Cyclical Government Spending Rules,
Income Inequality and Welfare
in Small Open Economies

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1 Introduction

• motivated by an empirical observation which appears, on the surface, to be counter-intuitive, namely the evidence of pro-cyclical fiscal behavior noted in a variety of studies

• stronger case can be made for counter-cyclical government spending behavior

• aim of the paper is to examine whether a case can be made to support pro-cyclical fiscal policy, especially for small open economies - importance of global shocks

• paper assesses the implications of cyclical fiscal spending policy for the case of a productivity shock, a domestic interest rate shock as well as for the case of external shocks coming from export demand and the terms of trade
we examine the cyclicality of government spending, but we embed the dynamics of income distribution across agents into a standard stochastic dynamic general equilibrium aggregate open-economy model - use Gorman preferences

three sets of simulated results

- impulse response paths of the aggregate variables, as well as the distribution of welfare for both pro- and counter-cyclical government spending under alternative shock scenarios

- compares the behavior of the simple fiscal rules with the Ramsay rules for alternative shocks to see how well simple rules approximate the more complex Ramsey rule targeted at maximizing welfare

- compare the effects of pro- and counter-cyclical government spending on welfare as well as on income distribution - focus on income inequality is particularly important for fiscal policy, because changes in fiscal policy have distributional implications
2 A Small Open-Economy Model

2.1 Households - Consumption and Labour

• The economy has $H$ heterogenous agents and each agent has one unit of time which is divided between work $L^i$ and leisure $l^i$:

$$L^i + l^i = 1$$

• agents have different initial endowments, but their utility functions are Gorman functions which imply that the entire group may be modelled as a single, representative agent at the macro-aggregate level:

$$U(C_t^i, l_t^i) = \frac{1}{\eta} \left( C_t^i \right)^\eta \left( l_t^i \right)^{-\omega \eta}$$

• each economic agent receives dividends, wage payments, pays income taxes, saves in the form of bank deposits. Each agent chooses consumption, labor, and deposits to maximize utility subject to the budget constraint.
• Euler equations:

\[
\omega C_t = (1 - \tau) \frac{W_t}{P_t} l_t \\
\left[ \frac{(C_t)^{\eta-1} (l_t)^{\eta \gamma}}{P_t} \right] = \beta \left[ \frac{(C_{t+1})^{\eta-1} (l_{t+1})^{\eta \omega}}{P_{t+1}} \right](1 + R_t^m)
\]

• agent consumes domestically produced goods \( C_t \) which is a composite of non-traded home goods \( C_t^h \) and internationally exported goods \( C_t^x \):

\[
C_t = \left[ (1 - \gamma) \frac{1}{\theta} (C_t^h)^{\frac{\theta-1}{\theta}} + (\gamma) \frac{1}{\theta} (C_t^x)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}
\]

\[
C_t^h = (1 - \gamma) \left( \frac{P_t^h}{P_t} \right)^{-\theta} C_t
\]

\[
C_t^x = \gamma \left( \frac{P_t^x}{P_t} \right)^{-\theta} C_t
\]
2.2 Production and Pricing

- contains two production sectors

  - a tradeable goods sector which draws on natural resources and produces goods for domestic and foreign consumption

    \[ Y_t^x = C_t^x + X_t = Z^x (L_t^x)^{\alpha^x} \]

    \[ \ln(X_t) = \rho^x \ln(X_{t-1}) + (1 - \rho^x) \ln(X) + \epsilon_t^x \]
    \[ \epsilon^x \sim N(0, \sigma^x) \]

  - a non-tradeable goods sector which imports intermediate goods and combines them with labour to produce goods for domestic private and public consumption

    \[ Y_t^h = C_t^h + G_t = Z_t^h \left[ \left(1 - \alpha^h\right) \left(\frac{L_t^h}{\kappa}\right)^{-\kappa} + \alpha^h \left(\frac{K_t}{\kappa}\right)^{-\kappa} \right]^{-\frac{1}{\kappa}} \]

    \[ \ln(Z_t^h) = \rho^z \ln(Z_{t-1}^h) + (1 - \rho^z) \ln(Z) + \epsilon_t^z \]
    \[ \epsilon^z \sim N(0, \sigma^z) \]
• Price determination

- prices in the tradeable goods sector are determined globally

\[
\ln(P_t^{x*}) = \rho^p \ln(P_{t-1}^{x*}) + (1 - \rho^p) \ln(\overline{P^{x*}}) + \epsilon_t^p
\]

\[
\epsilon_t^p \sim N(0, \sigma^p)
\]

- prices in the non-tradeable goods sector follow typical Calvo-pricing rules

\[
P_t^h = \left[ \xi (P_{t-1}^h)^{1-\zeta} + (1 - \xi) (P_t^o)^{1-\zeta} \right]^{\frac{1}{1-\zeta}}
\]

\[
P_t^o = \frac{A_t^{num}}{A_t^{den}} = \frac{Y_t^h (P_t^h)^{\zeta} A_t + \beta \xi A_t^{num}}{Y_t^h (P_t^h)^{\zeta} + \beta \xi A_t^{den}}
\]

\[
A_t = \left[ \frac{(1+R_t^n)W_t}{(1-\alpha)(Z_t^h)^{-\kappa} \left( \frac{Y_t^h}{L_t^h} \right)^{1+\kappa}} \right] + \frac{SP_{t}^{m*}}{\alpha(Z_t^h)^{-\kappa} \left( \frac{Y_t^h}{K_t} \right)^{1+\kappa}}
\]
2.3 Financial Sector

• accepts deposits from households, borrows internationally, and lends to the government and to domestic firms

\[(1 + \Phi_t^n)(1 + R_t) = (1 + R_t^n)\]

\[(1 - \Phi_t^m)(1 + R_t) = (1 + R_t^m)\]

\[(1 + R_t)S_t = (1 + R_t^* + \Phi_t^s)S_{t+1}\]

\[
\Phi_t^m = \overline{\Phi}^m + \varphi^m(M_{t-1} - \overline{M})
\]

\[
\Phi_t^n = \overline{\Phi}^n + \varphi^n(N_{t-1} - \overline{N})
\]

\[
\Phi_t^s = \overline{\Phi}^s + \varphi^s(F_{t-1} - \overline{F})
\]

\[
S_tF_t = [1 + R_{t-1}^* + \Phi_{t-1}]S_tF_{t-1} + S_tP_t^*K_t - P_t^xC_t^*
\]
2.4 Fiscal and Monetary Policies

- Monetary authority sets interest rate using a simple linear Taylor rule - inflation targeting

\[
R_t = \rho^r R_{t-1} + (1 - \rho^r) \left[ \bar{R}_t + \rho^\pi (\pi_t - \bar{\pi}) \right] + \epsilon_t^r \\
\epsilon_t^r \sim N(0, \sigma^r)
\]

- Treasury receives taxes and borrows to finance government expenditure

\[
B_t = (1 + R_{t-1}) B_{t-1} + P^h_t G_t - \tau W_t L_t + Q_t \\
Q_t = (1 + R^m_{t-1}) N_{t-1} - N_t (1 + \Phi^m_t + R^m_t) - \Phi^m_t M_t
\]

where \( Q_t \) is the amount of liquidity injected by the authorities to support its monetary policy.

- Cyclical government spending

\[
G_t = \bar{G} + \phi^g (Y_{t-1} - \bar{Y}) \\
\phi^g > 0, \quad \text{pro-cyclical rule} \\
\phi^g < 0, \quad \text{counter-cyclical rule}
\]

\[
Y_t = P^h_t Y^h_t + P^x_t Y^x_t
\]
### 3 Parameter Definitions

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Definitions</th>
<th>Calibrated Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>discount factor</td>
<td>0.96</td>
</tr>
<tr>
<td>( \eta )</td>
<td>relative risk aversion</td>
<td>-1.5</td>
</tr>
<tr>
<td>( \omega )</td>
<td>labor supply elasticity</td>
<td>0.5</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>share in consumption</td>
<td>0.3</td>
</tr>
<tr>
<td>( \theta )</td>
<td>intratemporal substitution elasticity</td>
<td>1.5</td>
</tr>
<tr>
<td>( \varphi^m, \varphi^n, \varphi^s )</td>
<td>risk premium parameters</td>
<td>0.01</td>
</tr>
<tr>
<td>( \xi )</td>
<td>Calvo persistence coefficient</td>
<td>0.15</td>
</tr>
<tr>
<td>( \zeta )</td>
<td>substitution elasticity for differentiated goods</td>
<td>6</td>
</tr>
<tr>
<td>( \rho^z, \rho^x, \rho^p )</td>
<td>autoregressive terms for shock processes</td>
<td>0.9</td>
</tr>
<tr>
<td>( \sigma^z, \sigma^x, \sigma^p, \sigma^r )</td>
<td>standard deviation for shocks</td>
<td>0.01</td>
</tr>
<tr>
<td>( \phi^g )</td>
<td>government spending rule, pro (counter)</td>
<td>0.1 (-0.1)</td>
</tr>
<tr>
<td>( \tau )</td>
<td>tax rate</td>
<td>0.2</td>
</tr>
<tr>
<td>( \rho^r, \rho^\pi )</td>
<td>Taylor coefficients</td>
<td>0.9, 1.5</td>
</tr>
<tr>
<td>( \kappa )</td>
<td>CES substitution parameter in production</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

**Case when the non-tradeable sector employs a greater proportion of the labor force**

| \( \alpha^h \) | coefficient of capital in CES function | 0.15 |
| \( \alpha^x \) | coefficient of labour in PF of tradeables | 0.85 |

**Case when the non-tradeable sector employs a smaller proportion of the labor force**

| \( \alpha^h \) | coefficient of capital in CES function | 0.70 |
| \( \alpha^x \) | coefficient of labour in PF of tradeables | 0.30 |
4 Simulated Results

4.1 Impulse Responses

We first compare the pro- and counter-cyclical spending rules for the four shocks. The solid lines are the paths generated under the pro-cyclical spending rule while the dashed lines are the corresponding paths for the counter-cyclical spending rule.
4.1.1 Productivity Shock

Impulse responses following a shock to productivity: pro-cyclical government spending (solid line) and counter-cyclical government spending (dashed line)
4.1.2 Interest Rate Shock

Impulse responses following a shock to the monetary policy interest rate: pro-cyclical government spending (solid line) and counter-cyclical government spending (dashed line)
4.1.3 Export Demand Shock

Impulse responses following a shock to export demand: pro-cyclical government spending (solid line) and counter-cyclical government spending (dashed line)
4.1.4 Terms of Trade Shock

Impulse responses following a shock to the export price: pro-cyclical government spending (solid line) and counter-cyclical government spending (dashed line)
4.1.5 Welfare Distributions

Welfare Comparisons for Pro- and Counter-Cyclical Fiscal Spending under Different Shock Scenarios
4.2 Ramsey and Simple Cyclical Fiscal Rules

Impulse Response of Government Spending under Pro-cyclical (solid line), Counter-cyclical (dashed line) and Ramsay Rules (dotted line)
4.3 Income Distributions

Initial Endowments, Hours worked and Income

\[
AI = 1 - \frac{1}{\bar{y}} \left( \prod_{i=1}^{H} y_i \right)^{1/H}
\]

where \( y_i \) is individual income for \( i = 1, 2, \ldots H \), with \( H \) representing the population size, and \( \bar{y} \) is the mean income.

Deaton (1997) modified Gini coefficient, \( DG \):

\[
DG = \frac{H + 1}{H - 1} - \frac{1}{H(H - 1) \bar{y}} \sum_{i=1}^{H} p^i y_i
\]

where \( p^i \) is the income rank of person \( i \), with the richest person having a rank of 1 and the poorest person having a rank of \( H \).
Measures of Income Inequality under Pro-cyclical (solid line) and Counter-cyclical (dashed line) Fiscal Rules
4.3.1 When It Rains: Response to Multiple Shocks

Measures of Inequality: Case of Multiple Shocks under Pro-cyclical fiscal behaviour (solid line) and Counter-cyclical behaviour (dashed line)
4.3.2 High Capital Intensity in Non-traded Sector

Measures of Income Inequality when the Non-Traded Sector is Highly Capital Intensive with Pro-cyclical fiscal behaviour (solid line) and Counter-cyclical fiscal behaviour (dashed line)
5 Concluding Remarks

- paper compares the effects of pro and counter-cyclical government spending on income inequality and welfare in a small open economy

- used a calibrated dynamic stochastic general equilibrium model - heterogeneous agents with Gorman utility function

- simulated results show that the type of government spending rule makes negligible difference to welfare, in the face of domestic or external shocks (productivity, domestic interest rates, terms of trade and export demand)

- In other words, in terms of the typical welfare measure based on discounted utility, there does not appear to be any reason for favouring a pro- or a counter-cyclical government spending rule
• but, simulations show that pro-cyclical government spending reduces income inequality by more than counter-cyclical behavior across the range of shocks considered

• simulated results provide support for the observed pro-cyclical spending behavior of governments, especially in emerging market countries, where more of the total supply of labour is employed in the non-traded sector

• Ramsey rule may be pro or counter-cyclical, depending on the type of shock
  
  – productivity shock: a pro-cyclical rule corresponds closely with the Ramsay rule

  – export demand shock: a counter-cyclical rule corresponds closely with the Ramsay rule.

  – no simple fiscal rule which can approximate an optimal welfare-maximising rule when the shocks are associated with the rate of interest or with the terms of trade.
• results show the importance of studying the dynamics of distributions as well as aggregates in macro models

• extension of analysis to allow for government investment spending (such as public infrastructure) would give a fuller picture of the effects of cyclical fiscal spending on income inequality and welfare in small open economies