Interest on cash with endogenous fiscal policy

Alexei Deviatov and Neil Wallace

April 2010
Monetary policy cannot be studied without describing fiscal policy

- allowable fiscal instruments

- how they are used

- (see, for example, Correia, I., J. Nicolini and P. Teles, Optimal fiscal and monetary policy: equivalence results. *JPE* 2008)

This paper

- policy implied by frictions that generate role for money

- main friction is imperfect monitoring
Imperfect monitoring and the role of currency

Observations

- currency used to evade taxation
- currency used in the underground economy

Suggest a connection between

- the role of currency and
- feasible taxation
Model based on Cavalcanti-Wallace 1999:

- an above-ground economy (perfectly monitored)
- an underground economy (anonymous)
- heterogeneous one-time costs of becoming monitored

For some examples,

- compute optimum (max ex ante representative-agent welfare)
- examine interest rate paid on currency at the optimum
The environment

- discrete time

- measure of infinitely-lived people with discounted (at rate $\beta$) utility preferences

- period utility is $u(x) - c(y)$

- production is perishable
Monitoring

Initial and permanent split of people into two groups

- $m$ people: perfectly monitored

- $n$ people: anonymous, not monitored at all, can hide money

- people publicly choose $m$ or $n$ status after receiving a private and independent draw from a distribution of
  
  - additively separable one-time utility cost of becoming $m$
  
  - the distribution is the realized cross-section distribution of costs
Meetings and money

Two stages at each date

- Stage 1: production and consumption in pairwise meetings at random with no double-coincidences ($1/K$ is prob of being producer and is prob of being consumer, $K \geq 2$)

- Stage 2: transfers of money

Outside money

- individual money holdings in $\{0, 1\}$

- money disintegrates at rate $\xi \in [0, 1]$
Optimal allocations

Allocations (initial distributions, trades, transfers) that maximize ex ante welfare subject to symmetry, stationarity, truth-telling, and no defection

Defections:

- individual and cooperative defections in stage 1 meetings

- individual defection at stage 2

Punishment: an $m$ agent $\rightarrow n$ agent
Extreme cases and the choice of $\beta$

First-best: $y^* = \arg \max[u(y) - c(y)]$

Everyone is $m$: first-best is implementable if

$$\frac{u(y^*)}{c(y^*)} \geq 1 + \frac{K(1 - \beta)}{\beta}. \quad (1)$$

Everyone is $n$: relevant constraint is

$$\frac{u(y)}{c(y)} \geq 1 + \frac{K(1 - \beta)}{1 - \theta}. \quad (2)$$

$\beta \in [\beta^*, \bar{\beta}]$, where

- $\beta = \beta^* \iff (1)$ at equality

- $\beta = \bar{\beta} \iff (2)$ at equality when $y = y^*$ and $\theta = 1/2$
Rate of return on money for $n$ people ($R$)

For consumer types $s \in \{(n, 1), (m, 1)\}$, let

$$R(s) = \frac{\text{expected discounted goods obtained}}{\text{output produced by } (n, 0) \text{ for consumer } s}$$

$R$ = average over $s$ (Friedman rule: $R = 1$)

$R$ is affected by

- the distribution of money
- trades between $n$ people and $m$ people
- disintegration rate
Examples

\[ u(y) = 1 - e^{-10y}, \quad c(y) = y, \quad K = 3 \]

Implies \( u'(0) = 10 \),

\[ y^* = \frac{\ln(10)}{10} \approx 0.23 \]

and

\[
\beta^* = \frac{1}{1 + \frac{(9/\ln 10)-1}{3}} \approx 0.5077
\]

\[
\bar{\beta} = \frac{1}{1 + \frac{(9/\ln 10)-1}{6}} \approx 0.6735.
\]
Lower-bound benchmark: everyone (treated as) $n$

<table>
<thead>
<tr>
<th>$\beta$</th>
<th>$\theta^{(n,1)}$</th>
<th>$y/y^*$</th>
<th>$\lambda$</th>
<th>$R_0$</th>
<th>$W_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta^*$</td>
<td>0.38</td>
<td>0.55</td>
<td>1</td>
<td>0.18</td>
<td>0.09</td>
</tr>
<tr>
<td>$\frac{\beta^*+\beta}{2}$</td>
<td>0.45</td>
<td>0.76</td>
<td>1</td>
<td>0.21</td>
<td>0.13</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.51</td>
<td>1.00</td>
<td>1</td>
<td>0.26</td>
<td>0.17</td>
</tr>
</tbody>
</table>
Exogenous fraction who are monitored

\[ \frac{R}{R_0} \] when fraction of \( m \) is \( \alpha \)

<table>
<thead>
<tr>
<th>( \beta ) ( \backslash ) ( \alpha )</th>
<th>1/4</th>
<th>1/2</th>
<th>3/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta^* )</td>
<td>0.84</td>
<td>0.81</td>
<td>undefined</td>
</tr>
<tr>
<td>( \frac{\beta^* + \beta}{2} )</td>
<td>0.91</td>
<td>0.88</td>
<td>undefined</td>
</tr>
<tr>
<td>( \beta )</td>
<td>0.95</td>
<td>0.95</td>
<td>1.04</td>
</tr>
</tbody>
</table>
Details for $\beta = \beta^* + \bar{\beta}$ and $\alpha = 1/4$

<table>
<thead>
<tr>
<th>$W/W_0$</th>
<th>$E_{\nu^m}/W_0$</th>
<th>$E_{\nu^n}/W_0$</th>
<th>$\theta^{(m1)}$</th>
<th>$\theta^{(n0)}$</th>
<th>$\theta^{(n1)}$</th>
<th>$\xi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.43</td>
<td>3.20</td>
<td>0.87</td>
<td>1/4</td>
<td>0.57</td>
<td>0.18</td>
<td>0.16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>stage-1 meeting</th>
<th>$y/y^*$</th>
<th>$\lambda$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n0)(n1)$^*$</td>
<td>0.573</td>
<td>1</td>
</tr>
<tr>
<td>(n0)(m1)$^*$</td>
<td>0.573</td>
<td>1</td>
</tr>
<tr>
<td>(m1)(n0)</td>
<td>0.113</td>
<td>-</td>
</tr>
<tr>
<td>(m1)(n1)$^\dagger$</td>
<td>0.381</td>
<td>1</td>
</tr>
<tr>
<td>(m1)(m1)$^*$</td>
<td>0.381</td>
<td>-</td>
</tr>
</tbody>
</table>
Endogenous choice of $m$ status

Aggregate features: $\beta = \frac{\beta^* + \tilde{\beta}}{2}$, $F = F(1/4, \mu)(x)$

<table>
<thead>
<tr>
<th>$\mu$</th>
<th>$W/W_0$</th>
<th>$E\psi^m/W_0$</th>
<th>$E\psi^n/W_0$</th>
<th>$\theta^{(m1)}$</th>
<th>$\theta^{(n0)}$</th>
<th>$R/R_0$</th>
<th>$\xi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.43</td>
<td>3.20</td>
<td>0.83</td>
<td>0.250</td>
<td>0.574</td>
<td>0.909</td>
<td>0.159</td>
</tr>
<tr>
<td>.2</td>
<td>1.35</td>
<td>3.16</td>
<td>0.85</td>
<td>0.249</td>
<td>0.574</td>
<td>0.909</td>
<td>0.156</td>
</tr>
<tr>
<td>.4</td>
<td>1.28</td>
<td>3.12</td>
<td>0.86</td>
<td>0.244</td>
<td>0.575</td>
<td>0.911</td>
<td>0.151</td>
</tr>
<tr>
<td>.6</td>
<td>1.21</td>
<td>3.06</td>
<td>0.88</td>
<td>0.235</td>
<td>0.579</td>
<td>0.915</td>
<td>0.143</td>
</tr>
</tbody>
</table>
Concluding remarks

Most studies omit the restrictions for feasible policies implied by the frictions that give money a role.

The omission is important. Why, for example, estimate US welfare costs of inflation ignoring:

- half of U.S. currency is held abroad
- currency heavily used in illegal activity
- explicit policy goal is to inhibit the use of currency

This paper: even with benign underground economy, an optimum does not always use feasible taxation to raise the return on currency.