Discussion of:
"Optimal Inflation for the U.S."
by Roberto Billi

Robert J. Tetlow

Federal Reserve Board

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Introduction

What I will be talking about:

- My take on the motivation for the paper
- Summarize a few points from the paper
- Ask some questions about the results and the modeling assumptions behind those results
- Explore the applicability of the results: does prescriptive nature of the title fit?

In the end keep this in mind: *this is a good paper.*
"As you know, core prices by many measures have increased very slowly over the last six months. With price inflation already at a low level, substantial further disinflation would be an unwelcome development..."

– Alan Greenspan before the House Committee on Financial Services, April 30, 2003

"[W]e face new challenges in maintaining price stability, specifically to prevent inflation from falling too low...[T]here is an especially pernicious, albeit remote, scenario in which inflation turns negative...engendering a corrosive deflationary spiral...it is incumbent on a central bank to anticipate any contingency, however remote, if significant economic costs could be associated with that contingency."

– Alan Greenspan before the House Committee on Financial Services, July 15, 2003
Motivation II: Japan

- Call Loan Rate (Effective, Averaged)
- Government Bonds Yields (10 Years Benchmark)

- GDP Growth Rate (Four-quarter)
- Inflation Growth Rate (Four-quarter)
What Roberto is doing:

- Take a very standard *linearized* NKB model in which a target rate of inflation of zero would be optimal, and...
  - Impose the ZLB constraint and recompute the optimal policy
  - Do it again, in a world of *model uncertainty* using the tools of *robust control theory*. 
Some literature

A very incomplete selection includes:

**The ZLB and policy:**

**Robust control:**

**Computational literature:**
The punchlines

The paper carries the following punchlines:

1. ZLB has *few consequences* for the choice of the inflation target: \( \pi^* \approx 0 \).
2. The ZLB has *very small consequences* for welfare (0.0036 percent of steady-state consumption).
3. This basic finding is remarkably robust to alternative parameterizations.
Very standard NKB model

\[ \pi_t - \gamma \pi_{t-1} = \beta E_t (\pi_{t+1} - \gamma \pi_t) + \kappa x_t + u_t \]  

(1)

\[ x_t = E_t x_{t+1} - \phi (i_t - E_t \pi_{t+1} - r^n_t) \]  

(2)

\[ u_t = \rho u u_{t-1} + \sigma \epsilon_t \epsilon_t \]  

(3)

\[ r^n_t = (1 - \rho_r) r_{ss} + \rho_r r^n_{t-1} + \sigma \epsilon_t \epsilon_t \]  

(4)

\[ i_t \geq 0 \ \forall \ t \]  

(5)

\[ L = \sum_{t=0}^{\infty} \beta^t [ (\pi_t - \gamma \pi_{t-1})^2 + \lambda x_t^2 ] \]  

(6)
The computational issues

- Up to the ZLB, the model is linear and small
- The ZLB introduces an occasionally binding constraint to the problem. See, e.g., Christiano-Fisher (2000) *JEDC*
- This means that the monetary authority must form expectations over future states conditional on the probability of the constraint being binding
- Hence the use of the numerical sequential Gaussian quadrature solution method.
The ZLB constraint binds a lot....but makes surprisingly little difference

\textit{Table 1}

\textit{Optimal Inflation Rates and Frequencies of ZLB}

<table>
<thead>
<tr>
<th>shocks -›</th>
<th>baseline</th>
<th>( \pi^* )</th>
<th>( \sigma(\pi) )</th>
<th>( pr(i \leq 0) )</th>
<th>( \Delta(\mu) )</th>
<th>memo:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with ZLB</td>
<td>0.17</td>
<td>1.9</td>
<td>27</td>
<td>0.0036</td>
<td>data*</td>
</tr>
<tr>
<td></td>
<td>w/o ZLB</td>
<td>0</td>
<td>2.1</td>
<td>37</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5*baseline</td>
<td>0.69</td>
<td>2.8</td>
<td>62</td>
<td>0.0223</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with ZLB</td>
<td>2.5</td>
<td>2.3</td>
<td>0</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

* U.S. GDP price inflation, quarterly at annual rates, 1984-2006.

- Even in extreme calibrations the representative agent wouldn’t pay squat to avoid the ZLB. Why?
A. Questions about calibration

1. The steady-state real interest rate

- $r_{ss}$ is set to 3.5 percent–high! Taylor (1993) set it (arbitrarily) at 2.
- Persistence of shocks to the equilibrium real rate is pretty low, $\rho_r = 0.8$.
- An alternative calibration in Table 4 shows $\pi^* = 0.61$, $pr(i \leq) = 69$ and $\Delta(\mu) = 0.0127$ in this case.
B. Gripes

1. **Implementability of the optimal policy**
   - The optimal policy is a so-called *targeting rule*, that is, an Euler equation. Implementability is an issue.
   - There is a short footnote that says implementability is "a difficult issue" that is relegated to "future research". Why?

2. **Decomposition of the optimal policy**
   - The optimal policy contains at least two parts: (1) *the positive target rate of inflation*, and (2) a *non-linear response function*.
   - Reifschneider and Williams (2000) emphasize non-linearity of policy as the ZLB gets more conditionally likely.
   - Others emphasize the minimization of the unconditional likelihood of the constraint binding by setting $\pi^* > 0$.
   - The two are confabulated here. It would be nice to do the decomposition.
There is drama...but the good guy always wins

- The model and computational methods push rational expectations pretty hard.
- It appears as though the ZLB is never an absorbing state. A happy ending is assured!

What if this were a French film?

- There would be some foreboding of doom, existential angst.
- As in Cogley and Sargent's papers, agents would worry more profoundly about avoid the ZLB state.
1. **Gaussian quadrature problems**
   - Work well when the function to be approximated is differentiable, less well with hard constraint problems like this one.
   - Based on a "matching moments" problem wherein it is assumed that a well-behaved steady state obtains.
   - An alternative would have been to do MCMC simulation.

2. **Error detection probabilities**
   - Make sense when 'errors' are a frequently observed thing, as they are in the model but not in practice.
   - May be too crude a tool when decision makers are asked to identify rarely occurring errors indicating misspecification.
This is a good paper addressing an important issue
The results are interesting—and surprising!
Swallowing the *prescriptive* story requires a certain "willful suspension of disbelief".