Fiscal Policy with Heterogeneous Agents and Incomplete Markets

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Review of Economic Studies, 2005

Discussion by: Axelle Ferriere

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Motivation

- **Ricardian Equivalence**: with lump-sum taxes, perfect capital markets and dynastic households, changes in the timing of taxes should not affect households’ optimal consumption decisions.

- What generates significant deviations from the Ricardian Equivalence result?

- Various alternative models featuring:
  - Distortionary taxes
  - Asset market imperfection
  - Imperfect intergenerational altruism
Empirical Evidence

Testing the Ricardian Equivalence:

- Natural experiments (1968 surtax, 1975 rebate):
  - Modigliani and Steindal (1977): **MPC between 0.3 and 0.58** (1975 rebate)
  - Blinder (1981): **MPC of 0.16** (1968 surtax and 1975 rebate)

- Studies based on micro data (CEX):
  - Souleles (2002): **MPC between 0.6 and 0.9** (pre-announced Reagan tax cuts, non-durable)
  - Parker (1999): **MPC of 0.2** (predictable changes in social security tax withholding)
Benchmark: The Bewley Model with Distortionary Taxes

A continuum of households:
- Bond economy, borrowing constraint
- Idiosyncratic shock on productivity $e_t$ (first-order Markov process)
  - $\mu_t(e^t)$ the probability of individual history $e^t = (e_0, ..., e_t)$

A representative firm

The government finances constant spendings $G$ using:
- One-period bond
- Income taxes follow a stochastic process (aggregate shock)
  - $\nu_t(\tau^t)$ the probability of history $\tau^t = (\tau_0, ..., \tau_t)$

Initial state of the economy: $z_0 = (m, B_{-1})$, with $m$ the initial distribution of agents over assets and productivity
Households

Maximization Problem

Households choose decision functions \( \{ n_t(e^t, \tau^t) \}_{t=0}^{\infty} \), \( \{ c_t(e^t, \tau^t) \}_{t=0}^{\infty} \), \( \{ a_t(e^t, \tau^t) \}_{t=0}^{\infty} \) to maximize:

\[
E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\gamma} \left[ \left( c_t - \psi \frac{n_t^{1+1/\epsilon}}{1+1/\epsilon} \right)^{1-\gamma} - 1 \right]
\]

s. t.

\[
c_t + a_t = [1 + (1 - \tau_t) r_t] a_{t-1} + (1 - \tau_t) w_t n_t \ \forall e^t \ \forall \tau^t \ \forall t
\]

\[
a_t \geq 0
\]

Initial wealth \( a_{-1} \), prices, taxes and probability measures, are taken as given.

Labor Supply

\[
n_t(\tau^t, e^t) = \left[ \frac{w_t(\tau^t) e_t(1 - \tau_t)}{\psi} \right]^\epsilon
\]
A standard Cobb-Douglas production function:

\[ Y_t(\tau^t) = K_{t-1}(\tau^{t-1})^\alpha N_t(\tau^t)^{1-\alpha} \]

Static maximization:

\[ r_t(\tau^t) = \alpha K_{t-1}(\tau^{t-1})^{\alpha-1} N_t(\tau^t)^{1-\alpha} - \delta \]

\[ w_t(\tau^t) = (1 - \alpha) K_{t-1}(\tau^{t-1})^\alpha N_t(\tau^t)^{-\alpha} \]

Feasibility:

\[ C_t(\tau^t) + G + K_t(\tau^t) = K_{t-1}(\tau^{t-1})^\alpha N_t(\tau^t)^{1-\alpha} + (1 - \delta) K_{t-1}(\tau^{t-1}) \]
Government

\[ G_t(\tau^t) = G \] and \( B_{-1} \) is given. Then, \( \forall t \forall \tau^t: \)

\[ B_t = G + (1 + r_t)B_{t-1} - \tau_t[r_tA_{t-1} + w_tN_t] \]

**Process for taxes:**

- **Assumption:** \( B_t(\tau^t) \in D \)
- **Taxes follow a Markov process:** \( B_{-1} \in D \Rightarrow B_t(\tau^t) \in D \forall \tau^t \)

<table>
<thead>
<tr>
<th>( B )</th>
<th>( D \geq B &gt; 0 )</th>
<th>( B = 0 )</th>
<th>( B = 0 \leq B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \pi_t((\tau_h, B), \tau_h) )</td>
<td>0</td>
<td>( \frac{B-D}{D-D}^\lambda )</td>
<td>1</td>
</tr>
<tr>
<td>( \pi_t((\tau_l, B), \tau_l) )</td>
<td>1</td>
<td>( \frac{D-B}{D-D}^\lambda )</td>
<td>0</td>
</tr>
</tbody>
</table>
An equilibrium is a set of policy functions of the households $c_t$, $n_t$, $a_t$, government debt $B_t$, aggregate variables $A_t$, $K_t$ and $N_t$, prices $w_t$ and $r_t$, taxes $\tau_t$, individual productivity shock $e_t$, probability measure $\mu^t$ and $\nu^t$, and an initial state $z_0$ such that $\forall \tau_t \forall e^t \forall t$:

1. $a_t, c_t, n_t$ solve the households’ maximization problem
2. $\{\mu^t\}$ and $\{\nu^t\}$ are consistent with the stochastic process for productivity and taxes
3. Aggregate quantities $A_t$, $C_t$, $N_t$ are consistent with individual decision rules
4. The market for savings clears:
   \[ K_t(\tau^t) + B_t(\tau^t) = A_t(\tau^t) \] (1)
5. Given prices, $N_t$ and $K_t$ are consistent with firm’s policy functions
6. Goods market clear
7. The government budget constraint is satisfied
Calibration & Algorithm

Calibration

TABLE 1
Parameter values and simulation targets common across economies

<table>
<thead>
<tr>
<th>Parameters set outside the model</th>
<th>Preferences</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferences</td>
<td>$\beta$ 0.96</td>
<td>$\alpha$ 0.36</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>1.0</td>
<td>$\delta$ 0.10</td>
</tr>
<tr>
<td>$\epsilon$</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

Simulation targets*

<table>
<thead>
<tr>
<th>Wealth distribution</th>
<th>Debt/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Gini</td>
<td>Mean</td>
</tr>
<tr>
<td>Mean wealth poorest 40%</td>
<td>0.78</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.35%</td>
</tr>
<tr>
<td>Autocorrelation</td>
<td>0.51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Log household productivity</th>
<th>Tax revenue/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.51</td>
</tr>
<tr>
<td>Autocorrelation</td>
<td>0.35%</td>
</tr>
</tbody>
</table>

*These target values apply to a 10,000 period simulation. In the complete-markets and overlapping-generations economies, household productivity is constant and the wealth distribution targets do not apply.

Algorithm: Krusell and Smith (1998)
Propensity to Consume out of Tax (when tax switch from high to low):

\[ \text{PCT} = 100 \times \frac{C_t - C_{t-1}}{T_t - T_{t-1}} \]

- **Imperfect asset market**: incomplete market with borrowing constraint (lump-sum taxes, infinitely-lived agents)
- **Distortionary taxes** (complete market, infinitely-lived agents)
- **OLG** (complete market, lump-sum taxes)
Incomplete Markets

Budget constraint with **lump-sum taxes**, \( \forall t, \forall \tau^t, \forall e^t \):

\[
    c_t + a_t = (1 + r_t)a_{t+1} + w_te_t n_t - \tau_t
\]

Two exercises:

- **Fixed prices/open economy**: constant interest rate \( r^* \) (implies constant \( (K/N)^*, w^*, N^*, K^*, Y^* \)). The feasibility constraint is now:

\[
    C_t(\tau^t) + X_t(\tau^t) + I + G = Y
\]

- **Closed economy**.
## Incomplete Markets (Lump-Sum, Infinitely-Lived Agents)

### Percentage Change on Impact Tax rev

<table>
<thead>
<tr>
<th>Model</th>
<th>Hours</th>
<th>GDP</th>
<th>C</th>
<th>I</th>
<th>(\frac{100 \times (C_t - C_{t-1})}{T_t - T_{t-1}})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Open Economy</strong></td>
<td>0.0</td>
<td>0.0</td>
<td><strong>0.40</strong></td>
<td>0.0</td>
<td>-14.9</td>
</tr>
<tr>
<td><strong>Closed Economy</strong></td>
<td>0.00</td>
<td>0.02</td>
<td><strong>0.30</strong></td>
<td>-0.66</td>
<td>-11.4</td>
</tr>
</tbody>
</table>

### Consumption sensitivity to the tax rate:

\[
\frac{C_i,\tau_h - C_i,\tau_l}{T_i,\tau_h - T_i,\tau_l}
\]

### (Wealth, Productivity) Sensitivity

<table>
<thead>
<tr>
<th>Model</th>
<th>e₁</th>
<th>e₂</th>
<th>e₃</th>
<th>(Wealth, Productivity)</th>
<th>e₁</th>
<th>e₂</th>
<th>e₃</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zero</strong></td>
<td>-1.00</td>
<td>-0.43</td>
<td>-0.03</td>
<td>Zero</td>
<td>-1.00</td>
<td>-0.40</td>
<td><strong>0.08</strong></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>-0.40</td>
<td>-0.21</td>
<td>-0.03</td>
<td>Median</td>
<td>-0.38</td>
<td>-0.18</td>
<td><strong>0.08</strong></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>-0.05</td>
<td>-0.03</td>
<td><strong>0.01</strong></td>
<td>Mean</td>
<td>-0.02</td>
<td><strong>0.03</strong></td>
<td>0.12</td>
</tr>
</tbody>
</table>
# Distortionary Taxes

*(Complete Markets, Infinitely-lived agents)*

<table>
<thead>
<tr>
<th>Percentage Change on Impact</th>
<th>Tax rev.</th>
<th>Hours</th>
<th>GDP</th>
<th>C</th>
<th>I</th>
<th>PCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-6.39</td>
<td>0.91</td>
<td>0.57</td>
<td>0.71</td>
<td>0.80</td>
<td>-23.2</td>
</tr>
</tbody>
</table>
OLG Model

### OLG (Lump-Sum Taxes, Complete Markets) - Fixed Prices

<table>
<thead>
<tr>
<th>Percentage Change on Impact Tax rev</th>
<th>PCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax rev.</td>
<td>Hours</td>
</tr>
<tr>
<td>-7.19</td>
<td>0.0</td>
</tr>
</tbody>
</table>

- Endogenizing prices would reduce the consumption response.
Distortionary Taxes & Incomplete Markets

### Results

<table>
<thead>
<tr>
<th>Tax rev.</th>
<th>Hours</th>
<th>GDP</th>
<th>C</th>
<th>I</th>
<th>(\frac{100 \times (C_t - C_{t-1})}{T_t - T_{t-1}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6.24</td>
<td>0.97</td>
<td>0.62</td>
<td><strong>0.92</strong></td>
<td>0.56</td>
<td><strong>-28.8</strong></td>
</tr>
</tbody>
</table>

**Consumption sensitivity to the tax rate:**

\[ \frac{C_{i,\tau_h} - C_{i,\tau_l}}{T_{i,\tau_h} - T_{i,\tau_l}} \]

<table>
<thead>
<tr>
<th>(Wealth,Productivity)</th>
<th>(e_1)</th>
<th>(e_2)</th>
<th>(e_3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>-1.28</td>
<td>-0.58</td>
<td>-0.36</td>
</tr>
<tr>
<td>Median</td>
<td>-0.51</td>
<td>-0.40</td>
<td>-0.36</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.01</td>
<td>-0.21</td>
<td>-0.34</td>
</tr>
</tbody>
</table>
Conclusion

- Income taxes and Incomplete Markets/Borrowing Constraint are both significant
- Wide variation in the response at the household level