Liquidity Constraints and Tax Policy in Small Open Economies

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15th Annual Conference on Computing in Economics and Finance
University of Technology Sydney
15 July – 17 July, 2009
Aim of the Paper

- Study scope of stabilizing tax policy under occasionally binding financial constraints.
  - Small open economy with liquidity constraints on consumers.
  - Limit on aggregate current account deficit.
  - Volatile and procyclical consumption spending.

- Fiscal policy predictions altered by financial frictions.
  - How to manage adverse shocks?
  - Gains from cyclical income tax policy?
  - Do gains from easing financial constraints offset tax distortions?
Previous Work and Contribution

- García-Cicco/Pancrazi/Uribe (07), Arellano/Mendoza (02), Barro (79), Stokey/Lucas (83), Kim/Kim (05), Benigno et al. (09)
  - Business cycles in emerging market economies.
  - Poor performance of neoclassical growth model.
  - Debt constraints harmless, unless always binding.
  - Tax smoothing over time/states in frictionless environment.
  - Gains from cyclical taxes limited, current account as buffer.
  - Tax policy intervention (costless) to support real exchange rate.

- Contribution...
  - Occasionally binding constraint in medium-scale model.
  - Computational issues addressed by penalty function approach.
  - Improvement of model fit through liquidity constraint.
  - Policy intervention not costless per se, distortionary taxes.
Basic Model

- Small open economy RBC model (Mendoza, 91).
  - Capital, labor, total factor productivity shock.
  - Incomplete asset markets, i.e. risk-free debt and constant $r$.
  - Perfectly competitive firms.

- Two distortions...
  - Flat-rate tax on labor income.
  - Consumer liquidity constraint.
Consumer Liquidity Constraint

- Foreign investors monitor build-up of debt (Valderrama, 02).
  - Finance fraction $\omega$ of expenditures, investment, tax and interest payments out of factor income (cash-flow criterion).
  - Limit on current account deficit in equilibrium.

$$d_t - d_{t-1} \leq \frac{1 - \omega}{\omega} (w_t n_t + r^k_t k_{t-1}) \equiv \kappa y_t, \quad \kappa \in (0, \infty).$$

- Past crises at various levels of debt, CA deficit matters.

- Distorted optimality conditions (shadow price of constraint $\mu_t$).

Debt: \[ U_c(t) - \mu_t = \beta E_t [(1 + r) U_c(t + 1) - \mu_{t+1}], \]

Labor: \[-U_n(t) = U_c(t)(1 - \tau^n_t) w_t + \mu_t \kappa w_t, \]

Capital: \[ U_c(t)[1 + \Phi'(t)] = \beta E_t \{ U_c(t + 1)[1 - \delta + r^k_{t+1} + \Phi'(t + 1)] + \mu_{t+1} \kappa r^k_{t+1} \}. \]
Fiscal Policy

- Focus on stabilization and substitution effects of tax policy, i.e. deviation from tax smoothing advice.
- Exogenous spending and debt policy thus irrelevant.
- Government budget constraint (compensated changes)
  \[ \tau_t = \tau^n_t w_t n_t \]  
  (lump-sum transfers) \( (\text{tax revenues}) \).

- Simple state-contingent policy rule (Kim/Kim, 05)
  \[ \tau^n_t = \bar{\tau}^n + \tau^a (a_t - \bar{a}) \]
  
  ▶ Choose parameter \( \tau^a \in [-1, 1] \) to maximize social welfare.
  ▶ Tax smoothing if \( \tau^a = 0 \).
Numerical Solution

- Second-order perturbation for computational feasibility.
- Penalty function in consumer’s objective.

\[ P(d_t, n_t, d_{t-1}, k_{t-1}) = \frac{\eta_1}{\eta_0} \exp[-\eta_0(\kappa(w_t n_t + r_t^k k_{t-1}) - (d_t - d_{t-1}))] \]

\[ -\eta_2(d_t - d_{t-1}) + \eta_3 n_t + \eta_4 k_{t-1} - \eta_5, \]

- Infinite penalty if liquidity constraint violated for \( \eta_0 \to \infty \), modified problem then equivalent to original one.
- Derivatives of \( P \) replace shadow prices \( \mu \) in FOCs.
- Terms \( \eta_i, i = 2, 3, 4, 5 \), for non-distorted steady state.

Application to Argentine data 93–07.

- Crisis 99–02: restrictions on current account borrowing.
- Calibrate deep structural parameters, vary limit \( \kappa \).
Impulse Responses Constant Tax, $\kappa \in \{\infty, 20\%, 5\\%\}$

Blue: $\kappa \to \infty$; green: $\kappa = 20\%$; purple: $\kappa = 5\%$.
## Impact of Constraint

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>$\kappa \to \infty$</th>
<th>$\kappa = 20%$</th>
<th>$\kappa = 5%$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Std. deviations relative to output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>1.16</td>
<td>0.20</td>
<td>0.30</td>
<td>0.42</td>
</tr>
<tr>
<td>Hours worked</td>
<td>0.40</td>
<td>0.76</td>
<td>0.69</td>
<td>0.61</td>
</tr>
<tr>
<td>Investment</td>
<td>2.78</td>
<td>0.91</td>
<td>2.16</td>
<td>2.86</td>
</tr>
<tr>
<td><strong>Correlations with output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>0.99</td>
<td>0.32</td>
<td>0.49</td>
<td>0.69</td>
</tr>
<tr>
<td>Hours worked</td>
<td>0.80</td>
<td>0.98</td>
<td>0.95</td>
<td>0.91</td>
</tr>
<tr>
<td>Investment</td>
<td>0.99</td>
<td>0.59</td>
<td>0.84</td>
<td>0.90</td>
</tr>
<tr>
<td>Current account / GDP</td>
<td>-0.64</td>
<td>0.92</td>
<td>0.83</td>
<td>0.76</td>
</tr>
<tr>
<td>Trade balance / GDP</td>
<td>-0.70</td>
<td>0.99</td>
<td>0.88</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Impulse Responses State-Contingent Tax, $\kappa = 5\%$

Blue: $\tau^a = 0$; green: $\tau^a = 1$; purple: $\tau^a = -1$. 
Welfare under alternative policies/borrowing limits.

\[ V_0 \equiv E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, 1 - n_t) \]

2\textsuperscript{nd}-order approximation of \( V_0 \) at point where
- Endogenous state variables take steady state values.
- TFP shock one std. deviation below unconditional mean.

Liquidity constraints relevant due to adverse shock.

Should government cut taxes or keep them fixed?
Optimal Cyclical Policy (2)

Tax feedback coefficient $\tau^a$

Conditional welfare $V_0$

Counter-cyclical taxes

Pro-cyclical taxes

Tax smoothing

$\kappa \to \infty$

$\kappa = 20\%$

$\kappa = 5\%$
Additional Results and Sensitivity

- Welfare gains in consumption units $\chi = \left( \frac{V_0^S}{V_0^C} \right)^{\frac{1}{\theta(1-\sigma)}} - 1$.
- Policy rule with lagged productivity $\tau^n_t = \bar{\tau}^n + \tau^a (a_{t-1} - \bar{a})$.
- Modified objective $W_O \equiv E_0 \sum_{t=0}^{\infty} \beta^t [U(\cdot) - P(\cdot)]$.
- Size of initial shock $|\varepsilon|/\sigma_\varepsilon \times 100$.
- Effectiveness of penalty function.
- Higher curvature $\eta_0$ of penalty function.
- Lower curvature $\eta_0$ of penalty function.
Lagged-Productivity Rule

\[ W_0 = -22.994 \]

Tax feedback coefficient \( \tau^a \) vs. Conditional welfare \( W_0 \)

- \( \kappa = 5\% \)
- \( \kappa = 20\% \)
- \( \kappa \to \infty \)

Counter-cyclical taxes

Tax smoothing

Pro-cyclical taxes
Modified Objective

The graph illustrates the conditional welfare $W_0$ as a function of the tax feedback coefficient $\tau^a$. Two cases are considered: $\kappa = 20\%$ and $\kappa = 5\%$. The graph shows how the welfare changes as the tax smoothing coefficient $\kappa$ approaches infinity for both pro-cyclical and counter-cyclical taxes.

Key points:
- $\kappa \to \infty$
- $\kappa = 20\%$
- $\kappa = 5\%$
- Counter-cyclical taxes
- Tax smoothing
- Pro-cyclical taxes

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Welfare Gains (% Permanent Consumption)

\[ \chi(\text{percent}) \]

- Tax feedback coefficient \( \tau \)
- Pro-cyclical taxes
- Counter-cyclical taxes
- Tax smoothing
- Pro-cyclical taxes

\[ \kappa = 5\% \]
\[ \kappa = 20\% \]
\[ \kappa \to \infty \]
Effectiveness of Penalty Function

- $\eta_0 = 10, \kappa \to \infty$
- $\eta_0 = 10, \kappa = 20\%$
- $\eta_0 = 10, \kappa = 5\%$
- $\eta_0 = 50, \kappa \to \infty$
- $\eta_0 = 50, \kappa = 20\%$
- $\eta_0 = 50, \kappa = 5\%$
- $\eta_0 = 100, \kappa \to \infty$
- $\eta_0 = 100, \kappa = 20\%$
- $\eta_0 = 100, \kappa = 5\%$
Badness of Shock

![Graph showing the relationship between Badness of shock in percent of $\sigma_\epsilon$ and Optimal feedback coefficient $\tau^a$. The graph includes points labeled 'Benchmark', 'Normal times', and 'Crisis times'.]
Lower Curvature

Conditional welfare $W_0$

Tax feedback coefficient $\tau$

Counter-cyclical taxes

Pro-cyclical taxes

Tax smoothing

$\kappa \rightarrow \infty$

$\kappa = 5\%$

$\kappa = 20\%$

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Higher Curvature

High curvature model

\[ \kappa \to \infty \]

\[ \kappa = 20\% \]

\[ \kappa = 5\% \]

Conditional welfare \( W_0 \)

Tax feedback coefficient \( \tau^a \)

Counter-cyclical taxes

Tax smoothing

Pro-cyclical taxes
## Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>Coefficient of relative risk aversion</td>
<td>2</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Consumption share parameter</td>
<td>0.26</td>
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<tr>
<td>$\alpha$</td>
<td>Share of capital in output</td>
<td>0.32</td>
</tr>
<tr>
<td>$r$</td>
<td>World real interest rate</td>
<td>0.085</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.125</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Adjustment cost parameter</td>
<td>0.42</td>
</tr>
<tr>
<td>$\sigma_\varepsilon$</td>
<td>Standard deviation of productivity innovations</td>
<td>0.021</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Persistence of productivity shocks</td>
<td>0.18</td>
</tr>
<tr>
<td>$\bar{d}/\bar{y}$</td>
<td>Average debt-to-GDP ratio</td>
<td>0.235</td>
</tr>
<tr>
<td>$\tau^n$</td>
<td>Average labor income tax</td>
<td>0.14</td>
</tr>
<tr>
<td>$\omega$</td>
<td>Liquidity requirement</td>
<td>0.95</td>
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<tr>
<td>$\kappa$</td>
<td>Current account borrowing limit</td>
<td>0.05</td>
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<tr>
<td>$\eta_0$</td>
<td>Curvature of penalty function</td>
<td>50</td>
</tr>
<tr>
<td>$\eta_1$</td>
<td>Shape of penalty function</td>
<td>0.51</td>
</tr>
</tbody>
</table>
Summary

- Liquidity constraints improve fit of neoclassical model.
- Labor tax smoothing sub-optimal with financial frictions.
- Cyclical tax policy can generate stabilization gains.
  - Gains from cyclical tax policy outweigh tax distortions.
  - Cut taxes in low-productivity states and vice versa.
  - Raises employment, investment, and output in bad states, eases liquidity constraints, smoothens out consumption.