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## 21. Quantitative Analysis of Policy Alternatives Using the FRB/US Model

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### *Executive Summary*

This note provides a quantitative assessment of the macroeconomic effects of various policy options. We examine the possible effects of alternative commitments to maintain the federal funds rate at (or near) zero for extended periods, quantitative easing in Treasury or agency securities, and fiscal actions, as well as the effects of a combination of various policies. In each case, we examine policy interventions of plausible magnitudes.

Based on model simulations, each policy intervention would provide a moderate degree of stimulus to economic activity and would prevent some of the decline in inflation projected in the October Greenbook. However, indicators of real activity and developments in financial markets—which have continued to deteriorate since the last FOMC meeting—point to persistently weak real activity and a substantial slowing in inflation over the next several years, and none of the policy options presented here would be sufficient, in isolation, to change this basic outlook. A combination of policy responses could yield appreciably more desirable outcomes for activity and inflation.

The degree of stimulus imparted by each policy option considered falls within a plausible range, but uncertainty about the size of these effects is considerable, with a number of factors suggesting that the effect of each policy examined may be larger or smaller than we present. All of the simulations use the FRB/US model, and other models would undoubtedly yield somewhat different estimates. This sensitivity is likely to be especially pronounced for the simulations that analyze the effects of conditional commitments to maintain a low path for the federal funds rate, as the degree of macro stimulus depends crucially on the importance of forward-looking behavior and on the perceived credibility of the commitments.

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## ***Introduction***

The projection in the October Greenbook included a substantial rise in unemployment and a pronounced deceleration in prices over the long run, with PCE price inflation falling to almost 1 percent in 2011. Since the October Greenbook closed, data on real activity and developments in financial markets imply a further weakening in the economic outlook, suggesting that the unemployment rate might well exceed 8 percent in 2009 and 2010 and that core PCE price inflation would be likely to fall below 1 percent by 2011.

Given these developments, the prescriptions for the path of the federal funds rate from some simple policy rules and from the optimal control exercises presented in the Bluebook call for holding the funds rate at zero for an extended period. As a result, any additional stimulus cannot come from lower *current* values of the funds rate, but instead must stem from alternative strategies. Such strategies include communicating a conditional commitment to keep the federal funds rate low for a protracted period, quantitative easing brought about by a large-scale increase in excess reserves, nontraditional policy actions (such as large-scale purchases of MBS), fiscal policy, and other types of policy actions discussed in the companion memos.

This note examines the quantitative magnitude of the stimulus from conditional commitments about the path of the funds rate and from nonconventional policy measures (such as those discussed in Notes 16 and 17) as well as from fiscal policy measures. All simulations use the FRB/US model and assume perfect-foresight/model-consistent expectations in financial markets; the latter assumption implies that expectations of future actions drive asset prices. The simulations are based on the October Greenbook projection. We assume that the Committee's underlying preferences are to stabilize inflation at  $1\frac{3}{4}$  percent and the unemployment rate at the NAIRU ( $4\frac{3}{4}$  percent) over the longer run. In all of the simulations, we assume that the effective floor on the nominal federal funds rate is zero; Notes 9 through 13 consider reasons for why the Committee might want to adopt a somewhat higher floor.

The following section focuses on commitments to keep the funds rate near zero; such commitments, if credible, are found to be quite powerful, particularly if the Committee were to signal a desire to push inflation somewhat higher on a sustained basis, perhaps to  $2\frac{3}{4}$  percent. We follow these simulations with a discussion of the effects of nontraditional policy actions (designed to lower term and/or risk premia) and fiscal policy, both of which provide moderate degrees of macro stimulus. The moderate degree of stimulus imparted by most of the options in isolation leads us to consider a simulation that combines a commitment to maintain the funds rate near zero, nontraditional policy actions to lower term/risk premia, and a fiscal stimulus package. Such a combination brings the unemployment rate back to the NAIRU more quickly and is much more successful at keeping inflation near  $1\frac{3}{4}$  percent.

### ***Benchmark Simulation under the Estimated Policy Rule***

The first row of Table 1 reports simulation results under the assumption that the nominal federal funds rate follows the path implied by the staff's estimated policy rule (subject to the zero lower bound). This policy rule can be interpreted as providing a reasonable characterization of the behavior of the FOMC over the past twenty years, and hence serves as a useful benchmark for the simulations presented below (including those showing the effects of alternative paths for policy); roughly speaking, it represents "policy as usual." The benchmark simulation is constructed using residuals from the FRB/US behavioral equations that are derived from the October Greenbook under the staff's projected path for the federal funds rate. Because the estimated rule implies a somewhat different path for the federal funds rate than that projected by staff, there is a small disparity between the simulation results reported in the first row of the table and the projections reported in the October Greenbook.

As indicated in Table 1, the estimated policy rule causes the federal funds rate to fall to zero during 2009-10 and thereafter to rise gradually, to about 1½ percent at the end of 2011 and 4¾ percent by the end of 2013. This policy stance is consistent with the unemployment rate remaining substantially above the NAIRU through 2011 and core PCE inflation falling to 1 percent by 2012-13.

### ***Conditional Commitments to Keep Short-term Interest Rates Low***

We next consider the implications of using an optimal control approach to derive an "optimal" policy path. This approach, which is routinely taken in Bluebook simulations, takes full account of intertemporal tradeoffs that may be exploited in formulating monetary policy, including the possibility of influencing current expectations about future short rates by making promises about future policy. As discussed in more detail in Note 20, monetary policy can potentially lessen the impact of a zero bound constraint by promising that it will maintain an expansionary tilt after the economy starts to recover. This can be achieved through a conditional commitment to keep future short-term interest rates relatively low, which in turn reduces current long-term real interest rates and stimulates output.

It bears emphasizing that the optimal policy paths reported below are *conditioned* on the future shocks that are projected to affect the economy, which in our simulations are simply the residuals derived from October Greenbook forecasts. The promise implied by the optimal policy requires only that policy remain expansionary relative to what it would do if it faced similar macroeconomic conditions, but had made no prior commitments that constrained its behavior. Thus, while maintaining very low nominal interest rates for a prolonged period turns out to be an implication of the optimal policy strategy based on the shocks implied by the October Greenbook, the optimal policy could imply a sharper upward adjustment of policy rates if economic fundamentals turned out to be more robust.<sup>2</sup>

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<sup>2</sup> The fact that the commitment is to a strategy for adjusting policy rates, rather than to a particular path, raises important communication challenges that are discussed in Note 20.

Moreover, the potential stimulus provided through a commitment channel should not be regarded as a “free lunch.” The *quid pro quo* is that the policymaker expects to have to keep output above potential and inflation above target for a prolonged period after the economy recovers. Clearly, the policymaker would prefer not to bear this cost, and indeed, would not do so in the absence of prior commitment. Accordingly, because the benefits of optimal policy are front-loaded, but the costs are paid afterwards, there is an incentive for policymakers to renege on their commitments. Our simulations make the strong assumption that the policymaker’s commitment to adhere to the optimal policy – and thus to follow through on its commitment – is fully credible. However, the benefits of strategies that rely on commitment hinge crucially on whether the private sector believes that the central bank will follow through on its promises.

The second row of Table 1 reports the outcome of a model simulation based on an optimal control policy which assumes that the Federal Reserve has a time-invariant inflation objective of 1¾ percent. The optimal policy implies a conditional commitment to pin the federal funds rate near zero percent through 2011; as emphasized above, this commitment is conditional on the outlook in the simulation. This policy commitment lowers long-term interest rates nearly 40 basis points in the short run and about 25 basis points over 2009-10.<sup>3</sup> The resulting stimulus to demand lowers the unemployment rate relative to that associated with the estimated policy rule path roughly ¼ percentage point over 2009-13. Less slack, and the signal from the zero federal funds rate that the Committee desires higher inflation than is perceived under “policy as usual,” boost inflation relative to the path associated with the estimated policy rule by nearly ½ percentage point; nonetheless, core PCE inflation remains below 1½ percent in 2012-13.

The third row of Table 1 considers a second optimal control simulation in which the Federal Reserve substantially raises its inflation target, at least for the foreseeable future. In particular, the inflation objective is set at 2¾ percent through 2017 (and eventually reverts back to 1¾ percent thereafter). This choice of inflation target is mainly meant to illustrate the possible effects of a target that is roughly one percentage point higher than the central tendency of the longer-run projections of FOMC members. However, it is worth observing that a long-run inflation target in this range is only modestly higher than the long-term inflation forecast of the Survey of Professional Forecasters.

The higher level of the inflation objective implies that the funds rate is pinned at zero through 2012 and only rises modestly in 2013. This strategy, which again is assumed to be fully credible in the simulation, lowers long-term interest rates 60 basis points in the near term; moreover, the maintenance of a low value for the funds rate in the face of an improving labor market in 2010-12 leads to a rise in inflation expectations. As a result, core PCE inflation does not decelerate much through 2011 and picks up substantially thereafter.

Overall, conditional commitments to keep the funds rate low can have powerful stimulative effects in the FRB/US model because the model both embeds forward-looking asset price determination and assumes full policy credibility on the part of financial market participants. The effects would be even larger if wage and price setters also had model-

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<sup>3</sup> This policy path is the optimal policy path given the assumed inflation objective of 1¾ percent and balanced preferences over the deviation of inflation from target, the unemployment gap, and changes in the federal funds rate; we routinely report these simulations for inflation objectives of 1.5 and 2 percent in the Bluebook.

consistent expectations, as a credible commitment to keep the funds rate persistently low would boost inflation expectations. However, it is worth emphasizing that the effects would be smaller under various other assumptions, such as imperfect credibility of the conditional commitment to a low path of the funds rate.

**Table 1: Commitment Strategies**

Measure and scenario	2009	2010	2011	2012-13
<i>Real GDP</i>				
Estimated policy rule	-0.2	2.4	4.8	4.8
Optimal control commitment	0.3	2.7	4.9	4.7
with higher inflation target	0.7	3.1	5.2	5.1
<i>Unemployment rate</i>				
Estimated policy rule	7.3	7.2	6.3	4.4
Optimal control commitment	7.1	6.9	6.0	4.2
with higher inflation target	7.0	6.7	5.6	3.6
<i>Core PCE inflation</i>				
Estimated policy rule	1.5	1.4	1.2	1.0
Optimal control commitment	1.6	1.5	1.3	1.4
with higher inflation target	1.7	1.6	1.5	1.8
<i>Federal funds rate</i>				
Estimated policy rule	0.0	0.0	1.4	4.7
Optimal control commitment	0.1	0.0	0.1	3.3
with higher inflation target	0.0	0.0	0.0	1.1

*Note:* The values for real GDP and core PCE inflation refer to percent changes from the fourth quarter of the preceding year. The unemployment rate and the federal funds rate are reported in percentage points for the final quarter of the specified year.

### *Nonconventional Policies and Fiscal Stimulus*

As discussed earlier (and in Notes 16 and 17), the Committee may implement nonconventional policies in an attempt to lower longer-term interest rates. Moreover, actions coordinated with fiscal authorities may prove desirable. We examine three related simulations.

In the first simulation, we assume that the Federal Reserve purchases \$750 billion of longer-term Treasury securities in the next two quarters and holds them through 2010. The staff estimates that such a program may reduce term premiums on long-term Treasury yields by 75 basis points through 2010. This large-scale purchase of Treasuries is assumed to have spillover effects in private debt markets, but with the effect on private term and risk premiums somewhat attenuated because investors regard public and private debt as imperfect substitutes; accordingly, our simulation assumes that private yields – including on corporate bonds, mortgages, and consumer loans -- fall 50 basis points.<sup>4</sup> We also assume that the nominal federal funds rate is held at zero through 2010 and then rises as prescribed by the estimated policy rule. As reported in table 2, this additional stimulus lowers the unemployment rate by  $\frac{1}{4}$  percentage point or slightly more over 2009-10; inflation is boosted only a bit relative to baseline.

An alternative approach to quantitative easing through Treasury purchases is the purchase of large quantities of agency MBS. This approach, which is already in the process of implementation, would likely lower private yields by more than an equivalent volume of purchases of Treasury securities. In this simulation, we assume that the FOMC engages in \$750 billion of purchases of Agency MBS, which are held through 2010. The staff estimates that such a program may lower mortgage rates by 125 basis points, yields on corporate bonds and consumer loans by 75 basis points, and Treasury yields by 50 basis points through 2010.<sup>5</sup> We assume that the nominal federal funds rate is held at zero through 2010 and then rises as prescribed by the estimated policy rule. This additional stimulus lowers the unemployment rate by  $\frac{1}{4}$  percentage point or slightly more over 2009-10; inflation is boosted by only 0.2 percentage points in 2012-13 relative to baseline.<sup>6</sup>

Some caveats are important in considering the simulations related to nontraditional policies. First, the FRB/US model does not have a role for the quantities of various assets held by the private sector, and as a result, the simulations are implemented via changes in long-term interest rates. Second, as discussed in Notes 16 and 17, there is considerable uncertainty about the reduction in interest rates that would occur in response to any given-sized asset purchase;

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<sup>4</sup> For a discussion of the evidence, see Note 16.

<sup>5</sup> See Note 17. These estimates are somewhat larger than would be implied by historical studies, reflecting an assumption that substantial purchases of these assets in the current environment of elevated yield spreads and strained market conditions would have a positive impact on market sentiment and would take the securities out of the hands of investors who demand the highest yield premium.

<sup>6</sup> The macroeconomic impact of these shifts may seem small relative to those in the previous simulation with purchases of Treasury securities given the larger impact on private term and risk premiums. Some of this is due to rounding. In addition, some of the additional impetus from larger effects on private term and risk premiums is offset by an increase in expected short rates at far horizons, which trims the decline in long-term rates that would accompany the fall in term and risk premiums. Finally, a portion of the smaller effect stems from a smaller depreciation of the dollar in second scenario: In the FRB/US model, the exchange value of the dollar is tied to yields on Treasury securities, not private yields.

thus, it is possible that much larger purchases would be required to elicit the interest rate responses assumed in our simulations. Lastly, other indirect effects of quantitative easing would possibly magnify its stimulus to aggregate demand. For example, lower long-term interest rates may lead to refinancing activity that boosts consumer demand more than assumed in these simulations; alternatively, the FRB/US model does not account for potentially beneficial effects on house prices and hence household wealth.<sup>7</sup>

Finally, a second round of fiscal stimulus is under active discussion and appears likely; indeed, the staff projection under preparation for the December Greenbook assumes that a substantial stimulus package will be enacted. In this scenario, we consider a \$300 billion program that delivers stimulus over 2009-10; the package is identical to the “bigger fiscal stimulus” package presented in the October Greenbook and includes tax cuts, increases in transfer payments, and federal aid to state and local governments.<sup>8</sup> Relative to baseline, the unemployment rate in this scenario is about  $\frac{1}{4}$  percentage point below baseline in 2010; however, the expiration of the stimulus package after 2010 implies a weakening of demand at that point, and both the unemployment rate and inflation differ little from baseline after 2010. (A larger package, especially targeted in areas likely to boost spending, would prove more stimulative and at this point appears likely to be enacted; however, we do not yet have many details regarding the plans of the incoming Administration and Congress.)

### ***Combination of Policies***

Each of the policy strategies outlined above, except for the commitment to an inflation objective of  $2\frac{3}{4}$  percent, fails to bring inflation to  $1\frac{3}{4}$  percent in 2012-13 because each policy alternative, taken alone, only partly ameliorates the poor outlook for demand. As a result, policymakers may wish to pursue a multi-pronged strategy. In this simulation, we assume that the Committee makes an unconditional commitment to hold the federal funds rate at zero through 2011, and engages in large purchases of Treasury securities through 2010 in order to lower term and risk premiums on government and private yields as outlined above, while fiscal policy implements the package assumed in the previous scenario. As reported in the last line of table 2, this combination proves effective, lowering the unemployment rate  $\frac{3}{4}$  percentage point relative to baseline in 2011 and boosting inflation about  $\frac{1}{2}$  to  $\frac{3}{4}$  percentage point relative to baseline.

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<sup>7</sup> Although households who refinance their mortgages at an appreciably lower mortgage rate might see a substantial increase in their discretionary income, that gain to the household sector as a whole would be offset by a reduction in aggregate interest income. For this reason, refinancings sparked by lower mortgage rates may not have a large a stimulative effect on household spending.

<sup>8</sup> Specifically, the package consists of a \$160 billion reduction in individual income taxes for 2009 through 2010, a \$50 billion increase in transfer payments spread over two years, and a \$90 billion increase in federal aid to state and local governments.

**Table 2: Nonconventional Policies and Fiscal Stimulus**

Measure and scenario	2009	2010	2011	2012-13
<i>Real GDP</i>				
Estimated policy rule	-0.2	2.4	4.8	4.8
Quantitative easing in Treasury debt	0.1	2.9	4.9	4.4
Quantitative easing in GSE debt	0.2	3.0	5.0	4.4
Fiscal stimulus	0.4	2.7	4.0	4.7
Combination of policies	1.3	3.5	4.4	4.4
<i>Unemployment rate</i>				
Estimated policy rule	7.3	7.2	6.3	4.4
Quantitative easing in Treasury debt	7.2	6.9	5.9	4.3
Quantitative easing in GSE debt	7.2	6.9	5.9	4.3
Fiscal stimulus	7.1	6.9	6.2	4.4
Combination of policies	6.8	6.3	5.5	4.0
<i>Core PCE inflation</i>				
Estimated policy rule	1.5	1.4	1.2	1.0
Quantitative easing in Treasury debt	1.6	1.5	1.2	1.1
Quantitative easing in GSE debt	1.6	1.5	1.3	1.2
Fiscal stimulus	1.5	1.6	1.4	1.1
Combination of policies	1.8	1.7	1.6	1.8
<i>Federal funds rate</i>				
Estimated policy rule	0.0	0.0	1.4	4.7
Quantitative easing in Treasury debt	0.0	0.0	2.2	4.9
Quantitative easing in GSE debt	0.0	0.0	2.3	4.9
Fiscal stimulus	0.0	0.0	1.5	4.9
Combination of policies	0.1	0.0	0.1	4.3

*Note:* The values for real GDP and core PCE inflation refer to percent changes from the fourth quarter of the preceding year. The unemployment rate and the federal funds rate are reported in percentage points for the final quarter of the specified year.