Some Fiscal Implications of Monetary Policy

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Outline

- Examine monetary transmission mechanism within stochastic environments.

- Focus on second moment implications of monetary policy.

- Specifically: Risk premium on nominal bonds.
  
  Primary Conclusion: Risk premium is lower under procyclical monetary policy

- Implications for tax policy (less confidence)

- Suggestions for empirical research
  
  1. Size of the risk premium.
  
  2. Cross country comparison
Preferences:

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left[ u(c_t) + v(1-h_t) \right] \]

Technology:

\[ y_t = z_t f(n_t) \]

- Money demand generated by cash-in-advance constraint

  Setup – eliminate inflation tax on labor.

  How:

  firms pay wages before workers visit goods market.

  Firms hold cash from one period to the next.

  To ensure that firms have sufficient liquidity, introduce an additional asset.

Timing of events in each period

<table>
<thead>
<tr>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>H: ((c_t, n_t, m_t))</td>
<td>(H: m_t \geq p_t c_t)</td>
<td></td>
</tr>
<tr>
<td>(z_t), observed</td>
<td>F: pay (w_t), (q_t) and (\pi_t)</td>
<td>F: sell (y_t)</td>
</tr>
<tr>
<td>G: (T_t, g_t, M_t)</td>
<td></td>
<td>G: (m^*_t \geq p_t g_t)</td>
</tr>
</tbody>
</table>
Constraints:

Firm

\[ p_t z_t f(n_t) = w_t n_t + \pi_t + \vartheta_t \]

Makes cash payments out of revenues from previous period and “dividends” from equity.

Household

\[ w_t n_t + k_{t-1}(\pi_t + Q_{1t}) + \zeta_{t-1}(\vartheta_t + Q_{2t}) + (1 + R_{t-1})B_{t-1}^c + (m_{t-1} - p_{t-1}c_{t-1}) - p_t T_t \geq B_t^c + m_t + Q_{1t}k_t + Q_{2t}\zeta_t \]

\[ m_t \geq p_t c_t \]

Government

\[ (M_t - M_{t-1}) + (B_t^g - B_{t-1}^g) + p_t T_t = m_t^* + R_{t-1}B_{t-1}^g \]

\[ m_t^* \geq p_t g_t \]

Assumptions:

Government expenditures and bonds are exogenous.

CIA constraints are always binding.
Equilibrium:

Markets clear

\[ z_t f(n_t) = y_t = g_t + c_t \]

Intratemporal efficiency:

\[ \frac{v'(1-n_t)}{u'(z_t f(n_t) - g_t)} = z_t f'(n_t) \]

Implication: Superneutrality of money.

Risk characteristics of nominal interest rates

Necessary condition associated with bond purchases:

\[
(1 + R_t)^{-1} = \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} \left( \frac{p_t}{p_{t+1}} \right) \right]
\]  

(2.21)

Define the ex-ante (Fisherian) real interest rate as:

\[
(1 + r_t) = (1 + R_t) E_t \left( \frac{p_t}{p_{t+1}} \right)
\]  

(2.22)
Using eq. (2.21) and the definition of the conditional covariance:

\[(1 + r_t)^{-1} = \beta E_i \left( \frac{u'_{t+1}}{u'_t} \right) + \frac{\beta Cov_t \left[ \left( \frac{u'_{t+1}}{u'_t} \right), \left( \frac{p_t}{p_{t+1}} \right) \right]}{E_t \left( \frac{p_t}{p_{t+1}} \right)} \]

or

\[(1 + r_t)^{-1} = (1 + rr_t)^{-1} + \frac{\beta Cov_t \left[ \left( \frac{u'_{t+1}}{u'_t} \right), \left( \frac{p_t}{p_{t+1}} \right) \right]}{E_t \left( \frac{p_t}{p_{t+1}} \right)} \]

\[rp_t = \frac{(1 + r_t)}{(1 + rr_t)} - 1 = -(1 + r_t) \frac{\beta Cov_t \left[ \left( \frac{u'_{t+1}}{u'_t} \right), \left( \frac{p_t}{p_{t+1}} \right) \right]}{E_t \left( \frac{p_t}{p_{t+1}} \right)} \]
Implications for two monetary policy rules

Interest rate target:

\[
(1 + R^*)^{-1} = \beta E_t \left[ u'_{t+1} \frac{p_t}{u'} \right] = \beta E_t \left[ u'_{t+1} \frac{y_{t+1}}{y_t} \frac{M_t}{M_{t+1}} \right]
\]

Price level target:

\[
p^* = \frac{M_t}{y_t}
\]

Proposition: Ex-ante real interest rates are lower under a price level target than under a nominal interest rate target.

Why: Covariance term \( \left( \frac{u'_{t+1}}{u'} \right) \left( \frac{p_t}{p_{t+1}} \right) \) is negative under interest rate target.

Intuition: Suppose technology shock is high – this implies current MU is low. Also, implies under interest rate target that the return on bonds is high. Nominal bonds pay well in those states of the world in which consumption is already high – risky.

Broad implication: The greater the procyclical behavior of inflation, the lower the risk premium on nominal debt.
Parametric Example – isoelastic preferences

\[ c_{t+1} = c_t \varphi_{t+1} \text{ where } \ln \varphi_t \sim N(0, \sigma^2) \]

Under a price level target:

\[
(1 + r^p) = \frac{1}{\beta E_t(\varphi^{-\theta}_{t+1})}
\]

Under an interest rate target (for comparison, \(1 + R^* = \beta^{-1}\))

\[
(1 + r^i) = \frac{E_t(\varphi^\theta_{t+1})}{\beta}
\]

Then, taking logs of both expressions:

\[ r^i - r^p \approx \theta^2 \sigma^2 \]

Implications from two countries: Italy and Belgium

<table>
<thead>
<tr>
<th>(\theta)</th>
<th>(r^i - r^p)</th>
<th>Cost (% of GDP)</th>
<th>(r^i - r^p)</th>
<th>Cost (% of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>0.05</td>
<td>4</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>0.20</td>
<td>16</td>
<td>0.22</td>
</tr>
<tr>
<td>2.5</td>
<td>40</td>
<td>0.33</td>
<td>25</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
<td>0.46</td>
<td>36</td>
<td>0.49</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>0.82</td>
<td>64</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Italy’s absolute cost when \(\theta = 3\) is roughly $5 billion.
**An Income Tax**

A tax on labor income:

\[
\frac{v'(1-n_t)}{u'(c_t)} = (1 - \tau_t) z_t f'(n_t)
\]

(2.28)

Heroic assumptions to permit comparison across monetary policy regimes:

a) Tax rates and revenues are positively related.

b) The average level of seignorage is zero under both regimes.

c) Path of real debt is identical in both regimes.

Focus on tax collections in period \( t+1 \):

**Price level stabilization rule:**

\[
\tau_{t+1} z_{t+1} f(n_{t+1}) = g_{t+1} + (1 + R_t^p) \frac{B_t^p}{p} - \frac{B_{t+1}^p}{p} - \frac{M_{t+1}^p - M_t^p}{p}
\]

(2.29)

**Nominal interest rate targeting rule:**

\[
\tau_{t+1} z_{t+1} f(n_{t+1}^i) = g_{t+1} + (1 + R_t^i) \frac{p_t^i}{p_{t+1}^i} \frac{B_t^i}{p_t^i} - \frac{B_{t+1}^i}{p_{t+1}^i} - \frac{M_{t+1}^i - M_t^i}{p_{t+1}^i}
\]

(2.30)
Price level target:

\[ p = \frac{M_{t+1}^p}{y_{t+1}^p} \]

Inflation target:

\[ \frac{M^i_{t+1} - M^i_t}{p^i_{t+1}} = y^i_{t+1} - y^i_t \left( \frac{u^i_t}{u^i_{t+1}} \right) \]

Difference in tax revenue:

(2.31)

\[ E_t[T^p_{t+1} - T^i_{t+1}] = E_t \left\{ [r^p_t - r^i_t] - [y^p_{t+1} - y^p_t] + [y^i_{t+1} - y^i_t \left( \frac{u^i_t}{u^i_{t+1}} \right)] \right\} \]

Focus on the last term:

Using assumptions of previous period:

\[ E [r^p_t - r^i_t] = \frac{\theta}{2} \left[ (1 - \theta) \sigma^2_i - (1 + \theta) \sigma^2_p \right] \]

Variance of output is greater under price level target:

when output is high, inflation is low \( \Rightarrow \) real tax returns are high.

Consequently, lower taxes are needed \( \Rightarrow \) less variability in output.
Conclusions:

Monetary policy matters for risk premium on nominally denominated debt.

The empirical questions:

How large is the risk premium? Shen (1998) estimates 100 basis points for UK data.

Cross-country analysis of inflation risk premium – should vary with monetary policy rules.

New Zealand, US comparison.