Taxation and Public Goods under Federalism: Exit, voice, and revenue equalization

Debra Hevenstone

University of Michigan, ETH, & ILO
(work with Ben Jann)

May 6, 2008
Questions

- Does the interaction between mobility & voting generate:
  - residential segregation?
  - lower tax rates for the rich?
- Does revenue equalization:
  - ameliorate inequalities?
  - discourage local tax collection?
  - encourage residential integration?
Tiebout’s “Pure Theory of Local Expenditures,” 1956

Theory
- areas offer baskets of public goods
- basket include tax rate
- households move, maximizing utility
- equilibrium provision of public goods
- reveals & aggregates preferences

Critiques
- Unrealistic assumptions
  - Perfect mobility
  - Perfect information
  - Wide array of public goods preferences
- Households consider other households’ preferences
- Preferences correlate with income
- Optimize average utility, or distributional goals?

Policy implication: devolve
Brandeis “Race to the Bottom,” 1933

Theory
- Competition between states to
  - attract wealthy
  - repel poor
  - attract businesses
- Leads to the dismantling of the state
  - environmental regulation
  - social support
  - taxes

Empirical tests:
- Welfare benefits (Rom & Peterson; Schram)
- Tax competition (Nechyba; Feld)
  Motivation for the EU common consolidated tax base commission (Estonia 0% tax on reinvested profit)
- Findings: some competition, but not to the bottom
  - Swiss taxes 2-person family, 200,000 CHF: Zug 8.3% cantonal tax vs. 13.37, 14.4, & 15.47% in Zürich, Aargau, and Luzern.

Policy implication: centralize
Hirschman’s “Exit Voice and Loyalty”, 1970

A *theory of social or organizational change*

- **Voice**: Change the organization from within
- **Exit**: Change the organization by leaving
- Use exit or voice depending on:
  - loyalty, freedom to leave, freedom of expression
- Devolution should increase exit and voice

*Policy implication: devolve?*
Many countries devolve tax collection

### Tax Revenue by Level of Government

<table>
<thead>
<tr>
<th>Switzerland 1999</th>
<th>income</th>
<th>sales / VAT</th>
<th>property</th>
<th>corporate</th>
<th>wealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>federal</td>
<td>16</td>
<td>100</td>
<td>1</td>
<td>41</td>
<td>0</td>
</tr>
<tr>
<td>cantonal</td>
<td>44</td>
<td>0</td>
<td>64</td>
<td>37</td>
<td>54</td>
</tr>
<tr>
<td>municipal</td>
<td>39</td>
<td>0</td>
<td>35</td>
<td>23</td>
<td>46</td>
</tr>
<tr>
<td>total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>101</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Swiss federal finance administration

### Share of Sub-National from Total Government Revenue 1997

<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>48.61</td>
</tr>
<tr>
<td>Switzerland</td>
<td>46.90</td>
</tr>
<tr>
<td>Denmark</td>
<td>45.66</td>
</tr>
<tr>
<td>Australia</td>
<td>43.32</td>
</tr>
<tr>
<td>Belarus</td>
<td>37.86</td>
</tr>
<tr>
<td>Russia</td>
<td>37.62</td>
</tr>
<tr>
<td>Germany</td>
<td>37.54</td>
</tr>
<tr>
<td>Finland</td>
<td>35.96</td>
</tr>
<tr>
<td>Sweden</td>
<td>34.46</td>
</tr>
<tr>
<td>South Africa</td>
<td>34.22</td>
</tr>
<tr>
<td>Norway</td>
<td>33.82</td>
</tr>
<tr>
<td>Austria</td>
<td>30.92</td>
</tr>
<tr>
<td>Iceland</td>
<td>28.81</td>
</tr>
<tr>
<td>Moldova</td>
<td>25.41</td>
</tr>
<tr>
<td>Latvia</td>
<td>24.03</td>
</tr>
<tr>
<td>Hungary</td>
<td>23.22</td>
</tr>
<tr>
<td>Italy</td>
<td>23.21</td>
</tr>
<tr>
<td>UK</td>
<td>22.10</td>
</tr>
<tr>
<td>Estonia</td>
<td>21.06</td>
</tr>
<tr>
<td>Lithuania</td>
<td>21.04</td>
</tr>
<tr>
<td>Poland</td>
<td>20.90</td>
</tr>
<tr>
<td>Czech</td>
<td>19.85</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>18.88</td>
</tr>
<tr>
<td>Albania</td>
<td>15.89</td>
</tr>
<tr>
<td>Portugal</td>
<td>12.83</td>
</tr>
<tr>
<td>Croatia</td>
<td>12.16</td>
</tr>
<tr>
<td>Slovenia</td>
<td>11.07</td>
</tr>
<tr>
<td>Belgium</td>
<td>11.03</td>
</tr>
<tr>
<td>New Zealand</td>
<td>10.84</td>
</tr>
<tr>
<td>Slovakia</td>
<td>8.04</td>
</tr>
</tbody>
</table>

Many countries redistribute revenue

- Federal governments can
  - Split the tax base (i.e. federal gets VAT, state gets income)
  - Create overlapping tax rights (federal & state split income)
  - Or federal collects all tax, distributes to states
  - First 2 often include revenue equalization
    - horizontally or vertically distributed
    - based on collected or potential revenue
    - equalization rate 0 to 100%
Why Switzerland?

- Most income tax set by cantons
- Tax rates can be voted on directly
- Possible to commute across cantons
- Evidence of tax-based migration

Swiss Income Tax:
- Federal: 16.4%
- Cantonal: 44.2%
- Municipal (cantonal add-on): 39.4%

Debra Hevenstone (Michigan, ETH, & ILO)
Swiss Cantonal Incomes Taxes

![Graph showing average tax rates for different annual incomes across various cantons.]

- Zürich
- Sarnen
- Zug
- Delsberg
- Zurich
- Sarnen
- Zug
- Genf

Average tax rates:
- 0%
- 5%
- 10%
- 15%
- 20%
- 25%
- 30%

Annual income:
- 150,000 CHF
- 250,000 CHF
- 350,000 CHF
- 450,000 CHF
- 550,000 CHF
- 650,000 CHF
- 750,000 CHF
- 850,000 CHF
- 950,000 CHF
- 1,000,000 CHF

Debra Hevenstone (Michigan, ETH, & ILO)
Swiss Cantonal Income Tax Formulae

\[ T = S(1 - e^{-ky_i}) \]
Swiss Federal Equalization Scheme: Tax capacity

\[ E_i = 0.3 NIC_i + 0.2 \frac{100}{B_i} 100 + 0.3 \left( \frac{T_i + \sum T_{im}}{H_i} \right) + 0.1 \left( \frac{U_p}{U_i} \right) + 0.1 \left( \frac{H_i}{km^2} \right) \]

- \( NIC_i \) national income for canton i
- \( H_i \) inhabitants in canton i
- \( B_i \) cantonal tax burden (income, wealth, profit, capital, & motor vehicle tax)
- \( T_i \) tax revenue in canton i
- \( T_m \) tax revenue in municipality m
- \( U_i \) total agricultural land
- \( U_p \) agricultural land in plain region

- First: high income cantons have more capacity
- Second: high burden cantons have less capacity
- Third: how much more could be collected
- Fourth: less mountainous areas to have more capacity
- Fifth: low population density areas have less capacity
Swiss Federal Equalization Scheme

- Tax capacity (with adjustments) used in:
  - Grants in aid
  - Revenue sharing
  - National Bank benefit
  - Contribute to fed social security

- Revenue equalization happened through > 10 formulae

- New goal: all > 85% of mean cantonal revenue/capita
The Economic Approach: Optimize utility

Max Cobb Douglas Utility

\[
U_j = \left( \frac{1}{n} \sum (y_i S(1 - e^{-k y_i})) \right)^{\alpha} \ast (h_j)^{\sigma} \ast (c_j)^{\gamma}
\]

s.t. income constraint

\[
y_j = y_j S(1 - e^{-k y_j}) + h_j + c_j
\]

\[
h_j \quad \text{housing costs}
\]

\[
c_j \quad \text{consumption}
\]

\[
t_i = S(1 - e^{-k y_i}) \quad \text{tax rate}
\]

\[
p = \frac{1}{n} \sum (y_i \ast S(1 - e^{-k y_i})) \quad \text{public goods/capita}
\]

... or ABM

- inductive rather than deductive
- measure spatial sorting
- test policy interventions
The Agent Based Modeling Approach: Routine

INITIALIZATION:
- create grid
- create jurisdictions with tax rates
- create parcels in jurisdictions
- create households with incomes and preferences for housing, public goods, private goods

MOVE:
- households assess hypothetical utility in vacant lots
- if enough lots are better, the household moves

VOTE:
- jurisdictions propose lower and higher tax rates
- citizens (that did not move) vote
- jurisdictions set taxes

EQUALIZATION PAYMENTS:
- central government calculates tax capacity
- central government sets jurisdictions' grants
- jurisdictions update their finances
- citizens update their utilities

E = trade off moving vs voting
A = equalization goal (0-100%)

Debra Hevenstone (Michigan, ETH, & ILO)
The ABM Approach

Agent Based Modeling Approach: Program

Debra Hevenstone (Michigan, ETH, & ILO)
Agent Based Modeling Approach: Starting values

- **Housing**
  - Sixteen jurisdictions, 625 units per jurisdiction
  - Vacancy of 8%
  - Occupied parcels’ value $= \frac{1}{3}$ occupants’ income
  - Empty parcels start with average of neighbors’ prices

- **Jurisdictions**
  - Max tax (S) starts: $\mu_S = .35 \sigma_S = .076$
  - Phase-in (k) starts $\mu_k = 2.25e^{-5} \sigma_k = .076$

- **Households**
  - Utility $= p^\alpha h^\sigma c^\gamma$
  - Preferences $\alpha, \sigma, \gamma$ have $\mu = .1, .3, .6$ & $\sigma = .02, .02, .04$
  - Normalized: $\alpha + \sigma + \gamma = 1$
  - Households assigned incomes $= \exp^y (\mu_y = 11, \sigma_y = 1)$

- Only S & k change during the simulation
Agent Based Modeling Approach: Main dynamics

- **Moving**
  - Households look at 10 vacant lots
  - Household compares utilities to current location
  - If more than \( \approx E \) proportion are better, household moves to best
  - \( E \) is *stickiness* or *exit-voice tradeoff*

- **Voting**
  - Government proposes a higher & lower tax scenario
  - \( k \) moves \( \pm 0 \) to \( .000001 \)
  - \( S \) moves \( \pm - .01 \) to \( .02 \) (crossover)
  - Households calculate utilities, vote for best scenario
  - Taxes change when over 60% vote higher or lower

*Experiment 1 varies \( E \) (decision to move vs vote) \( .05 \) to \( .5 \).*
Agent Based Modeling Approach: Experiment 2

- Tax Equalization
  - Compare jurisdictions by tax capacity
  - Transfer from high capacity to low capacity
  - No negative budgets

Cantonal Grant

\[ G = AP_j(R_j^* - R_j) \]

- \( G \): jurisdiction grant from federal (+ or −)
- \( A \): redistribution goal (0 to 1)
- \( P_j \): population jurisdiction \( j \)
- \( R_j^* \): national per capita tax revenue w/ avg \( j \)'s tax rates
- \( R_j \): \( j \)'s per capita tax revenue w/ avg \( j \)'s tax rates

Experiment 2 varies \( A \) (redistribution) 0 to 1
Experiment One Results: Tax Inequality

- jurisdictions' mean income
- p: poorest jurisdiction
- m: middle jurisdiction(s)
- r: richest jurisdiction

---
Experiment One Results: Segregation

- Always significant segregation
- Segregation might increase with stickiness
- Jurisdictions are more homogenous with stickiness
Experiment One: Higher utility through voting

![Bar chart](chart.png)

**Mean jurisdiction utility/income (exp 1)**

- Utility/Income vs. Exit vs. Voice
  - Values range from .32 to .39
  - Each bar represents a different E value (exit vs. voice) from .05 to .50

Debra Hevenstone (Michigan, ETH, & ILO)

Public Goods ABM

May 6, 2008
Validation

- Taxes too high for Switzerland data
- Jurisdictional differences match
- Chose $E = 0.3$ based on curve shape
- Better validation procedure necessary
Experiment Two Results: Tax Inequality

- **A=0.0**
- **A=0.1**
- **A=0.2**
- **A=0.3**
- **A=0.4**
- **A=0.5**
- **A=0.6**
- **A=0.7**
- **A=0.8**
- **A=0.9**
- **A=1.0**

- **jurisdiction’s mean income**
- **p** poorest jurisdiction
- **m** middle jurisdiction(s)
- **r** richest jurisdiction

Debra Hevenstone (Michigan, ETH, & ILO)  Public Goods ABM  May 6, 2008
Experiment Two Results: Tax Rates

- Tax rates become more unequal as equalization increases
- Tax rates stabilize at 30% redistribution
Experiment Two Results: Public Goods Provision

- Public goods plummet with equalization

![Graph showing public goods per capita vs. parameter setting for A, redistribution parameter]

Debra Hevenstone (Michigan, ETH, & ILO)
Results

Experiment Two

Rawlsian Perspective

Average utility of the poorest household

utility

A (redistribution)

richest jurisdiction
poorest jurisdiction
middle jurisdiction

Debra Hevenstone (Michigan, ETH, & ILO)
Conclusions

- **Experiment One**
  - Rich jurisdiction have lower, flatter taxes
  - Mean earner by jurisdiction pays about the same tax rate
  - Segregation first increases with stickiness
  - Jurisdictions become more homogenous with stickiness
  - Stickiness makes people happier

- **Experiment Two**
  - More equalization encourages rich areas to have lower, flatter taxes
  - Average household in rich jurisdiction pays about the same tax as the average household in other jurisdictions
  - Tax rates become more unequal with more equalization
  - Equalization encourages rich jurisdictions to offer fewer public goods
  - The poor in rich areas suffer from equalization

- **Overall conclusion**
  - If equality is the goal, centralize?
  - Real world stickiness makes sense
Improvements

- Model Specification
  - Households should move if best utility is $x\%$ > than current
  - Allow households to always vote?
  - Weak house pricing method...
  - Does segregation arise without house pricing mechanism?

- Problems
  - Model’s utility in experiment 2 is higher (when $A=0$)
  - Produces consistently higher taxes than Switzerland
  - Vary all parameter settings

- Expansions
  - Calculate preference exponents for poorest in rich districts
  - Calculate mobility by income.
  - Apply to US school funding / property taxes, other cases?
THANKS.