RESOLVING NEW KEYNESIAN ANOMALIES

WITH WEALTH IN THE UTILITY FUNCTION

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ANOMALIES IN NK MODEL AT ZLB

• collapse of output & inflation
• implausibly large effects of forward guidance
• implausibly large effects of government spending
• unlike what we have seen in recent ZLB episodes
  – ZLB in Japan: more than 20 years
  – ZLB in euro area: more than 10 years
  – ZLB in US: more than 5 years
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
EXISTING REMEDIES TO ZLB ANOMALIES

- Eggertsson, Mehrotra [2014]: OLG + wage rigidity
- 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)
MODEL
• 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 $i$: $y_j(t) = \left[p_j(t)/p(t)\right]^{-\epsilon} c(t)$
DYNAMICAL SYSTEM REPRESENTING GE

- monetary policy: real rate $r(\pi) = i(\pi) - \pi$
- optimal pricing by producers: standard Phillips curve
  \[
  \dot{\pi} = \delta \pi - \frac{\epsilon \kappa}{\gamma a} (y - y^n) \quad \text{with} \quad y^n = \frac{\epsilon - 1}{\epsilon} \cdot \frac{a}{\kappa}
  \]
- optimal saving by consumers: “discounted” Euler equation
  \[
  \frac{\dot{y}}{y} = r(\pi) + \underbrace{u'(0)y}_{MRS(\text{wealth},c)} - \delta
  \]
  so \[
  \frac{\dot{y}}{y} = r(\pi) - r^n + u'(0)(y - y^n) \quad \text{with} \quad r^n = \delta - u'(0)y^n
  \]
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>at natural steady state</th>
<th>ZLB</th>
<th>back to natural steady state</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r^n &gt; 0$</td>
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<tr>
<td>$i(\pi) = r^n + \phi\pi$</td>
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<td>$\phi &gt; 1$</td>
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</tr>
<tr>
<td>$y = y^n$</td>
<td></td>
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<tr>
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<td></td>
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</table>

$t = 0$                      $t = T$
\[ \dot{\pi} = \delta \pi - \frac{\varepsilon \kappa}{\gamma a} (y - y^n) \]
NK  |  PHASE DIAGRAM @ NATURAL STEADY STATE

\[ \pi = 0 \]

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

Phillips
\[ \frac{\dot{y}}{y} = (\phi - 1)\pi \]
NK | PHASE DIAGRAM @ NATURAL STEADY STATE

\[
\frac{\dot{y}}{y} = (\phi - 1)\pi
\]

\[y = y^n\]

Euler
\[\pi = 0\]

Phillips
$\dot{y} = -\pi - r^n$
NK | PHASE DIAGRAM @ ZLB STEADY STATE

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

Euler

\[ \pi = 0 \]

Phillips

\[ y = y^n \]
NK | LONGER ZLB: OUTPUT & INFLATION COLLAPSE

The diagram illustrates the relationship between inflation ($\pi$) and output ($y$) over time ($t$). The Euler equation is represented by a horizontal line at $\pi = 0$. The Phillips curve is shown as a line indicating the trade-off between inflation and unemployment. The points $t = 0$ and $t = T$ mark specific time periods on the graph.
WUNK | PHASE DIAGRAM @ NATURAL STEADY STATE

\[ \pi = 0 \]

\[ y = y^n \]

\[ \frac{\dot{y}}{y} = (\phi - 1)\pi + u'(0)(y - y^n) \]
WUNK | PHASE DIAGRAM @ NATURAL STEADY STATE

\[ y = y^n \]

\[ \frac{\dot{y}}{y} = (\phi - 1)\pi + u'(0)(y - y^n) \]
Euler

\[ \pi = 0 \]

Phillips

\[ y = y^n \]
\[
\frac{\dot{y}}{y} = -\pi - r^n + u'(0)(y - y^n)
\]
\[ \frac{\dot{y}}{y} = -\pi - r^n + u'(0)(y - y^n) \]
LONGER ZLB: CONVERGENCE TO STEADY STATE

\[ \pi = 0 \]

Euler

\[ y = y^n \]

Phillips

\[ t = 0 \quad t = T \]
FORWARD GUIDANCE
FORWARD-GUIDANCE SCENARIO

<table>
<thead>
<tr>
<th>Natural steady state</th>
<th>ZLB</th>
<th>Forward guidance</th>
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NK | FORWARD GUIDANCE

\[ \pi = 0 \]

\[ y = y^n \]

\[ t = T + \Delta \]

\[ t = T \]

Phillips curve
LONGER GUIDANCE: BOOM AT ZLB

\[ \pi = 0 \]
\[ t = 0 \]
\[ t = T + \Delta \]
\[ y = y^n \]
LONGER GUIDANCE: BOOM AT ZLB

\[ y = y^n \]

\[ \pi = 0 \]

\[ t = 0 ? \]

\[ t = T \]

\[ t = T + \Delta \]

Euler

Phillips

unstable line

 NK |
LONGER GUIDANCE: BOOM AT ZLB

The diagram illustrates the dynamics of economic variables over time. The Euler equation and the Phillips curve are key elements, showing how inflation ($\pi$) and output ($y$) evolve with time. The diagram highlights different time periods: $t = 0$, $t = T$, and $t = T + \Delta$, demonstrating the transition from initial conditions to eventual outcomes. The unstable line indicates the boundary beyond which the system may exhibit instability.
\[ t = T + \Delta \]

\[ \pi = 0 \]

Euler

Phillips

\[ y = y^n \]
\[ t = T + \Delta \]
\[ y = y^n \]
Euler  
Phillips
WUNK | ZLB + FORWARD GUIDANCE

Euler

Phillips

$\pi = 0$

$y = y^n$

$t = T$

$t = T + \Delta$
Euler (ZLB)  π  Euler (fwd guidance)  Phillips

π = 0

y = y^n

$\pi = 0$

$t = 0$

$t = T$

$t = T + \Delta$
OTHER ZLB PROPERTIES IN WUNK
PARADOX OF THRIFT | HIGHER MU OF WEALTH

\[ \pi \]

\[ y^n \]

Euler

Phillips

ZLB equilibrium
PARADOX OF THRIFT | HIGHER MU OF WEALTH

![Graph showing Euler and Phillips curves with point of intersection at y^n.]
PARADOX OF TOIL  |  LOWER DISUTILITY OF LABOR

\[ \pi \]

\[ y^n \]

\[ y \]
ABOVE-ONE GOVERNMENT-SPENDING MULTIPLIER
REALISM OF WUNK ASSUMPTION
• we rewrite the WUNK assumption:

\[ u'(0) > \frac{\varepsilon \kappa}{\delta \gamma a} \]

\[ \delta \times u'(0)y^n > \frac{\varepsilon \kappa}{\gamma a} y^n \]

\[ \delta \times (\delta - r^n) > \text{output-gap coeff. in Phillips curve} \]

• natural rate of interest: \( r^n \approx 2\% \)

• output-gap coefficient in Phillips curve \( \approx 3\% \)
  
  – VARs + microevidence on price-adjustment costs

• time discount rate: \( \delta \approx 35\% \)
  
  – laboratory + field + natural experiments

• WUNK assumption holds: 0.35 \times (0.35 - 0.02) = 0.12 > 0.03
all Phillips-curve coefficients satisfy WUNK
LIKELIHOOD TO SATISFY WUNK

lowest $\delta = 19\%$

72% of time discount rates satisfy WUNK