0)	**3.0** **(0.7, 5.3)**
Median Forecast*	**2.3**	2.4	**3.0**	3.0	**3.4**	3.3	**3.5**
September Tealbook	**2.4**		**3.7**		**4.6**		**5.0**

Model	Real Natural Rate of Interest r* (Q4)						
	2018		2019		2020		2021
	Sept	*June*	Sept	*June*	Sept	*June*	Sept
EDO - Board of Governors	**0.8** **(-3.3, 4.9)**	1.5 (-3.1, 5.8)	**1.7** **(-3.2, 6.7)**	1.7 (-3.1, 6.8)	**1.7** **(-3.4, 6.9)**	1.8 (-3.2, 6.9)	**1.7** **(-3.4, 6.7)**
New York Fed	**1.1** **(-0.5, 2.6)**	1.0 (-0.6, 2.6)	**1.3** **(-0.4, 3.1)**	1.3 (-0.5, 3.1)	**1.3** **(-0.5, 3.1)**	1.4 (-0.5, 3.2)	**1.3** **(-0.6, 3.2)**
PRISM - Philadelphia Fed	**-0.4** **(-3.2, 2.0)**	0.3 (-2.2, 3.8)	**0.4** **(-3.0, 3.6)**	1.0 (-2.7, 3.9)	**1.0** **(-2.0, 4.2)**	1.4 (-2.0, 4.3)	**1.5** **(-1.5, 5.0)**
Chicago Fed	**1.3** **(-0.5, 3.0)**	2.2 (-0.1, 4.5)	**0.7** **(-2.3, 3.7)**	0.9 (-2.2, 3.9)	**0.8** **(-2.6, 4.1)**	0.7 (-2.6, 3.9)	**0.8** **(-2.6, 4.2)**
Median Forecast*	**1.0**	1.2	**1.0**	1.1	**1.2**	1.4	**1.4**

Model	Output Gap (Q4)						
	2018		**2019**		**2020**		**2021**
	Sept	*June*	**Sept**	*June*	**Sept**	*June*	**Sept**
EDO - Board of Governors	**-0.3**	-0.4	**-0.1**	-0.1	**-0.2**	0.0	**-0.2**
	(-0.9, 0.3)	(-1.2, 0.4)	**(-1.6, 1.3)**	(-1.6, 1.4)	**(-2.1, 1.7)**	(-1.9, 1.9)	**(-2.3, 1.9)**
New York Fed	**-0.1**	-0.4	**-0.1**	-0.3	**-0.3**	-0.3	**-0.4**
	(-1.5, 1.3)	(-2.1, 1.2)	**(-2.6, 2.1)**	(-3.1, 2.1)	**(-3.5, 2.5)**	(-3.6, 2.6)	**(-4.2, 2.7)**
PRISM - Philadelphia Fed	**-2.5**	-1.5	**-2.0**	-1.1	**-1.5**	-0.9	**-1.2**
	(-3.3, -0.9)	(-2.6, -0.3)	**(-3.6, -0.8)**	(-2.3, 0.4)	**(-3.0, 0.0)**	(-2.3, 0.7)	**(-3.0, 0.3)**
Chicago Fed	**1.2**	2.0	**0.4**	1.0	**0.1**	0.1	**0.0**
	(0.7, 1.6)	(1.3, 2.8)	**(-1.5, 2.4)**	(-1.1, 3.1)	**(-2.7, 2.9)**	(-2.8, 3.0)	**(-3.1, 3.2)**
Median Forecast*	**-0.2**	-0.4	**-0.1**	-0.2	**-0.3**	-0.2	**-0.3**
September Tealbook	**2.4**		**3.2**		**3.2**		**2.7**

Real GDP Growth

Legend: New York, EDO, PRISM, Tealbook, Chicago

Core PCE Inflation

Legend: New York, EDO, PRISM, Tealbook, Chicago

Federal Funds Rate

Real Natural Rate

System DSGE Forecasts

Output Gap
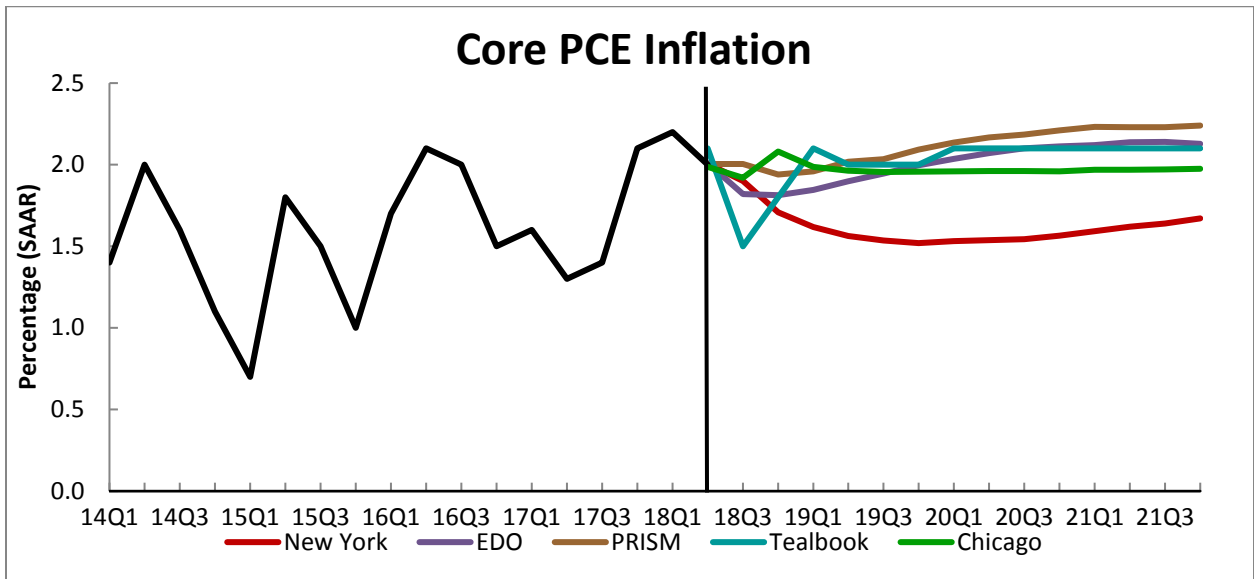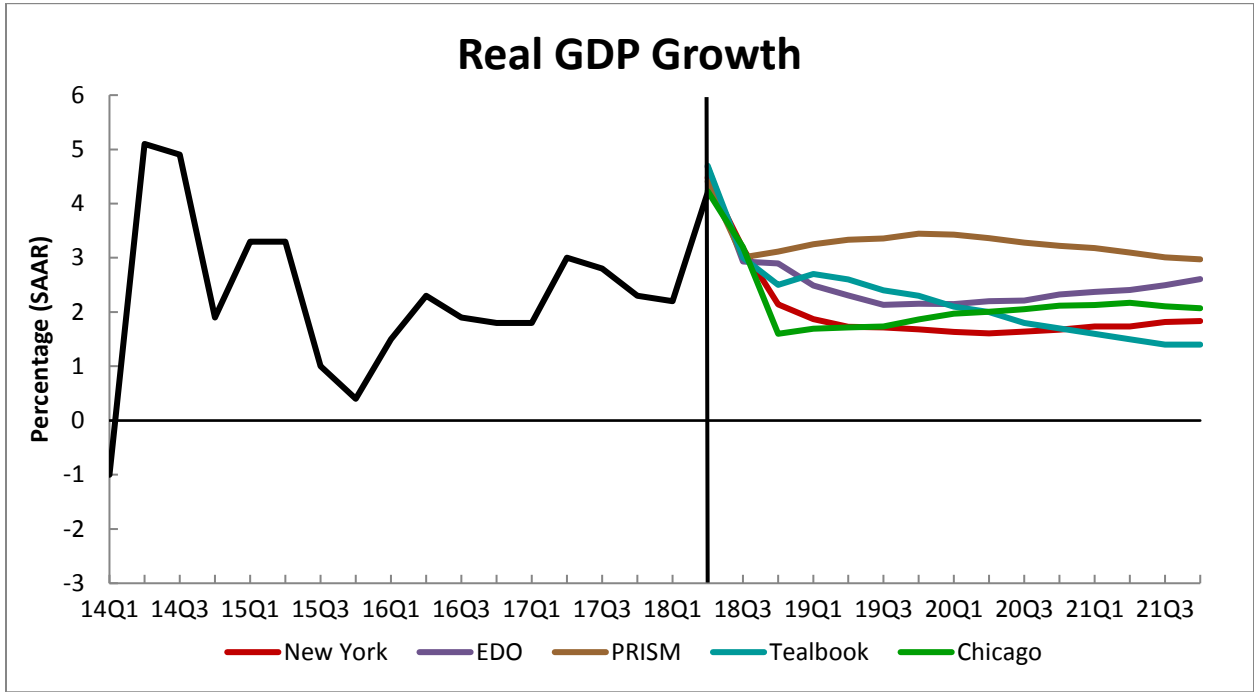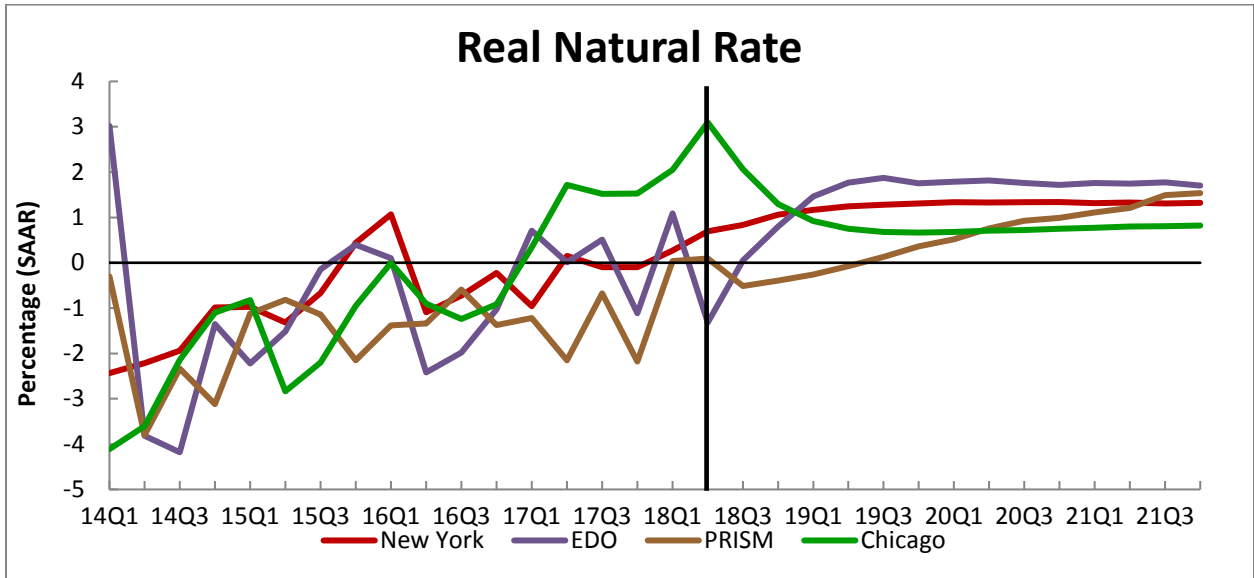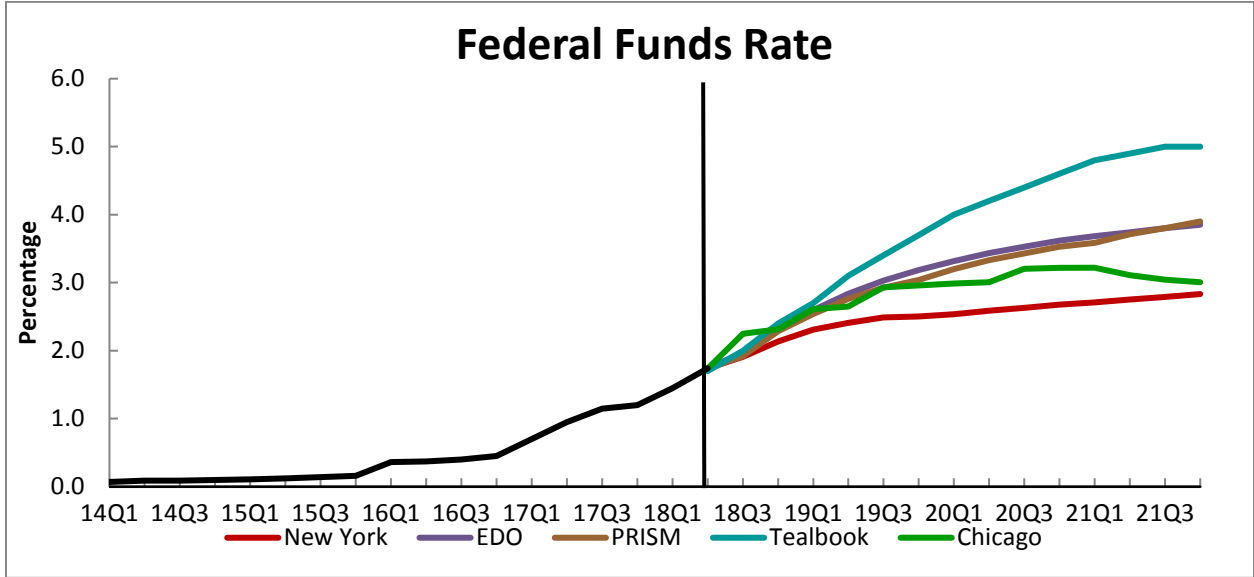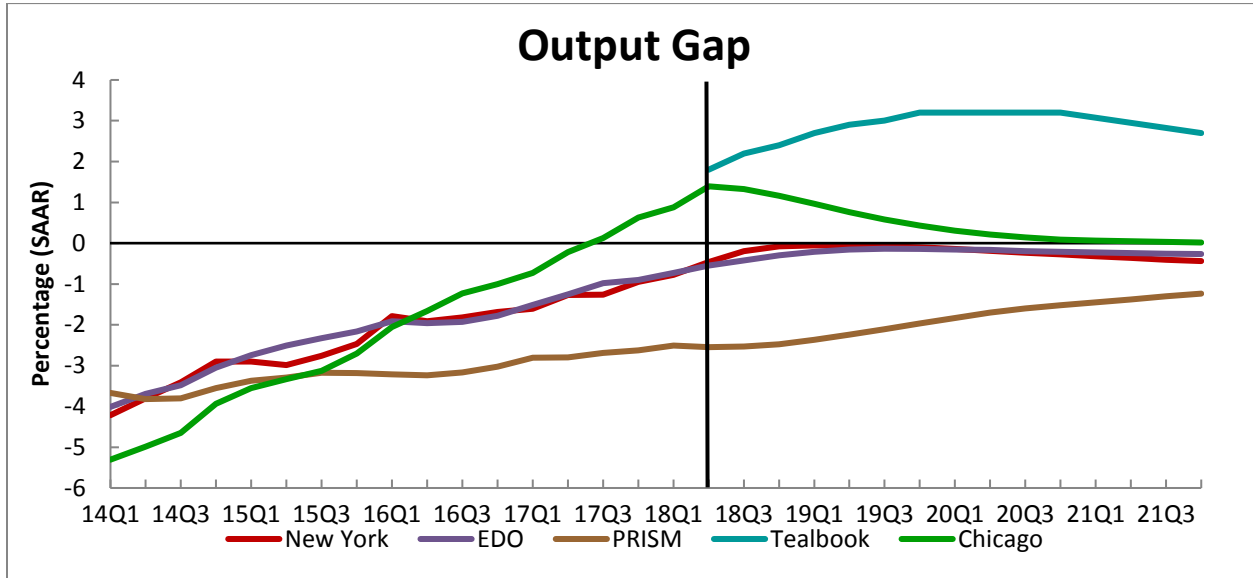
Detailed Descriptions of Individual Model Forecasts

The EDO Model

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

Real GDP growth is 2.4 percent, on average, over the projection horizon, below its trend rate of 2.9 percent. Inflation reaches the Committee's 2 percent objective in the fourth quarter of 2019 and hovers around a level slightly above 2 percent thereafter. Below-trend real GDP growth is driven by the slow fading of favorable risk premium shocks and the waning effects of the currently accommodative stance of monetary policy. On the nominal side, for a number of years, wages have been below the level consistent with the model's wage Phillips curve, holding down marginal cost and depressing inflation over that period. A gradual fading of these wage shocks will continue, contributing to the upward trajectory for inflation. Persistently adverse capital-specific risk premium shocks also contribute to the projected rise in inflation by raising the marginal cost of production.

The output gap, currently estimated to be -0.4 percent, is projected to reach -0.1 percent in the third quarter of 2019 but falls slightly thereafter, reaching -¼ percent in the last quarter of 2021. The real natural rate of interest—estimated to be 0.1 percent in the third quarter of 2018—is projected to increase to 1.9 percent in the third quarter of 2019 but falls slightly thereafter, reaching 1.7 percent in the final quarter of 2021, 0.4 percentage point below its steady-state value of 2.1 percent. The trajectories of the natural rate of interest and the output gap are heavily driven by the model's view that capital stocks are currently well below those that would have prevailed in the absence of nominal rigidities and the view that the investment-related shocks responsible for this condition are likely to dissipate slowly.

With inflation near the Committee's objective, the output gap reasonably close to zero, and the current federal funds rate still being low, the federal funds rate increases toward the long-run value of 4.1 percent over the forecast horizon. The pace of the increase is gradual, reflecting the inertia in the Taylor rule. The federal funds rate reaches 3.9 percent by the end of 2021, a bit below its long-run value.

The data on recent consumption and output have been stronger than the EDO model had projected in June, and the model interprets much of the boost as due to transitory improvement in the aggregate risk premium. Accordingly, the EDO model's forecast of real GDP growth in this round is modestly lower—about 25 basis points, on average—over the forecast horizon as the temporary boost gradually fades. Core PCE inflation has been revised up 10 basis points, on average, over the forecast horizon since June. The output gap is a shade higher in 2019 and about 10 basis points lower in 2020 and 2021. The estimated path of the real natural rate of interest over 2018 has been revised down appreciably since June because of negative revisions to the contribution of TFP growth shocks but is essentially unchanged in the remainder of the forecast horizon. The path of the federal funds is essentially unchanged since June, as the effects of the small upward revision of core PCE inflation offset the effects of the small downward revision in the output gap.

The NY Fed Model

The New York Fed model forecasts are obtained using data released through 2018Q2, augmented for 2018Q3 with the New York Fed staff forecasts (as of September 7) 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 2018Q3 averages up to September 7.

Based on this information, we project real GDP growth of 3.0 percent in 2018 on a Q4/Q4 basis, a significant increase relative to the June forecast of 2.3 percent. However, this is only a temporary surge, as GDP growth is anticipated to decline to around potential in the following three years: to 1.7 percent, 1.6 percent and 1.7 percent in 2019, 2020 and 2021, respectively. For comparison, in the June projections GDP growth was anticipated to be 1.9 percent in both 2019 and 2020. Inflation is forecast to be close to the FOMC's longer run goal this year at 1.9 percent, the same forecast as in June; the model also projects that inflation will decline to 1.6 percent in 2019, compared to the June forecast of 1.5 percent, and will remain around that value for the rest of the forecast horizon.

The output gap is projected to be -0.1 percent in 2018 and 2019, an improvement relative to the June projections of -0.4 percent and -0.3 percent for 2018 and 2019, respectively. Afterwards, however, the output gap is forecast to open up again to -0.3 percent in 2020 and -0.4

percent in 2021. The projection for the natural rate of interest is 1.1 percent in 2018, 0.1 percentage point higher than the June projection, and rises to 1.3 percent in 2019, remaining at that level for the rest of the forecast horizon. The federal funds rate rises steadily over the forecast horizon, but the path is 0.1 percentage point lower in each year relative to the June projections, standing at 2.1, 2.5, 2.7 and 2.8 percent in 2018 through 2021. This shallower path translates into approximately one more hike in 2018 and two more by 2020.

The projections for all 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 below 3 percent throughout the forecast horizon.

As in June, the main force that lifts real GDP growth in 2018 above its long-run average growth rate is continued improvement in financial conditions, as captured by positive contributions of both the financial and marginal efficiency of investment shocks. Over the medium term however, the contribution of these shocks tapers down and is offset by lower TFP growth and the gradual withdrawal of monetary accommodation. TFP shocks are also behind the modest widening of the negative output gap towards the end of the forecast horizon. The model projects near-target inflation for 2018, driven by a temporary increase in price markups. However, as in both the June and March forecasts, the model projects inflation returning below target in 2019 and beyond. The decline in inflation is driven primarily by negative shocks to wage and price markups, but also reflects lingering effects of the financial headwinds that hampered the recovery. The federal funds rate path is projected to remain below its long-run level of 4 percent throughout the forecast horizon owing to persistence in the interest rate rule, weak inflation projections, and persistently negative output gaps.

The PRISM Model

The Philadelphia Research Intertemporal Stochastic Model (PRISM) forecast is constructed using data through 2018Q2 that are then supplemented with a 2018Q3 nowcast based on the most recent Macroeconomic Advisors model forecast.

PRISM forecasts that output will grow at a 3.2 percent pace in 2018, up about 0.5 percentage points from the pace posted in 2017. Output growth is projected to be about 3.4 percent through the end of 2019, and then edge down to 3 percent by the end of 2021. The nowcast pins down real output growth in 2018Q3 at 3 percent and core inflation at 2 percent. Core inflation edges up to 2.2 percent by the end of the forecast horizon. The PRISM projection has the funds rate following an estimated policy rule through the forecast horizon: the federal funds rate averages 2.5 percent in 2019Q1 and advances steadily to reach 3.9 percent in 2021Q4. This monetary policy path is a bit shallower than the June projection.

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 -0.5 percent in 2018Q3. 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 2021. 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 -2.5 percent in 2018Q3 and shrinks slowly over the next three years to reach -1.2 percent at the end of 2021.

According to PRISM, above trend output growth in 2018Q2 was driven largely by positive shocks from government spending (which includes net exports) and labor supply. The outsized shock contribution to growth from government spending is not persistent though and by 2018Q3 the model has output growth only slightly above trend, with positive contributions from labor supply and investment shocks being nearly offset by negative contributions from TFP, financial conditions and monetary policy shocks. Going forward, output growth runs at a pace slightly above its steady state value over the forecast horizon with positive contributions from labor, investment, and government spending shocks largely offset by negative contributions from financial conditions and productivity shocks. Consumption growth (nondurables plus services) runs at a slightly below trend pace over the next 3 years, held down by shocks to TFP, government and investment. However, investment growth runs at a strong pace over the forecast horizon driven by shocks to productivity, the marginal efficiency of investment, and labor supply. Negative financial shocks act as a partial brake on investment growth over the next three years. By the end of 2020, investment growth tapers down to about 2.5 percent or so. The model continues to imply that the de-trended level of output is below its steady state and an important

factor in accounting for this gap is the lower-than-trend level of aggregate hours worked, which the model generates through a combination of labor supply shocks, financial shocks, and government spending shocks.

The 2018Q3 nowcast for core PCE inflation is 2 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. By 2019Q1 the funds rate averages 2.5 percent, rising to 3 percent in 2019Q4 and 3.9 percent in 2021Q4 -- a somewhat shallower path compared to the June 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 2018Q2 supplemented by judgmental Macro Advisers assumptions for 2018Q3 GDP, consumption, investment, core PCE inflation, and core CPI inflation. We included 2018Q3 expected inflation, both one-quarter ahead and over the next 10 years, taken from the Third Quarter SPF survey.[2] We used data on expected future funds rates from the July 23 Survey of Market Participants augmented with OIS rate changes since then to determine the federal funds rate path for the next 10 quarters.[3] The model rationalizes these expectations with forward guidance shocks. Beginning in 2021Q2, the model's estimated policy rule takes over.

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[2] Our estimation and forecasting matches two inflation measures to our model's inflation core CPI and core PCE, with appropriate corrections for their different mean inflation rates. Our forecasts reported in the previous system DSGE memo used only reported expectations for core PCE. We have added the CPI expectations to avoid problems with forecasters simply repeating the FOMC's inflation target back to the SPF as their long-run forecast.

[3] Specifically, we take the SMP results as our baseline path, and we adjust each rate on it by the change in the OIS rate for the analogous quarter from July 23 through September 7.

The model projects GDP growth for 2018 of 2.8 percent. This mostly embodies the very strong data in hand from the first two quarters and our assumed rate for 2018Q3 of 3.2 percent. Our projected growth rate for 2018Q4 equals 1.6 percent. Our forecast rises throughout 2019, reaching the model's potential growth rate of 2 percent in 2020Q2. Overall, we forecast annual Q4/Q4 GDP growth rates of 1.8 percent, 2.0 percent, and 2.1 percent in 2019, 2020, and 2021. This forecast represents a substantial improvement over the one we presented in the previous DSGE memo. Then as now, the tightening of financial conditions and gradual removal of monetary accommodations decrease expected GDP growth throughout the forecast horizon. However, the strong incoming data received since June leads the model to infer strong technological improvements. Their lingering effects lift our GDP forecast at all horizons.

Our forecasts for Q4/Q4 core PCE inflation equal 2 percent for all four years we forecast (2018 through 2021). This is basically unchanged from the forecast we gave in the previous DSGE memo. At that time, we highlighted incoming inflation data which was strong relative to recent experience. The inflation data received since then has reinforced the conclusion that inflation will be close to the FOMC's target in the short and medium term.

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 forecasts end-of-year output gaps for 2018 through 2021 of 1.2 percent, 0.4 percent, 0.1 percent, and 0 percent. These are substantially closer to potential than the analogous forecasts we reported in the previous DSGE memo. Since our growth forecasts are also stronger, we conclude that recent economic strength has arisen from growth in potential output more than from potentially inflationary output gaps. We forecast the natural rate of interest at the end of the year for 2018 through 2021 to equal 1.3 percent, 0.7 percent, 0.8 percent, and 0.8 percent. (The long-run natural rate equals 0.95 percent.)