RESOLVING NEW KEYNESIAN ANOMALIES
WITH WEALTH IN THE UTILITY FUNCTION

Pascal Michaillat (Brown)
Emmanuel Saez (Berkeley)

November 2019

Paper available at https://www.pascalmichaillat.org/11.html
ANOMALIES IN NK MODEL AT ZLB

- collapse of output & inflation
- implausibly large effects of forward guidance
- implausibly large effects of government spending
EXISTING REMEDIES TO ZLB ANOMALIES

• Gabaix [2016]: bounded rationality
• Diba, Loisel [2017]: interest on bank reserves
• Cochrane [2018]: fiscal theory of price level
• Bilbiie [2018] & Acharya, Dogra [2018]: heterogeneous agents
• this paper: **minimal deviation** from textbook model
  - equilibrium remains 2-dimensional (Euler + Phillips)
  - same derivations
  - only one coefficient changes in equilibrium system (Euler)
WHY WOULD PEOPLE VALUE WEALTH IN ITSELF?

• Keynes [1919]: “The duty of saving became nine-tenths of virtue and the growth of the cake the object of true religion…. Saving was for old age or for your children; but this was only in theory—the virtue of the cake was that it was never to be consumed, neither by you nor by your children after you.”

• Irving Fisher [1930]: “A man may include in the benefits of his wealth…the social standing he thinks it gives him, or political power and influence, or the mere miserly sense of possession, or the satisfaction in the mere process of further accumulation.”
WHY WOULD PEOPLE VALUE WEALTH IN ITSELF?

• Camerer, Loewenstein, Prelec [2005]: “brain-scans conducted while people win or lose money suggest that money activates similar reward areas as do other primary reinforcers like food and drugs, which implies that money confers direct utility, rather than simply being valued only for what it can buy.”

• evidence from economics, social psychology, sociology, social neuroscience: wealth is a marker of social status, and people value high social status
NK MODEL WITH WEALTH IN THE UTILITY
self-employed household $j \in [0, 1]$ maximizes utility

$$
\int_0^\infty e^{-\delta t} \left[ \ln(c_j(t)) + u\left(\frac{b_j(t)}{p(t)} - \frac{b(t)}{p(t)}\right) - \kappa h_j(t) - \frac{\gamma}{2} \pi_j(t)^2 \right] dt
$$

- consumption index: $c_j(t) = \left[\int_0^1 c_{jk}(t)^{(\epsilon-1)}/\epsilon \, dk\right]^{\epsilon/(\epsilon-1)}$
- aggregate wealth: $b(t) = \int_0^1 b_j(t) \, dj$
- inflation: $\pi_j(t) = \dot{p}_j(t)/p_j(t)$

subject to budget constraint:

$$
\dot{b}_j(t) = i(t)b_j(t) + p_j(t) y_j(t) - \int_0^1 p_k(t)c_{jk}(t) \, dk
$$

to production function: $y_j(t) = ah_j(t)$

to demand for good $i$: $y_j(t) = \left[\frac{p_j(t)}{p(t)}\right]^{-\epsilon} c(t)$
EQUILIBRIUM: EULER-PHILLIPS SYSTEM

- monetary policy: real rate $r(\pi) = i(\pi) - \pi$
- Phillips curve: standard

\[ \dot{\pi} = \delta \pi - \frac{\varepsilon \kappa}{\gamma a} (y - y^n) \quad \text{with} \quad y^n = \frac{\varepsilon - 1}{\varepsilon} \cdot \frac{a}{\kappa} \]

- Euler equation: “discounted”
  - $\dot{y}/y = r(\pi) + u'(0)y - \delta$
  - financial return on saving: $r(\pi)$
  - hedonic return on saving: $u'(0)y^n = \text{MRS(wealth, consumption)}$
  - so $\dot{y}/y = r(\pi) - r^n + u'(0)(y - y^n) \text{ with } r^n = \delta - u'(0)y^n$
TWO MODELS

• NK: standard New Keynesian model

\[ u'(0) = 0 \]

• WUNK: wealth-in-the-utility New Keynesian model

\[ u'(0) > \frac{\epsilon \kappa}{\delta \gamma a} \]
OUTPUT & INFLATION COLLAPSE
ZLB SCENARIO

<table>
<thead>
<tr>
<th>ZLB</th>
<th>back to natural steady state</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r^n &lt; 0$</td>
<td>$r^n &gt; 0$</td>
</tr>
<tr>
<td>$i(\pi) = 0$</td>
<td>$i(\pi) = r^n + \phi \pi$</td>
</tr>
<tr>
<td>$\phi &gt; 1$</td>
<td></td>
</tr>
</tbody>
</table>

$t = 0$  $t = T$
\[ \pi = 0 \]

\[ \pi \]

\[ y = y^n \]

\[ \pi = \delta \pi - \frac{e \kappa}{\gamma a} (y - y^n) \]
\[ \dot{\pi} = \delta \pi - \frac{\epsilon k}{\gamma a} (y - y^n) \]

\( y = y^n \)
$\frac{\dot{y}}{y} = (\phi - 1)\pi$

Euler

$\pi = 0$

Phillips

$y = y^n$
\[
\frac{\dot{y}}{y} = (\phi - 1)\pi
\]
NK › PHASE DIAGRAM IN NORMAL TIMES: SOURCE
NK PHASE DIAGRAM AT ZLB: SADDLE

\[ \pi = 0 \]

\[ y = y^n \]

\[ \frac{\dot{y}}{y} = (\phi - 1)\pi \]
\[ \frac{\dot{y}}{y} = -\pi - r^n \]
PHASE DIAGRAM AT ZLB: SADDLE

\[ \pi = 0 \]

\[ y = y^n \]

Euler

Phillips
NK \xrightarrow{\text{ZLB EPISODE}}
\[ \frac{\dot{y}}{y} = (\phi - 1)\pi \]
WUNK › PHASE DIAGRAM IN NORMAL TIMES: SOURCE

$\pi = 0$

$y = y^n$

$\frac{\dot{y}}{y} = (\phi - 1)\pi + u'(0)(y - y^n)$
WUNK  \ PHASE DIAGRAM IN NORMAL TIMES: SOURCE

\[ \pi = 0 \]

\[ y = y^n \]
\[ \frac{\dot{y}}{y} = -\pi - r^n \]
$y = y^n$

$$\frac{\dot{y}}{y} = -\pi - r^n + u'(0)(y - y^n)$$
\[ y = y^n \]
\[ \frac{\dot{y}}{y} = -\pi - r^n + u'(0)(y - y^n) \]
WUNK › PHASE DIAGRAM AT ZLB: SOURCE
WUNK \ LONGER ZLB: CONVERGENCE TO STEADY STATE

\[ \pi = 0 \]

\[ y = y^n \]

Euler

Phillips

\[ t = T \]

\[ t = 0 \]
FORWARD GUIDANCE
## FORWARD-GUIDANCE SCENARIO

<table>
<thead>
<tr>
<th>ZLB</th>
<th>forward guidance</th>
<th>back to natural steady state</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r^n &lt; 0$</td>
<td>$r^n &gt; 0$</td>
<td>$r^n &gt; 0$</td>
</tr>
<tr>
<td>$i(\pi) = 0$</td>
<td>$i(\pi) = 0$</td>
<td>$i(\pi) = r^n + \phi \pi$</td>
</tr>
<tr>
<td>$\phi &gt; 1$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- $t = 0$
- $t = T$
- $t = T + \Delta$
\( \pi = 0 \)

\( y = y^n \)

\( t = T + \Delta \)

Phillips

Euler
NK \rightarrow ZLB EPISODE + FORWARD GUIDANCE

\[ \pi = 0 \]

\[ y = y^N \]

Euler

Phillips

\[ t = T \]

\[ t = T + \Delta \]
ZLB EPISODE + FORWARD GUIDANCE

\[ y = y^n \]

\[ \pi = 0 \]

Euler

\[ t = T + \Delta \]

Phillips
NK \gtr ZLB EPISODE + FORWARD GUIDANCE

\begin{align*}
\pi &= 0 \\
y &= y^n \\
t &= 0 \\
t &= T + \Delta \\
t &= T
\end{align*}

Phillips
NK \ LONGER GUIDANCE: BOOM AT ZLB
LONGER GUIDANCE: BOOM AT ZLB
LONGER GUIDANCE: BOOM AT ZLB
WUNK \(\triangleright\) ZLB EPISODE + FORWARD GUIDANCE

\[ t = T + \Delta \]

\[ \pi = 0 \]

\[ y = y^n \]
$t = T + \Delta$

$y = y^n$

$\pi = 0$

$\pi$

$y$

Euler

Phillips
WUNK \ ZLB EPISODE + FORWARD GUIDANCE
WUNK \rightarrow LONGER GUIDANCE: LIMITED EFFECT

\[ y = y^n \]

Euler (ZLB) \quad \pi

Euler (fwd guidance)

Phillips

\[ \pi = 0 \]

\[ t = 0 \]

\[ t = T \]

\[ t = T + \Delta \]
OTHER ZLB PROPERTIES IN WUNK
PARADOX OF THRIFT: HIGHER MU OF WEALTH
PARADOX OF THRIFT: HIGHER MU OF WEALTH
PARADOX OF TOIL: LOWER DISUTILITY OF LABOR

\[
\begin{align*}
\pi & \quad 0 \\
y & \quad y^n
\end{align*}
\]

Euler \quad Phillips
PARADOX OF TOIL: LOWER DISUTILITY OF LABOR
PARADOX OF FLEXIBILITY: LOWER ADJUSTMENT COST
PARADOX OF FLEXIBILITY: LOWER ADJUSTMENT COST
ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER

\[ \pi = 0 \]

\[ c = c^n \]

Euler

Phillips
ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER

π = 0

c = c^n

π

Euler

Phillips

c
ASSESSMENT OF WUNK ASSUMPTION
\[ \delta - r^n > \frac{\lambda}{\delta} \]

- \( \lambda \) = output-gap coefficient in Phillips curve \( \approx 6\% \)
  - Mavroeidis, Plagborg-Moller, Stock [2014]
- \( \delta \) = annual time discount rate \( \approx 40\% \)
  - Frederick, Loewenstein, O’Donoghue [2002]
  - Andersen, Harrison, Lau, Rutstrom [2014]
- \( r^n \) = natural rate of interest \( \approx 2\% \)
- WUNK assumption holds: \( 40\% - 2\% = 38\% > 15\% = 6\% / 40\% \)
  - lowest acceptable household discount rate: 26%
  - lowest acceptable firm discount rate: 16%