Economic Conditions and the Federal Reserve's Balance Sheet Under a Simple Rule to Guide Large-Scale Asset Purchases

Bora Durdu, Eric Engen, and John Roberts
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I.   Introduction

The unemployment rate has declined from about 8 percent when the Committee announced the beginning of its current flow-based large-scale asset purchase program in September 2012 to 7½ percent in the second quarter of this year. In his June press conference, the Chairman outlined an illustrative scenario in which the pace of asset purchases would begin to slow later this year and purchases would cease altogether around the middle of next year, at which time the unemployment rate would be about 7 percent if the economy evolved broadly as the Committee thought most likely.

This memo uses stochastic simulations of the FRB/US model around the baseline forecast in the July Tealbook to evaluate the range of possible outcomes for both the Federal Reserve's balance sheet and macroeconomic activity at the time when the asset purchase program ends if the Committee were to use a simple rule that linked the pace of its purchases to the level of the unemployment rate. As noted in the minutes of recent meetings, some participants have suggested providing guidance about asset purchases based on numerical values for one or more economic variables, broadly similar to the Committee's guidance regarding its target for the federal funds rate. However, thus far, the Committee has not chosen to provide specific numerical guidance in its post-meeting statements. In the absence of such guidance, we have calibrated a simple rule that is consistent with the scenario outlined in the Chairman's June press conference, in which purchases would end when the unemployment rate falls to about 7 percent. Despite its limitations, analysis of this simple rule serves to illustrate some of the considerations that the Committee may want to take into account in deciding on the response of the pace of asset purchases to the evolution of economic conditions.

As with any model-based analysis, ours is subject to a number of caveats. First, these results are from only one model, and other models would likely deliver different results. Second, financial market participants are assumed to understand the simple rule determining asset purchases and to believe that the Committee will not deviate from it. In addition, economic agents are assumed to believe that the economy will evolve as described by the FRB/US model.

Subject to these caveats, the main conclusions from the stochastic simulations using the simple rule for purchases are:

- There is a significant probability – about 25 percent – that purchases would not conclude by the end 2014 under the simple rule for asset purchases and the July Tealbook baseline. As might be expected given the nature of the rule, the longer purchases continue, the larger the portfolio becomes. So, for example, in simulations where purchases continue beyond 2014, the maximum size of the Federal Reserve's portfolio generally exceeds $5 trillion.

- In our simulations where purchases do cease by the end of 2014, the rate of real GDP growth over the prior four quarters is typically quite robust at the time that purchases end—usually in the range of 3 to 3½ percent. However, in about 15 percent of these simulations, real GDP growth is less than 2 percent when the rule would call for purchases to end. Expected inflation four quarters ahead is typically above 1½ percent at the time purchases end, while actual PCE price inflation over the previous four quarters is usually about 1¼ percent at this time.

- In the July Tealbook baseline, the federal funds rate begins to increase from its effective lower bound four quarters after asset purchases are assumed to end. In the stochastic simulations, the time interval between the end of purchases and liftoff of the federal funds rate is in the range of three to five quarters for 36 percent of the simulations. In a similar share of simulations—typically those with very rapid real GDP growth at the time of lift-off—this interval is only one to two quarters, while the smaller share of simulations in which there is a very wide gap between the dates of these policy actions are usually associated with tepid GDP growth.

II. Stochastic Simulations Using a Simple Rule for Asset Purchases

We calibrate the simple rule used in these simulation to generate purchases of $85 billion per month as long as the unemployment rate in the previous quarter is 7½ percent or higher and the monthly pace of purchases declines by about $15 billion for each 0.1 percentage point decrease in the unemployment rate; purchases stop when the unemployment rate reaches 7 percent.[1] As long as the unemployment rate has not yet fallen to 7 percent, the simple rule allows the pace of purchases to increase, up to a maximum of $85 billion per month, in response to a rise in the unemployment rate. Once the unemployment rate falls to 7 percent, however, the program is assumed to end and purchases do not restart, even if the unemployment rate in later periods rises back above 7 percent.

A couple of assumptions are worth highlighting. First, economic agents are assumed to be forward looking, and financial market participants are assumed to have rational expectations. Specifically, expectations of financial market participants are model consistent, and so forward guidance about the federal funds rate affects long-term interest rates, equity prices, and the foreign exchange value of the dollar, while expectations of other economic agents are derived from a small-scale VAR model, not the full FRB/US model. Second, we embed a simple formula in the FRB/US model that produces effects on the term premium similar to those obtained in the staff's standard scoring of asset purchases. Third, we assume that the federal funds rate is kept at its effective lower bound until the unemployment rate crosses the 6½ percent threshold or projected inflation exceeds its 2½ percent threshold; thereafter it is assumed to follow the prescriptions of the inertial version of the Taylor (1999) rule used in the Tealbook.[2]

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[1] Specifically, the monthly pace of purchases (*PURCH*) in quarter t are prescribed by:
$PURCH(t) = 85 + 150 \times [UR(t-1) - 7.6]$, where UR is the unemployment rate, and $0 \leq PURCH(t) \leq 85$. In addition, purchases are not restarted after the program ends when the unemployment rate initially reaches 7 percent. After the purchase program ends, we assume for computational simplicity that asset holdings decline at a rate of $100 billion per quarter.

[2] The inertial Taylor (1999) rule is defined as: $i(t) = 0.85\, i(t-1) + 0.15[r^* + 1.5\, \pi(t) - 0.5\, \pi^* - gap(t)]$, where the nominal federal funds rate target is i, the equilibrium real short-term interest rate is r^*, the inflation rate is π, the inflation target is π^*, and *gap* is the output gap (the percent difference between actual real GDP and its potential level).

We examine the distribution of macroeconomic performance at the time that asset purchases end under the simple rule in response to a wide range of shocks to the economy. To do this, we run simulations of the FRB/US model in which the model is repeatedly subjected to shocks of the type experienced since the late 1960s. This stochastic-simulation approach allows us to construct probability distributions for future economic conditions, conditional on the particular characterization of monetary policy used in the simulations and the dynamics of the model.[3] At the time when the purchase program ends under the rule, we also examine the distribution of the size of the balance sheet and the likelihood that the federal funds rate will begin to increase from its effective lower bound by a particular date.

Implications for the balance sheet

The top panel of Figure 1 shows the simulated probability distribution for the date that asset purchases would end under the simple rule described earlier. The median stopping date—that is, the date at which, in half the simulations, purchases have ended— is the second quarter of 2014, similar to what is assumed in the July Tealbook baseline. However, in one-quarter of the simulated outcomes, purchases continue beyond the end of next year. The top panel of Figure 2 shows the distribution of the peak size of the Federal Reserve's balance sheet. The median of the peak balance sheet size in these simulations is about $4 trillion, and those simulations that call for purchases to extend beyond 2014 account for the outcomes in which the portfolio becomes very large.

The Committee, however, may be averse to letting the Federal Reserve's asset holdings become very large for a number of reasons. For example, the marginal cost of asset purchases may be perceived to be rising as the size of the balance sheet increases. While it is difficult to know at what point the costs of additional purchases would be

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[3] The stochastic simulations are run by shocking various components of aggregate spending, productivity and hiring, wages and prices, asset prices, and other factors from 2013:Q2 through 2018:Q4, with the shocks in each quarter randomly drawn from the 1969-2009 set of FRB/US model equation residuals; 4,000 replications of these simulations are used to construct probability distributions for various economic and financial variables, conditional on a given characterization of monetary policy. We maintain our baseline assumptions for expectations formation discussed earlier, in that financial market participants have model-consistent expectations while other agents base their expectations on the predictions of a small-scale VAR model. However, the shocks are assumed to be unanticipated by all agents.

determined to exceed the benefits, in the remainder of our analysis we examine as one rather arbitrary possibility that purchases would be terminated under any economic circumstances by the end of 2014, effectively limiting the maximum size of the balance sheet to $4.8 trillion under the assumed asset purchase rule. This date limit is reached in about 25 percent of the simulations in our full sample. Not surprisingly, average economic performance in the portion of the simulations that are excluded by this restriction is weaker than in the truncated sample where the simple rule prescribes a ceasing of the purchase program by the end of 2014. At the beginning of 2015, average real GDP growth over the previous year is less than 3 percent in the simulations that are excluded (compared to above 3½ percent in the truncated sample used in the remainder of this memo) and the average unemployment rate is about 7½ percent. In addition, more than 10 percent of the simulations that are excluded contain a recession before the end of 2014. A potential consequence of announcing a numerical criterion for asset purchases but then ending purchases before that target is met – a cost that would be incurred about one-quarter of the time under this early termination strategy, but is not analyzed in this memo – is that in such an outcome the FOMC could be perceived as unable to provide additional monetary policy accommodation through purchases and simultaneously less credible in its policy announcements, thus possibly reducing the effectiveness of its forward guidance for the federal funds rate.

The bottom panel of Figure 1 shows the distribution of the stopping date for the purchase program, while the bottom panel of Figure 2 displays the distribution of the peak balance sheet size, both for the truncated sample of the simulations in which purchases are completed by the end of 2014. Among this restricted set of simulations, the median date when purchases are complete is the first quarter of next year, one quarter earlier than in the full sample. Also, in this sample, the median peak balance sheet size, which is below $4 trillion, is somewhat smaller than in the full sample and the distribution of the peak size is much tighter.

Implications for macroeconomic outcomes

Figure 3 shows the distributions of several key macroeconomic variables at the time that the simple rule predicts a cessation of purchases in the truncated sample (in

which the purchase program stops no later than the end of 2014). As shown in the top-left panel, real GDP growth is typically quite strong at the time purchases end—on average, about 3¼ percent over the preceding four quarters. That outcome lines up with the staff baseline, in which purchases halt in mid-2014 when real GDP growth is around 3¼ percent. In about 15 percent of cases, however, real GDP growth is under 2 percent at the time purchases end. In a small portion of these simulations, the decline in the unemployment rate, despite slow GDP growth, is associated with a further decrease in the labor force participation rate. Importantly, simulations in which the unemployment rate falls to 7 percent and the purchase program ends despite slow real GDP growth are often associated with low productivity growth. For example, the four-quarter increase in output per hour is less than 1 percent, on average, in the cases in which real GDP growth is below 2 percent in the top-left panel of Figure 3.

As shown in the top-right panel of Figure 3, expected inflation over the next four quarters is 1.6 percent, on average, at the time purchases cease, while total PCE inflation over the previous four quarters averages 1.3 percent (not shown). In the July Tealbook baseline, four-quarter-ahead PCE inflation in the third quarter of 2014 (after purchases are assumed to end) is 1.4 percent, while trailing inflation is 1.3 percent. In about 1 percent of the simulations, expected inflation is below 1 percent at the time purchases cease.

The bottom panels of Figure 3 show distributions for two key labor-market indicators—average monthly employment growth and the labor-force participation rate—in the quarter that purchases end. In the July Tealbook projection, total job growth averages 200,000 per month at the time when purchases are assumed to end and the labor force participation rate is 63.3 percent. In the truncated sample of our stochastic simulations, total payroll employment gains are typically quite strong in the quarter that purchases end, averaging more than 300,000 per month. Regarding labor force participation, in less than 5 percent of the simulations, the participation rate is at or below 63 percent. A decline in the participation rate of this magnitude would offset the reduction in the unemployment rate and leave the employment-population ratio about flat.

The timing of the ending of asset purchases and the liftoff of the federal funds rate

Figure 4 plots the date that the purchase program ends against the date that the federal funds rate begins to rise from its effective lower bound in the truncated sample of our stochastic simulations, with the size of the circles indicating the relative frequency of the plotted pair of outcomes. In the staff baseline, there is a four-quarter gap in the timing of the cessation of purchases and the first increase in the federal funds rate. In more than one-third of the simulations, the timing gap is in the range of three to five quarters and thus is similar to the staff's baseline assumptions. In a roughly equal proportion, the interval is two quarters or less. However, in about one-fourth of the cases, the first increase in the federal funds rate occurs more than five quarters after purchases cease. This could happen, for example, if a temporary acceleration in economic activity were to push the unemployment rate down to 7 percent and the purchase program ended, but economic growth slowed thereafter.

In Figure 4, as in all of the model simulations, the unemployment rate and projected inflation thresholds for the federal funds rate guidance announced by the Committee are not triggers. In particular, once a critical value (6½ percent for the unemployment rate and 2½ percent for projected inflation) is crossed, the federal funds rate follows the prescriptions of the inertial version of the Taylor 1999 rule, and that rule may not call for the funds rate to rise above its effective lower bound immediately. However, in more than 90 percent of the simulations plotted here, the federal funds rate rises one quarter after the unemployment rate threshold is crossed. That is, in these cases, once the unemployment rate falls below 6½ percent, the policy rule calls for an essentially immediate increase in the federal funds rate. In the few exceptions where the federal funds rate begins to rise more than one quarter after a threshold is crossed, the reason that the policy rate does not increase right after the unemployment rate threshold is crossed is because inflation is relatively low compared to the Committee's longer-run objective; in these cases, the average inflation rate at the time the unemployment rate threshold is crossed is below 1¼ percent.

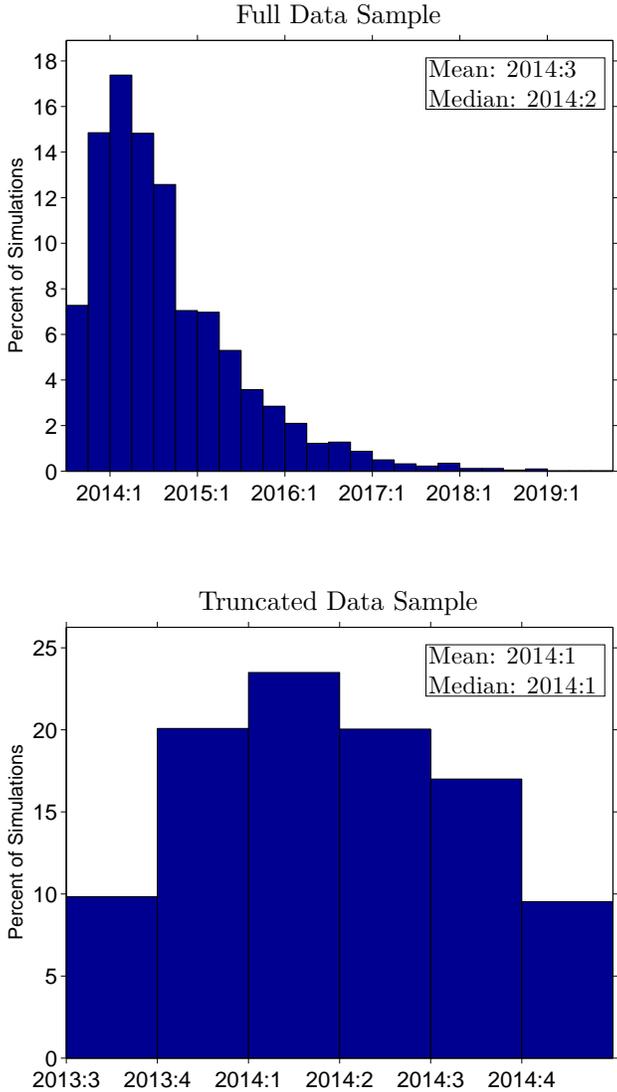Figure 1: Distribution of Stopping Dates (Full vs. Truncated Sample)

Full Data Sample

Mean: 2014:3
Median: 2014:2

Truncated Data Sample

Mean: 2014:1
Median: 2014:1

Figure 2: Peak Portfolio Size (Full vs. Truncated Sample)

Full Data Sample

Mean: 4,283
Median: 3,983

Truncated Data Sample
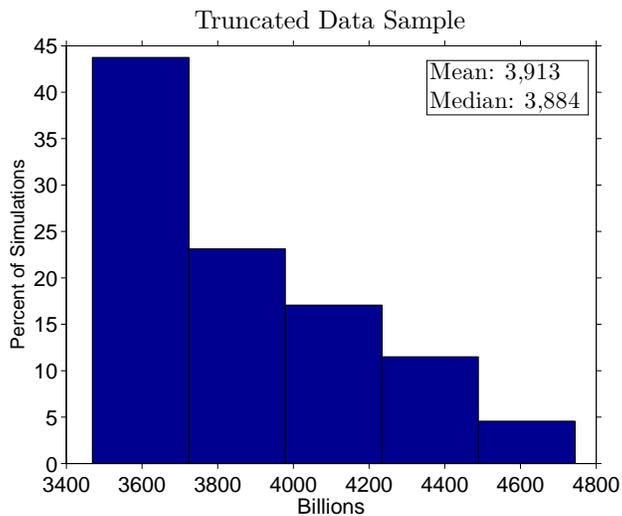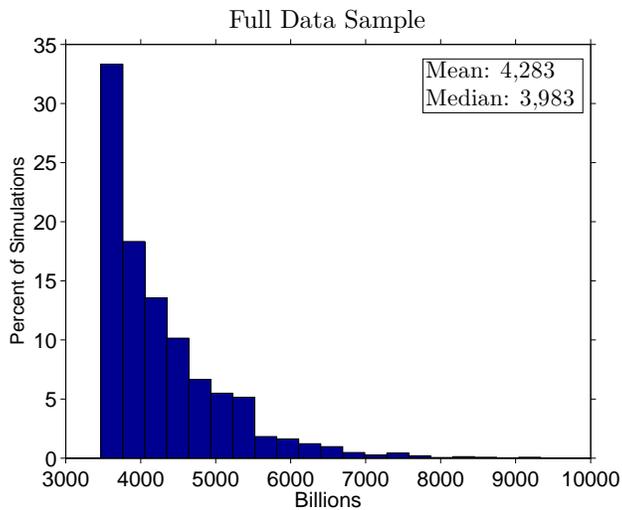
Mean: 3,913
Median: 3,884

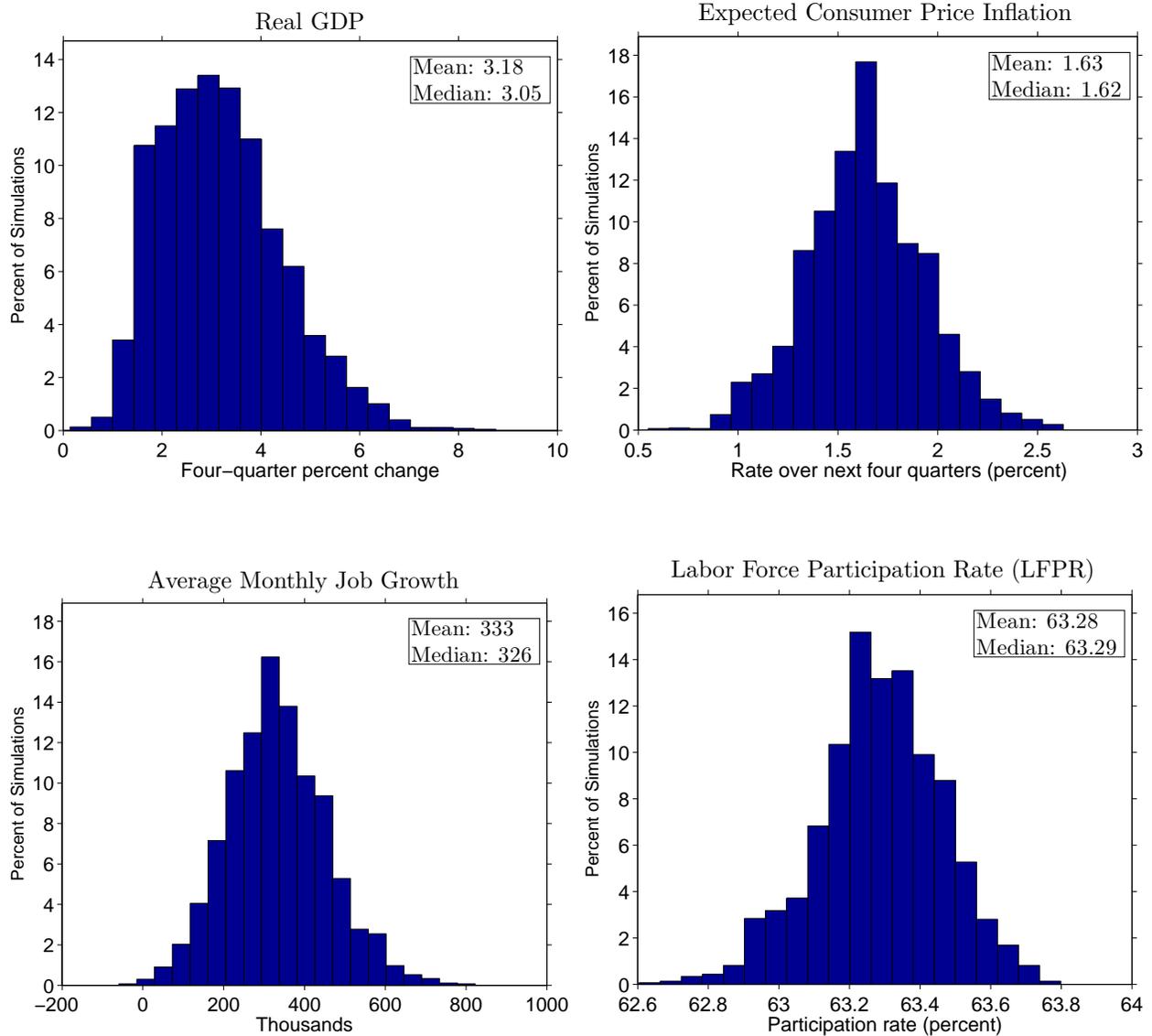Figure 3: The Distribution of Economic Outcomes as of the Date Purchases End
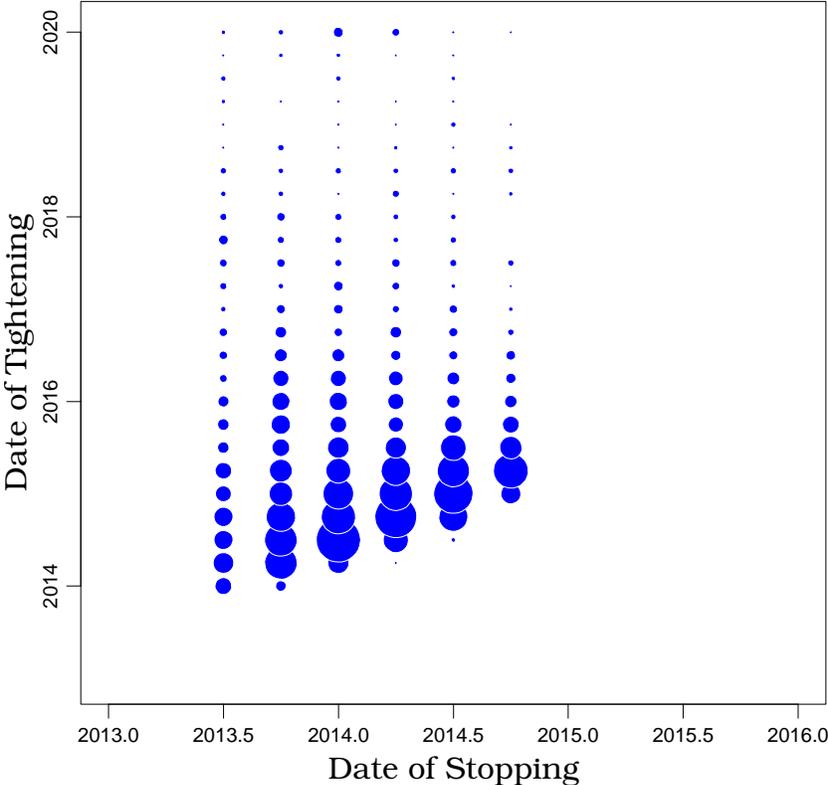
Figure 4: Liftoff Date for Federal Funds Rate and Stopping Date for Asset Purchases

Notes: The size of bubbles are determined by the number of simulations.