Quantitative Easing
and the “New Normal” in
Monetary Policy

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The analysis and conclusions set forth are those of the authors and do not indicate concurrence by the Federal Reserve Board or other members of its staff.
Motivation
Interest rates may stay very low...

\[ r^* \text{ (Kiley, 2015)} \quad \text{Long-run inflation expectations} \quad \text{Sum} \]
& Fed balance sheet ↑ when economy hit ELB

Assets of the Federal Reserve

Source: Federal Reserve Board
The questions I ask

• If $r^*$ is low, how often will the ELB bind, and what are the resulting consequences for price stability and full employment?

• How effective is QE at ameliorating these consequences?

• Is effective use of QE consistent with its deployment as a secondary monetary-policy tool?
How I answer my questions

• Use simulations of FRB/US model
  • Used in Reifschneider and Williams (2000), Williams (2009), and Kiley and Roberts (2017)

• Consider the effects of the ELB under alternative assumptions regarding $r^*$ when the inflation target is 2 percent

• Examine alternative approaches to QE, differing in the speed and size of deployment and the degree of symmetry in the approach
Preview of main results

• Under traditional policy approaches, the ELB may bind much more often than previously appreciated
  • This should be expected: Even a mild recession would likely push interest rates to zero, starting from a 3 percent level

• QE can ameliorate these consequences in the FRB/US model

• To do so, QE must be deployed quickly and be sizable – but can remain a secondary tool
ELB risk without QE
ELB Frequency - policy as usual ($\pi^* = 2$)

\[ i(t) = r^* + 2 + 1.5(\pi^4(t) - 2) + y(t) \]
Consequences of policy as usual ($\pi^* = 2$)

\[ i(t) = r^* + 2 + 1.5(\pi^4(t) - 2) + y(t) \]

![Graph showing Inflation with RMSE and Mean for different interest rates.]

- Mean
  - $i^* = 6$ percent
  - $i^* = 3$ percent

- RMSE
  - $i^* = 6$ percent
  - $i^* = 3$ percent
Consequences of policy as usual ($\pi^* = 2$)

$$i(t) = r^* + 2 + 1.5(\pi^4(t) - 2) + y(t)$$
Quantitative easing
How can these risks be managed?

• Raise inflation target $\pi^*$ (e.g., Ball, ‘14)

• Commit to make up inflation shortfalls/use forward guidance
  • Very powerful in New-Keynesian model (e.g., Eggertsson and Woodford, ‘03)
  • Power of forward guidance may not be realistic (Kiley, ‘16; McKay et al, ‘16)

• Quantitative easing
  • Note that this is only one of these approaches adopted by central banks so far
Quantitative easing

• Buy long-term asset (e.g., Treasuries) by issuing short-term liabilities

• First round effect is to lower yields on long-term Treasury securities
  • $500 billion QE ↓ term premium on 10-yr Treasury @20bp (Ihrig et al, ‘12)

<table>
<thead>
<tr>
<th>FOMC policy</th>
<th>Marginal TPE from program</th>
<th>TPE at onset of program</th>
<th>Expected TPE as of 2013:Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSAP I</td>
<td>-38</td>
<td>-38</td>
<td>-6</td>
</tr>
<tr>
<td>Reinvestment into Treasury securities</td>
<td>-8</td>
<td>-30</td>
<td>-9</td>
</tr>
<tr>
<td>LSAP II</td>
<td>-13</td>
<td>-40</td>
<td>-14</td>
</tr>
<tr>
<td>Reinvestment into Agency MBS securities</td>
<td>-3</td>
<td>-48</td>
<td>-30</td>
</tr>
<tr>
<td>MEP</td>
<td>-17</td>
<td>-64</td>
<td>-44</td>
</tr>
<tr>
<td>MEP II</td>
<td>-11</td>
<td>-65</td>
<td>-54</td>
</tr>
</tbody>
</table>

Effects of Quantitative Easing in U.S. on Treasury Yields
Quantitative easing in FRB/US I

• Movements in long-term interest rates affect equity prices, other interest rates, and exchange value of dollar
  • Literature shows range for pass-through to other asset prices (Kiley, ‘14 &’16)

• Financial conditions affect activity and inflation

• Effects of QE on activity/inflation different from those of adjustments in short-term interest rate for equal-sized movements in 10-yr yield
Quantitative easing in FRB/US II
## Alternative size and speed of QE approaches

<table>
<thead>
<tr>
<th>QE1: Initiation of purchases (AP(t)) when $r(t)&lt;0.25$ &amp; $y(t)&lt;-5$ at a rate of $25$ billion per quarter per unit of $y(t)&lt;-5$, implying approximately <strong>$500$ billion in QE</strong> if the output gap equals -7.5 for four quarters</th>
<th>QE3: Initiation of purchases (AP(t)) when $r(t)&lt;0.25$ &amp; $y(t)&lt;-2.5$ at a rate of $25$ billion per quarter per unit of $y(t)&lt;-2.5$, implying approximately <strong>$1$ trillion in QE</strong> if the output gap equals -7.5 for four quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>QE2: Initiation of purchases (AP(t)) when $r(t)&lt;0.25$ &amp; $y(t)&lt;-5$ at a rate of $50$ billion per quarter per unit of $y(t)&lt;-5$, implying approximately <strong>$1$ trillion in QE</strong> if the output gap equals -7.5 for four quarters</td>
<td>QE4: Initiation of purchases (AP(t)) when $r(t)&lt;0.25$ &amp; $y(t)&lt;-2.5$ at a rate of $50$ billion per quarter per unit of $y(t)&lt;-2.5$, implying approximately <strong>$2$ trillion in QE</strong> if the output gap equals -7.5 for four quarters</td>
</tr>
</tbody>
</table>
Outcomes under alternative QE approaches

ELB FREQUENCY

Output gap

Inflation

- No QE
- QE1
- QE2
- QE3
- QE4
Is effective QE a modest and secondary tool?

• QE4 is effective

• QE4 is large, but not beyond bounds of experience

• QE4 uses the balance sheet as a secondary tool

<table>
<thead>
<tr>
<th>Media size</th>
<th>Mean size</th>
<th>75th percentile</th>
<th>90th percentile</th>
<th>95th percentile</th>
<th>ΔQE&gt;0 &amp; i(t)&gt;0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$90 billion</td>
<td>$613 billion</td>
<td>$567 billion</td>
<td>$1.87 trillion</td>
<td>$3.21 trillion</td>
<td>6.7</td>
</tr>
</tbody>
</table>
QE vs other approaches
Other risk-mitigation approaches

• Raise inflation target (e.g., Ball, 2014)
  • Consider $\pi^*=3$

• Commit to overshoot objectives/use forward guidance (e.g., Eggertsson and Woodford, 2003)
  • Use rule from Kiley and Roberts (2017)

\[ i^*(t) = i^*(t - 1) + .125(\pi^4(t) - 2 + y(t)), \]
\[ i(t) = \max[i^*(t), i^{ELB}] \]
QE and other risk management approaches

ELB frequency

Output gap

Inflation

- QE4
- Overshooting
- $\pi^*=3$

- mean
- RMSD ($\pi-2$)
Key auxiliary points on each approach

• QE
  • Modeling of transmission channels relatively unexplored and active use of balance sheet may be more/less effective than herein

• Raising inflation target
  • could undermine credibility; and
  • locks in any costs associated with higher inflation

• Commitment strategies/forward guidance
  • raise credibility challenges (owing to time-inconsistency)
  • relies on promises to act -- in contrast to QE, where contemporaneous action is taken
Comparison to other research and wrap up
Comparison to earlier work

• ELB is much more likely to bind and the effects on output and inflation are larger than in previous analyses

• Previous FRB/US analyses (Chung et al, 2012; Reifschneider, 2016)
  • Our analysis considers systematic strategies under alternative assumptions about long-run level of interest rates across a range of economic conditions
  • Earlier work primarily scenario based

• Previous DSGE work (Carlstrom et al, 2016; Quint and Rabanal, 2017)
  • Did not focus on ELB risk associated with low interest rates
Wrap up

• The ELB will bind very frequently (40 percent or more) if $r^*$ is 1 percent or lower under a policy-as-usual approach

• QE can ameliorate these effects in the FRB/US model
  • FRB/US may overstate efficacy of QE (e.g., Kiley, 2014)

• QE can be effective even as a secondary tool, if deployed quickly and in size