The Distributional Consequences of Government Spending

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Government provision of public goods: mechanism to redistribute wealth across society
Background

- Government provision of public goods: mechanism to redistribute wealth across society
- Massive increase in public infrastructure spending in countries like China and India to sustain growth rates of the last decade

What effect might these pro-growth policies have on the distributions of wealth, income, and welfare? This is an important policy question: Inequality has been rising in both OECD and non-OECD countries (Atkinson, 2003, Smeeding, 2002). Reducing inequality may be a social objective for the government (Anand and Segal, 2008).
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Objectives and Contributions

- Synthesizes two independent strands of research into a unified framework:

  - Growth-Inequality literature has not dealt with issues related to public investment and its financing.
  - Public investment-Growth literature has generally ignored distributional questions.
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Source of heterogeneity: initial distribution of private capital (wealth) (Atkinson 2003, Checchi and Garcia-Penalosa 2010)
The Analytical Framework

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  - a determinant of growth and distributional dynamics: affects relative factor returns
Firms (indexed by $j$) are all identical and use the following CES production technology

$$Y_j = A \left[ \alpha (X_P L_j)^{-\rho} + (1 - \alpha) K_j^{-\rho} \right]^{-1/\rho}$$
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- $K$ : aggregate stock of private capital-amalgam of physical and human capital, as in Romer (1986)
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- $s = 1/(1 + \rho)$: elasticity of substitution between private capital and "effective" labor in production
Since all firms are identical, the production function pins down the economy-wide average real wage and return on capital:

\[
w = \omega(z, l) K, \quad \omega(z, l) = \alpha A^{-\rho} \left[ \frac{y(z, l)}{1 - l} \right]^{1+\rho} z^{-\rho(1-\varepsilon)}
\]

\[
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- \( z = K_G / K \): economy-wide ratio of public to private capital
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- \( y(z, l) = A \left[ \alpha \left\{ (1 - l) z^{1-\varepsilon} \right\}^{-\rho} + (1 - \alpha) \right]^{-1/\rho} \): average product of private capital (output-capital ratio)
The Model

Consumers

- Continuum of infinitely-lived consumers, indexed by $i$
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- The $i$-th consumer's (cross section's) resource allocation problem:

  $$
  \text{Maximize } U_i = \int_0^{\infty} \frac{1}{\gamma} \left[ C_i^{-\upsilon} + \theta (X_U l_i)^{-\upsilon} \right]^{-\gamma/\upsilon} e^{-\beta t} dt
  $$

subject to

  $$
  \dot{K}_i = (1 - \tau_k) rK_i + (1 - \tau_w) w(1 - l_i) - (1 + \tau_c) C_i - T
  $$

  $$
  K_i(0) = K_{i,0}, \quad K_{i,0} \neq K_{m,0}
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- $X_U = K^K 1 - \varphi : \text{composite "public-private" externality (creates units of "effective" leisure), } 0 \leq \varphi \leq 1$
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- \( X_U = K^\varphi K_G^{1-\varphi} \): composite "public-private" externality (creates units of "effective" leisure), \( 0 \leq \varphi \leq 1 \)
- \( q = 1/(1 + \nu) \): intratemporal elasticity of substitution between consumption and effective leisure
Provides the aggregate stock of public capital (e.g. infrastructure), whose evolution is given by

\[ \dot{K}_g = G = gY, \quad 0 < g < 1 \]
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- Maintains a balanced budget
  \[ G = \tau_k rK + \tau_w w(1 - l) + \tau_c C + T \]
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- Lumpsum tax revenues, \( T \), is a fraction of aggregate GDP:

\[
T = \tau Y, \quad 0 < \tau < 1
\]
Due to the Gorman (1953) properties, the aggregate equilibrium is *independent* of distributional characteristics:

\[
\frac{\dot{z}}{z} = g \frac{y(z, l)}{z} - [(1 - g)y(z, l) - \Omega(z, l)l]
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\frac{\dot{l}}{l} = \frac{H(z, l)}{J(z, l)}
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Evolution of the aggregate economy represents the behavior of averages:

\[ z(t) = \bar{z} + (z_0 - \bar{z})e^{\mu t} \]

\[ l(t) = \bar{l} + \frac{(\mu - a_{11})}{a_{12}}[z(t) - \bar{z}] \]
Aggregate Equilibrium Dynamics

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- Convergence to a balanced growth path in the steady-state
Relative capital/wealth is defined as $k_i = K_i / K$
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Evolution of relative wealth:

$$k_i(t) - 1 = \left[ 1 + \frac{\delta_1(\tilde{z}, \tilde{l})}{\mu - \delta_2(\tilde{z}, \tilde{l})} (z_0 - \tilde{z}) e^{\mu t} \right] (\tilde{k}_i - 1)$$
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Steady-state relationship between relative wealth and leisure:

$$\tilde{l}_i - \tilde{l} = \left[ \tilde{l} - \frac{\Delta(\tilde{z}, \tilde{l})}{\Gamma(\tilde{z}, \tilde{l})} \right] (\tilde{k}_i - 1)$$
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Dispersion of relative wealth:

$$\sigma_{k}(t) = \frac{\sigma_{k,0}}{\left[ 1 + \frac{\delta_1(\bar{z}, \bar{l})}{\mu - \delta_2(\bar{z}, \bar{l})} \{z(t) - \bar{z}\} \right]}$$
Distributional Dynamics: Income

- Relative income: \( y_i = \frac{Y_i}{Y} \)
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Dispersion of pre-tax relative income:

$$\sigma_y(t) = \zeta(t)\sigma_k(t)$$
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- Dispersion of **post-tax** relative income:
  \[
  \sigma_{y}^N(t) = \left[ \zeta(t) + \frac{s_k(t)(\tau_w - \tau_k)(1 - \zeta(t))}{(1 - \tau_w)(1 - s_k(t)) + (1 - \tau_k)s_k(t)} \right] \sigma_k(t)
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- \( s_k(t) \): share of capital in total income
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\[
s_k(t) - [1 - s_k(t)] \frac{l(t)}{1 - l(t)} \left[ 1 - \frac{\Delta(\tilde{z},\tilde{l})}{\Gamma(\tilde{z},\tilde{l})} \right] \left[ 1 + \frac{\delta_1(\tilde{z},\tilde{l})}{\mu - \delta_2(\tilde{z},\tilde{l})} \{ z(t) - \tilde{z} \} \right]^{-1}
\]
Relative welfare:

\[
\frac{U_i}{U} = \left[ 1 + \left( 1 - \frac{\Delta(\tilde{z}, \tilde{l})}{\Gamma(\tilde{z}, \tilde{l})} \right) (\tilde{k}_i - 1) \right]^\gamma
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Dispersion of relative welfare

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Effects on the distributional dynamics of wealth and income
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• Effects on the distributional dynamics of wealth and income

• **Nature of the growth-income inequality relationship along the transition path**
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Robustness check:
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- intratemporal elasticity of substitution between
• **Increase in government spending on public capital**, financed by an increase in
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  - consumption and leisure in utility
Benchmark Specification of Structural Parameters

<table>
<thead>
<tr>
<th>Preferences</th>
<th>$\beta = 0.04$, $\gamma = -1.5$, $\theta = 1.75$, $\nu = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>$A = 0.6$, $\alpha = 0.6$, $\rho = 0$</td>
</tr>
<tr>
<td>Externalities</td>
<td>$\varepsilon = \varphi = 0.6$</td>
</tr>
<tr>
<td>Fiscal</td>
<td>$g = 0.05$, $\tau = 0.05$, $\tau_k = \tau_w = \tau_c = 0$</td>
</tr>
</tbody>
</table>

- **Benchmark**: Cobb-Douglas production and utility functions
Benchmark Equilibrium and Aggregate Steady-State Effects

- Benchmark equilibrium:
Benchmark Equilibrium and Aggregate Steady-State Effects

Benchmark equilibrium:

<table>
<thead>
<tr>
<th>Financing Policy</th>
<th>ź</th>
<th>Ŷ</th>
<th>ŷ</th>
<th>ñ(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum tax financing, ( \tau = 0.05 )</td>
<td>0.531</td>
<td>0.714</td>
<td>0.243</td>
<td>2.29</td>
</tr>
</tbody>
</table>
Benchmark Equilibrium and Aggregate Steady-State Effects

- Benchmark equilibrium:
  
<table>
<thead>
<tr>
<th>Financing Policy</th>
<th>$\tilde{z}$</th>
<th>$\tilde{l}$</th>
<th>$\tilde{y}$</th>
<th>$\tilde{\psi}(%)$</th>
</tr>
</thead>
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</tbody>
</table>

- An increase in government spending from 5% to 8% of GDP ($dg = 0.03$)
Benchmark Equilibrium and Aggregate Steady-State Effects

- Benchmark equilibrium:
  
  | Financing Policy | \( \tilde{z} \) | \( \tilde{l} \) | \( \tilde{y} \) | \( \tilde{\psi}(\%) \) |
  |------------------|----------------|----------------|----------------|
  | Lump-sum tax financing, \( \tau = 0.05 \) | 0.531 | 0.714 | 0.243 | 2.29 |

- An increase in government spending from 5% to 8% of GDP (\( dg = 0.03 \))

<table>
<thead>
<tr>
<th>Policy Change (( dg = 0.03 ))</th>
<th>( d\tilde{z} )</th>
<th>( d\tilde{l} )</th>
<th>( d\tilde{\psi} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum tax-financing (( d\tau = 0.03 ))</td>
<td>0.259</td>
<td>−0.01</td>
<td>0.206</td>
</tr>
<tr>
<td>Capital income tax-financing (( d\tau_k = 0.075 ))</td>
<td>0.353</td>
<td>−0.006</td>
<td>0.101</td>
</tr>
<tr>
<td>Labor income tax-financing (( d\tau_w = 0.05 ))</td>
<td>0.268</td>
<td>0.002</td>
<td>0.168</td>
</tr>
<tr>
<td>Consumption tax-financing (( d\tau_c = 0.096 ))</td>
<td>0.265</td>
<td>−0.001</td>
<td>0.179</td>
</tr>
</tbody>
</table>
Wealth Inequality

Effects of an Increase in Government Spending: Lumpsum Tax-financing
Wealth Inequality

Effects of an Increase in Government Spending: Distortionary Tax-financing

................. Capital income tax-financed  ----  Labor income tax-financed  ------  Consumption tax-financed
Income Inequality
Effects of an Increase in Government Spending: Lumpsum Tax-financing

Pre- and Post-tax Income Inequality
Income Inequality
Effects of an Increase in Government Spending: Distortionary Tax-financing

Pre-tax income inequality

Post-tax income inequality

................. Capital income tax-financed    ----- Labor income tax-financed    ----- Consumption tax-financed
The distributional effects of an increase in government spending are robust to

\[ s = \frac{1}{1 + \rho} \] (Figure 3)

\[ q = \frac{1}{1 + \upsilon} \] (Figure 4)

relative magnitude of the composite public-private externality in the utility and production functions, \( \phi \) and \( \epsilon \) (Table 4)
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Robustness to Structural Parameters

- The distributional effects of an increase in government spending are robust to
  - the intratemporal elasticity of substitution between private capital and labor in the production function, \( s = 1/(1 + \rho) \) (Figure 3)
  - the intratemporal elasticity of substitution between consumption and leisure in the utility function, \( q = 1/(1 + v) \) (Figure 4)
  - relative magnitude of the composite public-private externality in the utility and production functions, \( \phi \) and \( \varepsilon \) (Table 4)
### A. Composite Externality in Utility and Production, $\varepsilon = \varphi = 0.6$ (Benchmark Case)

<table>
<thead>
<tr>
<th>Policy Change</th>
<th>Short Run Change</th>
<th>Long Run Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum tax-financed increase in $g$</td>
<td>0.129</td>
<td>-2.602</td>
</tr>
<tr>
<td>Capital income tax-financed increase in $g$</td>
<td>0.044</td>
<td>-9.174</td>
</tr>
<tr>
<td>Labor income tax-financed increase in $g$</td>
<td>0.096</td>
<td>-0.110</td>
</tr>
<tr>
<td>Consumption tax-financed increase in $g$</td>
<td>0.106</td>
<td>-3.117</td>
</tr>
</tbody>
</table>

### B. Public Good Externality in Utility Function: $\varphi = 0, \varepsilon = 1$

<table>
<thead>
<tr>
<th>Policy Change</th>
<th>Short Run Change</th>
<th>Long Run Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum tax-financed increase in $g$</td>
<td>-0.107</td>
<td>-4.964</td>
</tr>
<tr>
<td>Capital income tax-financed increase in $g$</td>
<td>-0.215</td>
<td>-11.631</td>
</tr>
<tr>
<td>Labor income tax-financed increase in $g$</td>
<td>-0.136</td>
<td>-2.511</td>
</tr>
<tr>
<td>Consumption tax-financed increase in $g$</td>
<td>-0.128</td>
<td>-5.468</td>
</tr>
</tbody>
</table>

### C. Public Good Externality in Production Function: $\varphi = 1, \varepsilon = 0$

<table>
<thead>
<tr>
<th>Policy Change</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum tax-financed increase in $g$</td>
<td>0.409</td>
<td>-2.287</td>
</tr>
<tr>
<td>Capital income tax-financed increase in $g$</td>
<td>0.377</td>
<td>-9.087</td>
</tr>
<tr>
<td>Labor income tax-financed increase in $g$</td>
<td>0.375</td>
<td>0.113</td>
</tr>
<tr>
<td>Consumption tax-financed increase in $g$</td>
<td>0.385</td>
<td>-2.938</td>
</tr>
</tbody>
</table>
### A. Composite Externality in Utility and Production, $\varepsilon = \varphi = 0.6$ (Benchmark Case)

<table>
<thead>
<tr>
<th>Policy Change</th>
<th>$d\bar{W}$ (%)</th>
<th>$d\tilde{\sigma}_W$ (%)</th>
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</thead>
<tbody>
<tr>
<td>Lump-sum tax-financed increase in g</td>
<td>4.012</td>
<td>5.415</td>
</tr>
<tr>
<td>Capital income tax-financed increase in g</td>
<td>1.790</td>
<td>3.620</td>
</tr>
<tr>
<td>Labor income tax-financed increase in g</td>
<td>3.139</td>
<td>2.996</td>
</tr>
<tr>
<td>Consumption tax-financed increase in g</td>
<td>3.398</td>
<td>2.946</td>
</tr>
</tbody>
</table>

### B. Public Good Externality in Utility Function: $\varphi = 0$, $\varepsilon = 1$

<table>
<thead>
<tr>
<th>Policy Change</th>
<th>$d\bar{W}$ (%)</th>
<th>$d\tilde{\sigma}_W$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum tax-financed increase in g</td>
<td>6.830</td>
<td>5.773</td>
</tr>
<tr>
<td>Capital income tax-financed increase in g</td>
<td>5.041</td>
<td>3.872</td>
</tr>
<tr>
<td>Labor income tax-financed increase in g</td>
<td>5.930</td>
<td>3.312</td>
</tr>
<tr>
<td>Consumption tax-financed increase in g</td>
<td>6.198</td>
<td>3.299</td>
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### C. Public Good Externality in Production Function: $\varphi = 1$, $\varepsilon = 0$

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<tr>
<td>Lump-sum tax-financed increase in g</td>
<td>3.384</td>
<td>6.300</td>
</tr>
<tr>
<td>Capital income tax-financed increase in g</td>
<td>1.227</td>
<td>4.929</td>
</tr>
<tr>
<td>Labor income tax-financed increase in g</td>
<td>2.554</td>
<td>3.926</td>
</tr>
<tr>
<td>Consumption tax-financed increase in g</td>
<td>2.801</td>
<td>3.902</td>
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</table>
Conclusions

- **Three issues:**
  - Effects of pro-growth and pro-scalar policies on inequality
  - Nature of the growth-inequality relationship generated by public investment and financing policies
  - Trade-offs between average welfare and its dispersion due to government spending policies

**Summary of results:**
- Government spending increases wealth inequality in transition, but income inequality may be subject to intertemporal trade-offs
- The growth-inequality relationship depends on (a) magnitude of externalities (b) financing policies (c) time period of consideration
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Future Work

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