Educational Policy and Intergenerational Mobility

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Motivation

- Rank-Rank slope: Correlation between child income ranking and adult income ranking.
- There is a considerable variation in the rank-rank slope across states.

	State	Rank-Rank		State	Rank-Rank
1st	California	0.237	46th	Mississippi	0.414
2nd	Utah	0.244	45th	Louisiana	0.395
3rd	Idaho	0.248	44th	Delaware	0.394
4th	Wyoming	0.255	43rd	Ohio	0.392
5th	Nevada	0.263	42nd	Alabama	0.390

Table 1: Top 5/Worst 5 States on Rank-Rank Slope

(Datasource: Chetty et al (2014))

Research Question

- Research Question: What factors generate the variation across states?

This Paper

- Our argument: Variation in public school educational policy and spending can partially account for it.
  - Early child investments are critical in improving child's human capital. (Cunha and Heckman (2007), Caucutt and Lochner (2012))
  - Public school spending plays an important role.
- We consider three aspects of public school spending across districts.
  1. Level.
  2. Finance systems.
  3. Distribution.
- We construct a dynamic model.
  - Key Ingredients:
    1. Child's human capital formulation. (early vs late)
    2. Disutility from inequality.
    3. Districts vote over tax rate.

The Preview of Result

- Our model captures the data well.
  - Three aspects of public school spending are important to understand the intergenerational mobility.
- Counterfactual simulations suggest that
  - The distribution of public school spending and educational policy has a large impact on the intergenerational mobility.
  - The impact of the level is modest.

Selected Related Literature

- Papers on Intergenerational mobility.
  - U.S. (Aggregate) : Becker and Tomes (1979, 1986), Solon (1992), Restuccia and Uttutia (2004), Mazmunder (2005).
  - Cross-country: Corak (2013), Holter (2014), Abbott and Gallipoli (2015).
  - U.S. (County) : Chetty et al (2014).
- Papers on public school spending.
  - Public school finance system: Murray et al (1998), Hoxby (2001), Card and Payne (2002), Fernandez and Rogerson (1998, 2003), Ferreyra (2009).

Roadmap

1. Facts
2. Model
3. Calibration
4. Results
5. Conclusion

The List of the Datasources

- Rank-Rank slope: Chetty et al (2014).
- Public school spending: US Census of Bureau, Murray et al. (1998), Corcoran et al. (2003).
- Child family income: Chetty et al (2014).
- Characterization of educational policy: American Education Finance Association. (1995).

Education Expenditure Inequality

Year	1972	1977	1982	1987	1992	1997
Gini Coefficient ($\times$100)	16.3	15.0	13.8	15.8	15.5	13.0
Theil index ($\times$100)	43.7	37.1	31.0	40.7	40.5	30.6
Within states	13.7	14.4	14.0	12.6	13.4	9.9
Between states	33.0	22.8	17.0	28.2	27.1	20.7

Table 2: Education Expenditure Inequality within and between States

(Datasource: Murray et al. (1998), Corcoran et al. (2003))

Level of Public School Spending

- Average public school spending per pupil varies across states.

	State	Level		State	Level
1st	New Jersey	$ 9,961	46th	Utah	$ 3,827
2nd	New York	$ 9,582	45rd	Mississippi	$ 4,205
3rd	Connecticut	$ 9,159	44th	Idaho	$ 4,372
4th	Rhode Island	$ 7,767	43rd	Alabama	$ 4,673
5th	Maryland	$ 7,425	42nd	Arkansas	$ 4,717

Table 3: Top 5/Worst 5 States on Average Public School Spending per Pupil

(Datasource: U.S. Census Bureau)

Public School Finance Systems

- Three main systems:
  1. Full state funding system. (3 states in 1993-1994)
     - Financed only by statewide taxes.
  2. Foundation program. (39 states)
     - Minimum amount of public spending is guaranteed.
  3. Equalization program. (6 states)
     - The targeted revenue based on the tax base is guaranteed.

Importance of Level and Educational Policy

- The overall correlation between the rank-rank slope and average public school spending is -0.0128.
- Creating two subgroups improves the correlation.
  - -0.0632 (foundation program)
  - -0.5939 (percent equalization/guaranteed tax base program).

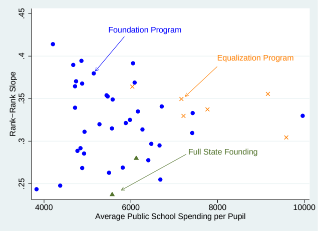

Figure 1: Relation between Public School Spending per Pupil and Rank-Rank Slope

(Datasource: U.S. Census Bureau and Chetty et al.(2014))

Distribution of Public School Spending

- Distribution of public school spending varies considerably among states.
  - Example: Colorado and Georgia (Figure 2).
    - # of school districts, level of school spending and educational policy are similar.
    - Rank-Rank slope is different. (0.269 (CO), 0.349 (GA))

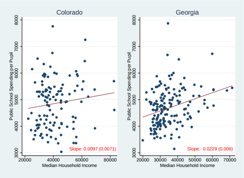

Figure 2: Distribution of Public School Spending per Pupil in Colorado and Georgia

(Datasource: U.S. Census Bureau)

Model Environment

- Three-period model with voting over tax rate.
  - 1st period: 18 years.
    - School districts decide on their consumption and invest in their children.
  - 2nd & 3rd: 6 years.
    - Children decide on their consumption and human capital.
- Continuum of individuals.
- In a state s, there are n districts each indexed by j has income y_{sj}.
  - No heterogeneity within a school district.

Human Capital Formation

- 1st period: Depends on public, private resources, and child's learning ability:

$$h_{csj2} = a_{csj} x_{sj1}^{\gamma_1} \bar{x}_{sj}^{\gamma_2}, \tag{1}$$

- 2nd & 3rd period: Based on a Ben-Porath type production function:

$$h_{csj3} = a_{csj} (n_{csj2} h_{csj2})^{\eta_1} x_{sj2}^{\eta_2} + h_{csj2}. \tag{2}$$

- Pubic resources are obtained from an income tax.
  - Level of public resources determined by the public school finance system.

Preferences

- School districts' preferences contain
  - Own consumption. ($u(c_{sj})$)
  - Child's utility in the following periods. ($V(a_{csj}, h_{csj}, g_{csj})$)
    - Depends on their consumption in the two periods.
  - Disutility from inequality. ($d(\frac{\sigma_{h_{csj2}}}{\mu_{h_{csj2}}})$)
    - Based upon Alesina and Giuliano (2009).
    - Assume that school district j cares about the coefficient of variation of child's human capital.
- Preferences are given by

$$u(c_{sj}) + \theta V(a_{csj}, h_{csj2}, g_{csj}) - \xi_s d(\frac{\sigma_{h_{csj2}}}{\mu_{h_{csj2}}}),$$

- θ: Degree of altruism.

Child's Problem

- Child earns wage, w_c.

$$w_c = (1 - p_s)w_s + p_s w_{U.S.}$$

- Solution to $V(a_{csj}, h_{csj2}, g_{csj})$ is

$$V(a_{csj}, h_{csj2}, g_{csj}) = \max_{c_{csj2}, c_{csj3}, n_{csj2}, x_{sj2}} u(c_{csj2}) + \beta u(c_{csj3})$$

subject to

$$c_{csj2} + \frac{c_{csj3}}{1+r} + x_{sj2} = w_c h_{csj2}(1 - n_{csj2}) + \frac{w_c h_{csj3}}{1+r} + g_{csj},$$

and (2).

Full State Funding

- Public school spending is financed by a statewide income tax. ($\bar{x}_{sj} = \bar{x}_{sj' \equiv} \bar{x}_s$) Thus,

$$\bar{x_s} = \tau_s \mu_s = \tau_s \frac{1}{n} \sum_{j=1}^{n} y_{sj}. \tag{3}$$

- School district's utility maximization problem is

$$max_{c_{sj1}, x_{sj1}, g_{csj}, \tau_s} u(c_{sj}) + \theta V(a_{csj}, h_{csj2}, g_{csj}) - \xi_s d(\frac{\sigma_{h_{csj2}}}{\mu_{h_{csj2}}}),$$

subject to

$$c_{sj} + x_{sj1} + g_{csj} = (1 - \tau_s) y_{sj},$$

(1) and (3).

Full State Funding

- We assume that τ_s is determined by majority voting.
  - Computation: Individual preference are single peaked in τ_s.
  - The equilibrium income tax rate τ_{sm} must satisfy

$$\int I_{\{\tau_{sj} \geqq \tau_{sm}\}} dF(y_{sj}) \geq \frac{1}{2},$$

$$\int I_{\{\tau_{sj} \leqq \tau_{sm}\}} dF(y_{sj}) \geq \frac{1}{2}.$$

Foundation Program

- Minimum level of public spending funded by statewide tax, τ_s, is guaranteed.
- School districts can spend more by imposing local tax τ_l.
- The equation for $\bar{x}_{sj}$ is

$$\bar{x_{sj}} = \tau_s \mu_s + \tau_{lj} y_{sj}, \tag{4}$$

Foundation Program

- First, given τ_s, school district's utility maximization problem is

$$max_{c_{sj1},x_{sj1},g_{csj},\tau_{lj}} u(c_{sj}) + \theta V(a_{csj}, h_{csj2}, g_{csj}) - \xi_s d(\frac{\sigma_{h_{csj2}}}{\mu_{h_{csj2}}}),$$

subject to

$$c_{sj} + x_{sj1} + g_{csj} = (1 - \tau_s - \tau_{lj})y_{sj}.$$

(1), (4), and $\tau_{lj} \geqq 0$.

- Next, based on $\{c_{sj1}, x_{sj1}, g_{csj}, \tau_{lj}\}$, school districts choose τ_{sj}.
    - The equilibrium income tax rate τ_{sm} must satisfy

$$\int I_{\{\tau_{sj} \geqq \tau_{sm}\}} dF(y_{sj}) \geq \frac{1}{2},$$

$$\int I_{\{\tau_{sj} \leqq \tau_{sm}\}} dF(y_{sj}) \geq \frac{1}{2}.$$

Equalization Program

- State government sets z_s.
- If actual tax revenue is less than the revenue based on z_s, the difference is funded by τ_s.
- Thus, $\bar{x_{sj}}$ and τ_s can be written as

$$\bar{x_{sj}} = \begin{cases} \tau_{lj} z_s & (\text{if } y_j \leqq z_s) \\ \tau_{lj} y_{sj} & (\text{otherwise}) \end{cases}, \tag{5}$$

$$\tau_s \mu = \int_j \tau_{lj} (z_s - y_{sj}). \tag{6}$$

Equalization Program

- First, given z_s, school district's utility maximization problem is

$$max_{c_{sj},x_{sj1},g_{csj},\tau_{lj}} u(c_{sj}) + \theta V(a_{csj}, h_{csj2}, g_{csj}) - \xi_s d(\frac{\sigma_{h_{csj2}}}{\mu_{h_{csj2}}}),$$

subject to

$$c_{sj} + x_{sj1} + g_{csj} = (1 - \tau_s - \tau_{lj})y_{sj}.$$

subject to (1), (5) ,(6), and $\tau_{lj} \geqq 0$.

- Next, based on $\{c_{sj1}, x_{sj1}, g_{csj}, \tau_{lj}\}$, school districts choose z_{sj}.
    - The equilibrium income tax rate z_{sm} must satisfy

$$\int I_{\{z_{sj} \geqq z_{sm}\}} dF(y_{sj}) \geq \frac{1}{2},$$

$$\int I_{\{z_{sj} \leqq z_{sm}\}} dF(y_{sj}) \geq \frac{1}{2}.$$

Recap of Model Elements

- Parents matter: Income, Schooling.
- States matter: Public school finance systems, Distribution of income, Inequality over redistribution.
- District matter: Local tax.
- Student matter: Ability.

Calibration

- Preferences: CRRA utility function,

$$\frac{c_{sj}^{1-\alpha}}{1-\alpha} + \theta V(a_{csj}, h_{csj2}, g_{csj}) - \xi_s \frac{(\frac{\sigma_{h_{csj}}}{\mu_{h_{csj}}})^{1-\kappa}}{1-\kappa},$$

$$V(a_{csj}, h_{csj}, g_{csj}) = \frac{c_{csj2}^{1-\zeta}}{1-\zeta} + \beta \frac{c_{csj3}^{1-\zeta}}{1-\zeta}.$$

- District income: Parametrized as

$$y_{sj} = w_{sj} h_{sj} = w_{sj} exp(\phi s_{sj}) \iota_s$$

- Child's learning ability:

$$a_{csj} = exp(\rho s_{sj}) \epsilon_{sj},$$

where $\epsilon_{sj} \sim logN(\mu_s, \sigma_s^2)$.

Fixed Parameters (Table 4)

Parameter	Value	Description
α	2.0	CRRA coefficient, $\frac{c_{sj}^{1-\alpha}}{1-\alpha}$.
ζ	2.0	CRRA coefficient, $\frac{h_{csj}^{1-\zeta}}{1-\zeta}$.
θ	0.5	Coefficient of Altruism
β	0.96^6	Discount factor
r	$(1+0.04)^6-1$	Interest Rate
ϕ	0.1	Return of schooling on human capital, Mincer (1974)
η_1	0.4	Return of time for human capital
η_2	0.2	Return of private inputs
ρ	0.05	Coefficient of schooling for child's learning ability.

Estimation

- Estimated Parameters: $[\kappa, \gamma_1, \gamma_2]$ and $[\xi_s, \mu_s, \sigma_s^2]$.
- Estimate $[\kappa, \gamma_1, \gamma_2, \xi, \mu_s, \sigma_s^2]$ in Washington State and $[\xi_s, \mu_s, \sigma_s^2]$ in others.
- Use simulated method of moments.
- Targeted moments:
  1. Average public school spending per pupil
  2. Average child family income.
  3. Coefficient of variation on child family income.
  4. 10 percentile of child family income.
  5. 90 percentile of child family income.
  6. Correlation between school district income and child family income.
  7. Correlation between school district income and public school spending per pupil.
- Washington (Full state funding): Use 1-6.
- California (Full state funding): Use 1-3.
- Others (Foundation program): Use 1,2, and 7.

Estimation Result

- $\kappa = 2.198, \gamma_1 = 0.106, \gamma_2$=0.379.

Parameter	s =CA	s =CO	s =GA	s =MI	s =NH	s =NJ	s =OH	s =OR	s =VA	s =WA
ξ_s	0.333	0.826	0.668	0.699	0.610	0.471	0.479	0.429	0.814	0.051
μ_s	1.099	1.217	0.924	0.983	0.949	1.039	0.990	1.074	0.994	1.198
σ_s	0.392	0.158	0.378	0.468	0.554	0.481	0.497	0.354	0.481	0.219

Table 5: Parameter Estimates $[\xi_s, \mu_s, \sigma_s]$

Selected Targeted Moments

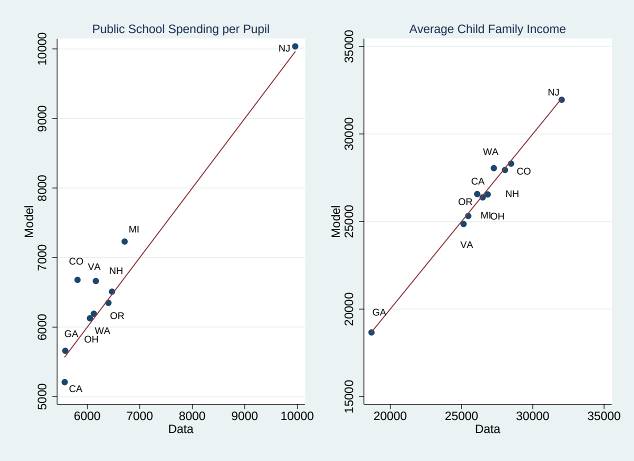

Figure 3

Selected Targeted Moments

Figure 4: Public School Spending by Parents' Income

Linearity of Rank-Rank

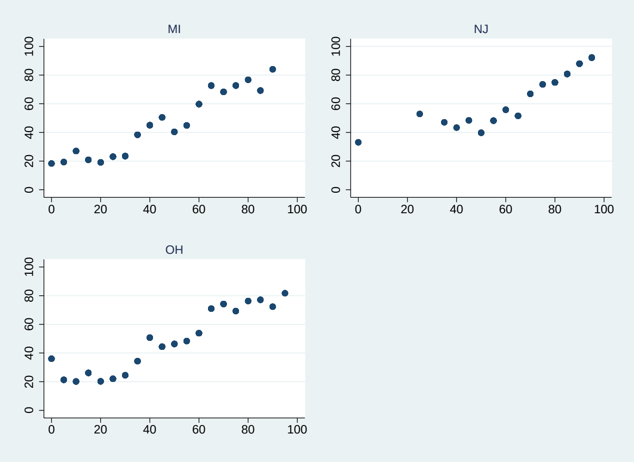

Figure 5: Mean of Child Income Ranking by Adult Income Ranking

Rank-Rank Slope

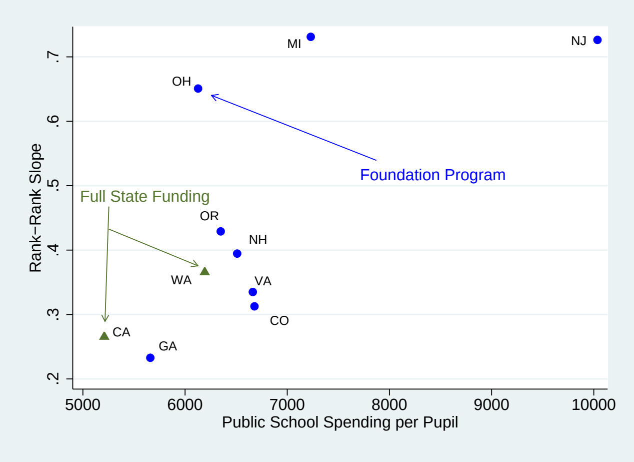

Figure 6

Counterfactual Simulations

- Three counterfactual simulations.

1. No heterogeneity on coefficient of disutility from inequality.
   - $\xi_s = \xi_{s'} = \bar{\xi_s}$.
   - $\xi_s = \xi_{s'} = 0$.
2. No heterogeneity in public school finance system.
   - Switch to a full state funding.
3. No heterogeneity in public school spending.
   - $\bar{x_{js}} = x_{j's'} = \bar{x}$.

Same Disutility from Inequality

- Overall, there are modest changes.

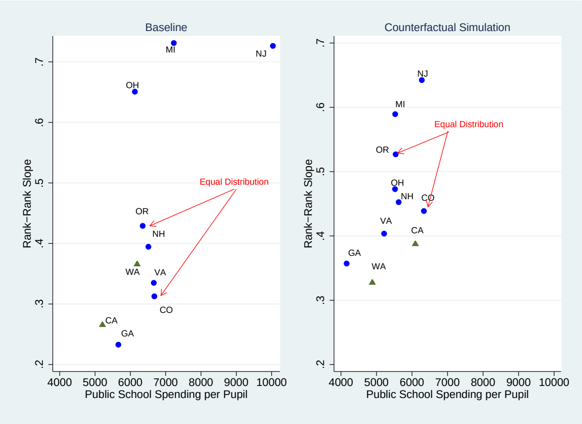

Figure 7

No Disutility from Inequality

- Intergenerational mobility becomes lower in Colorado and Oregon.

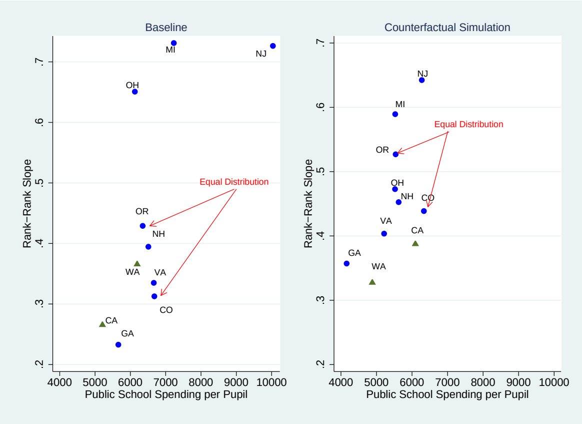

Figure 8

Switching to a Full State Funding

- Improves intergenerational mobility.
  - Especially for states which have unequal distribution.

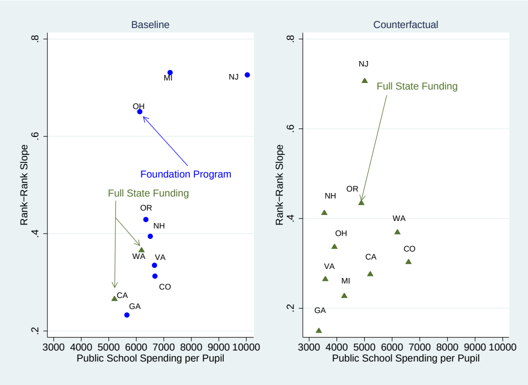

Figure 9

Same Public School Spending

- Impact of level of public school spending is modest.

Figure 10

Conclusion

- Public school spending can account for 30% of the variation in intergenerational mobility across school districts.
- Three aspects: Level, educational policy and distribution.
- Counterfactual simulations show that the impact of the distribution of the public school spending and educational policy is large.