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

Date: January 13, 2012

To: Federal Open Market Committee

From: Deborah J. Danker

Subject: DSGE Models Update

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

System DSGE Project Forecasts[1]

January 13, 2012

Scott Brave Jeffrey Campbell Jonas Fisher Alejandro Justiniano

Federal Reserve Bank of Chicago

[1] This memo describes the joint work of many contributors to the Federal Reserve System DSGE Modeling Project, including Hess Chung, Jean-Phillipe Laforte, Michael Kiley, Marco Del Negro, Argia Sbordone, Michael Dotsey, and Keith Sill.

This memo presents the economic forecasts for real GDP growth, core PCE inflation, and the federal funds rate from the four contributors to the System DSGE modeling project: the Board (the "EDO" model), New York, Philadelphia (the "PRISM" model), and Chicago. We first give an overview of all four forecasts and then provide model-by-model details.

Summary of Forecasts

The current forecasts for real GDP growth, core PCE inflation, and the federal funds rate, as well as those presented in our November 2011 memo are displayed tabularly and graphically at the end of this summary section. These forecasts treat 2011Q4 estimates for real GDP growth and core PCE inflation as data and project beyond that date. The EDO estimate for real GDP growth in this forecast launch quarter equals 2.6 percent, while the other three estimates range between 3.2 and 3.4 percent. The projections are also conditional on the anticipation that the federal funds rate will remain near zero through at least mid-2013. Chicago assumes that takeoff occurs in 2013Q4, while EDO puts it at 2014Q1. The models forecasts of the interest rate in 2014Q4 range from 1.7 to 2.4 percent

The growth projections for 2012 (Q4/Q4) differ substantially across the models. Three of the models (EDO, Chicago, and New York) have an overall subdued view of the recovery, and ascribe this lackluster performance mainly to financial headwinds from the Great Recession. On the contrary, PRISM forecasts a strong rebound in economic activity over the next two years driven by a labor market recovery. In detail, EDO forecasts very lackluster growth in 2012, below 2%, while Chicago and New York's forecasts are slightly more optimistic, with a forecast around 3%, and PRISM sees the economy growing at 5%. In 2013 and 2014 the New York and Chicago forecasts remain subdued at 2%, while EDO sees growth around 3%. In PRISM growth slows down relative to 2012, but remains above 4%.

Inflation forecasts are closer to one another, and all foresee inflation below 2% throughout the forecast horizon. Inflation forecasts for 2012 are around 1% for all models, and then rise gradually over the forecast horizon, albeit a slightly different speeds. All the models account for the rise in inflation at the beginning of 2011 with temporary factors. Chicago's forecast remains below 1 percent for 2013 and 2014, while New York's forecast rises to 1.2 and 1.6 percent in

those years. Like Chicago, EDO's and PRISM's inflation forecasts are relatively stable over the forecast horizon.

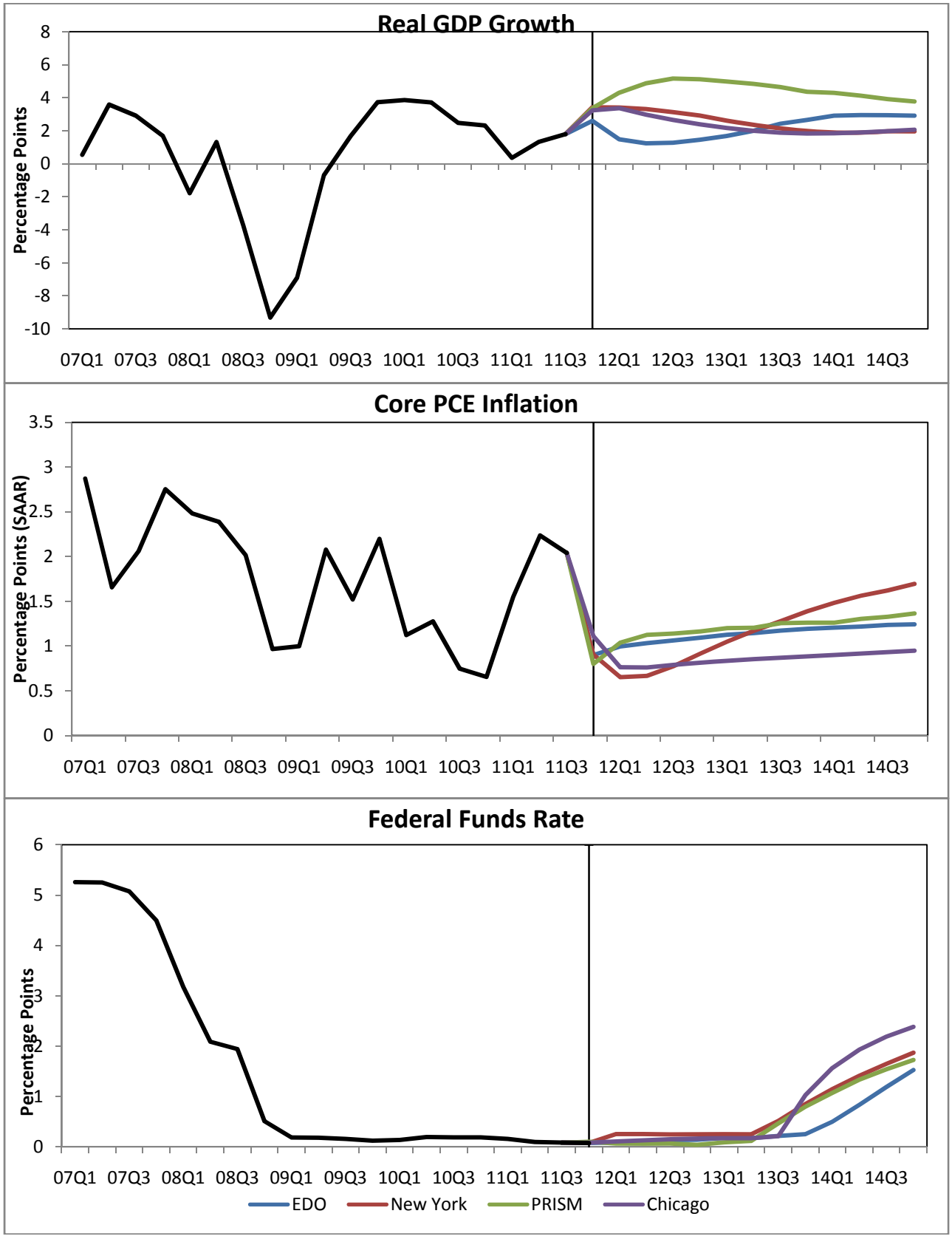
Forecast Summary

Model	Output Growth (Q4/Q4)					
	2012		2013		2014	
	Jan	Nov	Jan	Nov	Jan	Nov
EDO - Board of Governors	**1.6 (-1.5,4.1)**	1.9 (-0.1,3.9)	**2.3 (0.5,4.0)**	2.6 (0.9,4.5)	**3.0 (1.3,4.7)**	3.0 (1.3,4.8)
New York Fed	**3.2 (0.2,5.3)**	2.6 (-0.8,5.0)	**2.3 (-1.4,5.1)**	1.8 (-1.8,4.8)	**1.9 (-1.4,5.2)**	1.8 (-1.5,5.1)
PRISM - Philadelphia Fed	**5.0 (1.6,8.7)**	5.0 (1.4,8.9)	**4.8 (0.7,8.8)**	4.7 (0.8,9.0)	**4.1 (0.1,8.4)**	4.2 (0.2,8.4)
Chicago Fed	**2.8 (-.-)**	2.0 (.,.)	**2.0 (-.-)**	1.6 (.,.)	**1.9 (-.-)**	2.1 (.,.)
Median Forecast*	**3.0**	2.3	**2.5**	2.2	**2.5**	2.5

Model	Inflation (Q4/Q4)					
	2012		2013		2014	
	Jan	Nov	Jan	Nov	Jan	Nov
EDO - Board of Governors	**1.1 (0.4,1.7)**	1.4 (0.8,2.1)	**1.2 (0.5,1.8)**	1.4 (0.7,2.1)	**1.3 (0.6,1.9)**	1.4 (0.7,2.1)
New York Fed	**0.7 (0.1,1.3)**	1.0 (0.3,1.7)	**1.2 (0.3,1.9)**	1.3 (0.4,2.0)	**1.6 (0.6,2.3)**	1.6 (0.7,2.4)
PRISM - Philadelphia Fed	**1.1 (-0.1,2.4)**	1.5 (0.2,2.8)	**1.2 (-0.2,2.8)**	1.5 (0.0,3.1)	**1.3 (-0.3,3.0)**	1.6 (0.0,3.1)
Chicago Fed	**0.8 (-.-)**	1.4 (.,.)	**0.9 (-.-)**	1.2 (.,.)	**0.9 (-.-)**	1.2 (.,.)
Median Forecast*	**0.9**	1.4	**1.2**	1.4	**1.3**	1.5

Model	Federal Funds Rate (Q4)					
	2012		2013		2014	
	Jan	Nov	Jan	Nov	Jan	Nov
EDO - Board of Governors	**0.4 (0.0,1.8)**	0.1 (0.0,1.9)	**0.6 (0.0,2.1)**	0.5 (0.0,2.3)	**1.8 (0.4,3.3)**	1.8 (0.6,3.6)
New York Fed	**0.2 (0.3,1.3)**	0.2 (0.3,1.4)	**0.8 (0.3,2.2)**	0.9 (0.3,2.3)	**1.9 (0.5,3.4)**	1.9 (0.6,3.5)
PRISM - Philadelphia Fed	**0.0 (-1.4,1.5)**	0.1 (-1.5,1.9)	**0.8 (-1.5,2.9)**	1.0 (-1.4,3.2)	**1.7 (-1.0,4.1)**	2.1 (-0.2,5.0)
Chicago Fed	**0.2 (-.-)**	0.1 (.,.)	**1.0 (-.-)**	1.5 (.,.)	**2.4 (-.-)**	2.6 (.,.)
Median Forecast*	**0.2**	0.1	**0.8**	1.0	**1.8**	2.0

Forecasts Launched from 2011:Q4



Detailed Model Forecasts

The Board's EDO Model

The EDO model projects that real GDP will advance at a pace modestly below trend going forward-- about 2.3 percent on average, over 2012-2014. This projection is conditional on the anticipation that the policy rate will remain at its effective lower bound until 2013Q1. The slightly above-trend pace of growth is accompanied by inflation just above 1 percent per year, substantially below the target of 2 percent, reflecting the labor market slack apparent in the shortfall of output relative to its long-run trend estimated by EDO. The federal funds rate does not lift appreciably above its effective lower bound until early 2014.

As was true previously, the projected recovery is strongly influenced by the unwinding of the adverse shocks to financial conditions in 2008 and early 2009. Since October, however, the model estimates that private sector beliefs regarding the pace of this unwinding have become somewhat more pessimistic, while the path for potential output has been revised down. The persistent financial headwinds defer capital spending by firms and households and weigh on consumption expenditures as well. Judged by the model's view of the historically typical monetary policy rule, the anticipated stance of monetary policy is unusually accommodative through the end of 2015, substantially offsetting the drag due to the anomalously slow improvement in financial conditions.

The New York Model

The FRBNY model forecast is obtained using data released through 2011Q3, augmented for 2011Q4 with observations on the federal funds rate and the spread between Baa corporate bonds and 10-year Treasury yields, and the NY Fed staff forecast for real GDP growth, core PCE inflation and growth in total hours.

The projections for real activity are somewhat more upbeat than in November. Output growth forecasts for 2012, 2013, and 2014 (Q4/Q4) moved up to 3.2, 2.3, and 1.9 percent, respectively, from 2.6, 1.8, and 1.8, respectively, in November. Nonetheless, the model still projects a lackluster recovery in economic activity. In both June and November the model had been

projecting a substantial slowdown in core inflation relative to the first half of 2011. The most recent data, as incorporated in the FRBNY now-cast of 2011Q4 inflation, suggest that a slowdown has indeed taken place and may have been even more pronounced than anticipated. As a consequence, projections for the short and medium run inflation shifted down relative to November, with 2012, 2013, and 2014 (Q4/Q4) forecasts at 0.7, 1.2, and 1.6 percent, respectively, from 1.0, 1.2, and 1.6, respectively.

There is significant uncertainty around the real GDP forecasts, with 68 percent bands covering the interval 0.2 to 5.4 percent in 2012 (Q4/Q4), and -1.4 to 5.1 percent in 2013 (Q4/Q4). For inflation, the 68 percent probability bands for 2012 and 2013 (Q4/Q4) are within the 0-2 percent interval, implying that the model places great probability on inflation realizations below the implicit FOMC target at least through 2013. The uncertainty measured by the forecast bands largely reflects randomness in future shocks, rather than uncertainty about the structure of the economy - where the latter is captured by the posterior distribution of the model's parameters.

The broad strokes of the story associated with the forecast have not changed since November. The headwinds from the financial crisis - captured by both spread and MEI (marginal efficiency of investment) shocks - result in a subdued recovery, low real marginal costs, and consequently low inflation. Spread shocks raise the cost of capital and thereby hinder entrepreneurs' ability to channel resources to the productive sector. MEI shocks directly affect the technological ability of entrepreneurs to transform investment goods into productive capital. The model attributes the pickup in core inflation in 2011 to mark-up shocks, which capture temporary swings in inflation, such as those due to oil price fluctuations.

The model does not view the federal funds rate at the zero lower bound as deviating significantly from the estimated policy rule, at least through the end of 2012. After this, however, the federal funds rate in 2013 and 2014 is forecast to be about 50bp lower than implied by the historical rule. This policy accommodation was anticipated by the public, however, and hence its impact on output and inflation was largest when announced in 2011, and is negligible by 2013.

The Philadelphia Fed's PRISM Model

The Philadelphia Intertemporal Stochastic Model (PRISM) forecast is constructed using data through 2011Q3 that are then supplemented with 2011Q4 projections of output, consumption, investment, wages, and hours worked from the most recent Macroeconomic Advisors forecast, (which forecasts 2011Q4 real GDP growth of about 3.4 percent).

PRISM continues to forecast a fairly strong recovery with real GDP growth at about 5 percent (Q4/Q4) in 2012 and 2013, falling to about 4 percent in 2014. While output growth is projected to be fairly robust, inflation remains contained at about 1.3 percent through the forecast horizon. The forecast assumes that the funds rate remains in a range of 0 to 25 basis points through mid-2013. By the end of 2013, the funds rate is projected to increase to about 0.8 percent. By the end of 2014, the funds rate stands at a bit over 1.75 percent.

According to PRISM; TFP, MEI and monetary policy shocks have been key factors accounting for below-trend real output growth in 2011. The uptick in core PCE inflation in 2011 is largely driven by temporary factors, principally by mark-up shocks. Going forward, the model predicts a decline in core PCE inflation from its 2011 pace. The rise in real output growth in 2012 and 2103 is driven by strong consumption growth, which is projected to be a bit above 4 percent over the next three years, and to a lesser extent by investment growth, which is expected to run at an above-trend pace as well.

Shocks that capture frictions in the labor market play an important role in explaining the recent recession. The model expects the impact of these shocks to wane considerably over the forecast horizon, and consequently projects a strong rebound in the labor market. This rebound in aggregate hours lies behind PRISM's strong growth forecasts for output, and at the same time puts upward pressure on inflation. This pressure is offset though by discount factor shocks that shift preferences toward future consumption, increased saving, and higher investment. The ensuing capital deepening lowers marginal costs and so helps to keep inflation in check. Consumption rebounds and inflation edges higher as these shocks unwind over the forecast horizon.

Conditioning on the policy rate remaining at the zero lower bound through mid-2013 has a significant impact on the forecasts. Were the federal funds rate expectations not used as conditioning information for the forecast, PRISM would project a significantly stronger path for core inflation, a moderately stronger path for real output growth, and consequently a much more aggressive monetary policy tightening over the next 3 years. Under the conditional forecast, the model assigns a stronger role for discount factor shocks in the shock decomposition history, which then induce a lower expected path for inflation going forward.

The Chicago Model

The Chicago model forecast incorporates data through 2011Q3 augmented with estimates for 2011Q4 based on the incoming monthly data and the Chicago staff forecast. The most important 2011Q4 estimates for this exercise are real GDP, real Investment, and core PCE-based inflation. Recall that we also add a sequence of forward guidance shocks regarding the future path of the federal funds rate as part of our forecasting exercise. Currently, these shocks hold the federal funds rate below 25 basis points through 2013Q3.

The use of data on long-term inflation expectations shapes the model's forecast for inflation by anchoring a time varying end-point. The Taylor rule in the model includes an intercept that is allowed to slowly drift. This intercept shift, referred to as the *inflation drift* shock, dominates changes in long-run expected inflation and is disciplined by equating the 10-year average of model-based expected consumer price inflation with ten-year ahead core CPI forecasts derived from a reduced form affine term structure model. Long-run expected core CPI inflation, currently at roughly 1.4 percent, remains well below the model's 2.5 percent steady state level.

Throughout the past year, policy has been a consistent boost to real GDP (adding 1.2 percent to real GDP growth), whereas other fundamentals have been a drag on growth or absent. It is worth noting, however, that while demand has been a slight drag for the year as a whole, it has come in better than expected over the second half of the year. Regarding prices, supply shocks have accounted for the bulk of the variation in our forecast. Early in 2011, adverse supply shocks lifted core PCE inflation well above our initial forecast of just under 1 percent. More recently, favorable supply shocks have brought our forecast back down.

In spite of expansionary forward guidance in monetary policy, inflation expectations drifted down somewhat in 2011, although one could still fairly describe them as being well-anchored. The model ascribes this development to negative realizations of the inflation drift shock. Over the second half of 2011 these shocks subtracted 0.2 percent from four quarter core PCE inflation.

Our forecasts for real GDP growth and inflation in 2012 have both changed substantially from November. We are now forecasting 2012 Q4/Q4 real GDP growth to be 2.8 percent as opposed to 2.0 percent in November. Stronger Q4 investment spending both by households and businesses leads the model to infer a modest improvement in financial fundamentals which propels growth in 2012. For inflation, momentum from a negative price mark-up shock inferred from incoming Q4 data lowered our 2012 forecast for core PCE inflation from 1.4 to 0.8 percent.

In contrast, the incoming data for 2011Q4 leave our forecasts for both 2013 and 2014 only marginally changed from November at about 2 percent GDP growth and 0.9 core PCE inflation. The one substantial change in our forecasts at these horizons revolves around the federal funds rate, and this involves a change in the assumption that the extended period will last through at least the third quarter of 2013. Extending the extended period leaves our forecast for the funds rate at 1.0 percent by the end of 2013 compared with our forecast of 1.5 percent in November. The 75 bps increase in the funds rate in this quarter reflects the model's view that current policy is extraordinarily accommodative given recent inflation and output growth. Throughout 2014, the funds rate rises a bit less than 20 bps per meeting and ends the year at 2.4 percent.