Fund substitution and the public cost-sharing of private forest investments

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Presentation outline

1. Rationale for the study
2. Basic assumptions for the study
3. Theory
4. Data
5. Econometric model
6. Results
7. Conclusions
Rationale for the study

- Forest investment are costly and slowly maturing: The socially optimal level of investments is not warranted
  - Relative low return of forest capital (i.e. the forest trees and land) makes alternative investment projects or consumption more attractive than wood production
  - In order to sustain the socially optimal level of wood supply the government must finance the private forest investors
  - Once the private forest owner starts his forest investment project, the government will support and partly cover the financial costs
- How forest owner behaviour is affected, are the effects of cost-sharing substitutive or complementary with private share of financing?

Basic assumptions for the study

- Assume that forest owner can increase and improve his/her forest stock with investments and forest management in forest capital
- In this context we define forest capital input as methods which improve the forest stand and soil
- This type of investments include:
  - preparation for natural and artificial regeneration,
  - seeding and planting,
  - tending of seedling stands,
  - forest fertilization,
  - forest drainage
- Some investments reduce harvesting costs, e.g.:
  - construction and improvement of forest roads
Theory

- The model of public cost sharing of private forest investment describes the optimal choice between the private financing of investments and public investment aid.
- Public support consists of a lump sum transfer and fixed share rate rule of private funds.
  - Forest owner optimises his/her private funding with respect to sharing contract.
  - Government actions and choices are given as exogenous.
  - Fund substitution depends on the curvature conditions of forest investment and fund cost functions.
    - If the stock effects from investments are almost linear and if marginal costs of public and private funding are increasing with the funding levels, the fund substitution is not present.
    - In more general cases substitution is present.
- The model does not allow for structural testing of fund substitution hypothesis but helps us to interpret empirical results.

Data

- Panel data consists of regional observation of 19 Forestry District Boards in Finland in years 1983-2000 (since 1996 a conversion from Forestry Centres to previous FDBs is carried out).
- Following variables are used:
  - PRIVfunds = private total costs of forest investments.
  - PUBfunds = government investment grants, loans, and aid to private forest investors.
  - INCOME = private forest owners’ income from wood selling.
  - i = nominal interest rate of commercial bank loans.
  - HECT = total forest area affected by forest investments (in hectares).
  - Pe = one period ahead market price expectations.
  - D2 = dummy starting in year 1993 for alternative forest income taxation system.
  - D3 = regional percentages of alternative forest tax systems adopted since 1993.
Econometric model

- Supply of private funds
  \[ \text{PRIVfunds} = f(\text{PUBfunds}, \text{INCOME}, i, \text{HECT}, \text{Pe}) \]
  \(-() \quad (+) \quad (-) \quad (+) \quad (+)\]

- Demand for public funds
  \[ \text{PUBfunds} = g(\text{PRIVfunds}, \text{INCOME}, i, \text{HECT}, \text{Pe}) \]
  \((+) \quad (-) \quad (+) \quad (+) \quad (-)\]

\[ \begin{align*}
\text{PRIVfunds}_i &= a_0 + D1 + D2 + D3 + a_1 \text{PUBfunds}_i + \\
&= a_2 \text{INCOME}_i + a_3 i + a_4 \text{HECT}_i + a_5 \text{Pe}_i + \epsilon_i \\
\text{PUBfunds}_i &= b_0 + D1 + D2 + D3 + b_1 \text{PRIVfunds}_i + \\
&= b_2 \text{INCOME}_i + b_3 i + b_4 \text{HECT}_i + b_5 \text{Pe}_i + \eta_i \\
i &= 1, 2, \ldots, 19 \text{ (regions)} \quad \text{and} \quad t = 1, \ldots, 18 \text{ (1983-2000)}.
\end{align*} \]

Results

Fixed effects LS-estimates for models of private funds (PRIVfunds) and public cost sharing funds (PUBfunds) of investments

<table>
<thead>
<tr>
<th>Exogenous Variable</th>
<th>PRIVfunds</th>
<th>PUBfunds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>estimate</td>
<td>t-value</td>
</tr>
<tr>
<td>D1</td>
<td>0.295*</td>
<td>(3.06)</td>
</tr>
<tr>
<td>D2</td>
<td>-0.664*</td>
<td>(-2.92)</td>
</tr>
<tr>
<td>D3</td>
<td>1.101*</td>
<td>(3.17)</td>
</tr>
<tr>
<td>INCOME</td>
<td>0.236*</td>
<td>(22.67)</td>
</tr>
<tr>
<td>i</td>
<td>-0.137*</td>
<td>(-2.52)</td>
</tr>
<tr>
<td>HECT</td>
<td>0.318*</td>
<td>(10.54)</td>
</tr>
<tr>
<td>PE</td>
<td>-0.264*</td>
<td>(-2.29)</td>
</tr>
</tbody>
</table>

*R* statistically significant at 5% level

R²: 0.778, 0.662

Fixed effects $\chi^2(18)$: 181.09, 53.86
p-value: (0.00), (0.00)

342 observations:
N=19 forest board districts,
T =18 years 1983-2000
Results

Fixed effects 2SLS-estimates for models of private funds (PRIVfunds) and public cost sharing funds (PUBfunds) of investments

<table>
<thead>
<tr>
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<th>PRIVfunds</th>
<th>PUBfunds</th>
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<th>PRIVfunds</th>
<th>PUBfunds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Whole</td>
<td>Soutern Finland</td>
<td>Northern Finland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N=19, T=18</td>
<td>N=15, T=18</td>
<td>N=4, T=18</td>
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<tr>
<td>R²</td>
<td>0.748</td>
<td>0.592</td>
<td>0.863</td>
<td>0.324</td>
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</table>

*) statistically significant at 5% level

<table>
<thead>
<tr>
<th></th>
<th>PRIVfunds</th>
<th>PUBfunds</th>
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<th>PUBfunds</th>
<th>PRIVfunds</th>
<th>PUBfunds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>t-value</td>
<td></td>
<td></td>
<td></td>
<td>t-value</td>
</tr>
<tr>
<td>Income (INCOME)</td>
<td>0.244*</td>
<td>(10.32)</td>
<td>0.190*</td>
<td>(3.92)</td>
<td>0.943*</td>
<td>(7.5)</td>
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<tr>
<td>Investment (Di)</td>
<td>0.230*</td>
<td>(2.58)</td>
<td>0.243*</td>
<td>(2.21)</td>
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<td></td>
<td>−0.417*</td>
<td>(−2.26)</td>
<td>−0.043</td>
<td>(−0.38)</td>
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<tr>
<td></td>
<td>0.683*</td>
<td>(2.52)</td>
<td>0.061</td>
<td>(0.16)</td>
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<tr>
<td>Interest rate (i)</td>
<td>−0.138*</td>
<td>(−2.38)</td>
<td>−0.285*</td>
<td>(−4.21)</td>
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<td></td>
<td>0.258*</td>
<td>(23.06)</td>
<td>0.295*</td>
<td>(12.78)</td>
<td>−0.311*</td>
<td>(−1.68)</td>
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<tr>
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<td>(−0.378*)</td>
<td>(−7.42)</td>
<td>(−0.340*)</td>
<td>(−5.33)</td>
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<tr>
<td></td>
<td>0.912*</td>
<td>(11.49)</td>
<td>0.819*</td>
<td>(8.34)</td>
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<td></td>
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<td>(6.20)</td>
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<td></td>
<td></td>
<td>(2.65)</td>
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<td>(3.65)</td>
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<tr>
<td></td>
<td></td>
<td>−0.247*</td>
<td>−0.511*</td>
<td>(−3.46)</td>
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<tr>
<td></td>
<td></td>
<td>(−1.94)</td>
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Reduced form estimates for exogenous variables

- Income effects on public funds demand are insignificant regardless the region analysed.
- Income effects on private funding supply are quite similar across the regions.
- Interest rate effects are more significant in northern Finland and the effect are more severe with public funding.
- Investment area effects on public funding are especially large in northern Finland.
- Price expectations effects are three times larger in northern Finland compared with findings in southern Finland.
Conclusions

- 2SLS estimation results rejected the substitution alternative
- Private and public funding of investments are related to each other complementary
- However, the relationships between them are not symmetric
  - 10% increase in private investment funding increases public funding demand with same rate, but
  - 10% increase of public funds increases the private funds supply 2.4%
  - Significant income effects are found only for private funding
  - In northern Finland investment scale effects are large for public financial aid
- Results imply that government cost-sharing investment programs have been incentive supporting: They have increased, not “crowded out”, the private investments.