

Oligopsony and Collective Bargaining

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Research Question: Study presence and consequences of oligopsony power and collective bargaining for K-12 Teachers in Pennsylvania

Why is this interesting?

- Teachers have specialized skills, but are almost entirely employed by locally monopolistic school-boards: oligopsony power.
- Galbraith (1954) talks about the “countervailing” power of labor unions in the presence of monopsonistic employer.
- Unions are prevalent across the world (40 percent of Quebec’s labor force), as is collective wage setting across sectors (Germany), and in the public sector (33 percent in US).

What we do

- Use detailed microdata on all teachers and schools in Pennsylvania.
- Nash-in-Nash Bargaining model with externalities applied to the labor market.
- Use estimated model to simulate:
 1. Efficiency of Unions.
 2. Equilibrium labor market outcomes without teacher unions.
 3. Outcomes where union negotiates one schedule for entire state - Sectoral Bargaining.

Oligopsony and Collective Bargaining Model

Preliminary Evidence

Structural Model

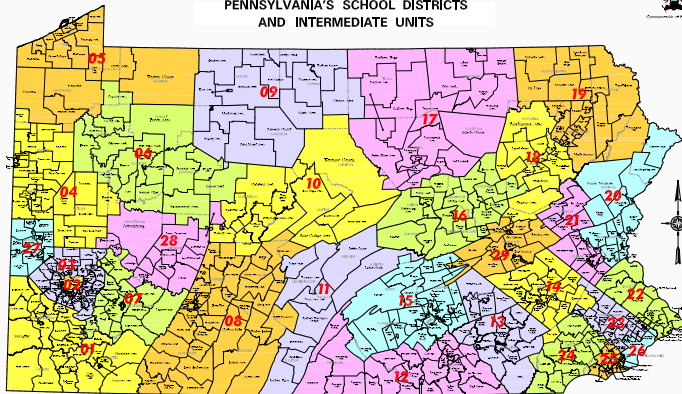
Estimation

Counterfactuals

The Setting: Public Schools in Pennsylvania

- 499 School Districts and 245 Charter Schools in Pennsylvania — over 90% teachers in School Districts.
- School Districts and Teachers Unions negotiate a collective agreement. Few unions in charter schools.
- Salaries are schedules based on experience and degree alone.
- Salaries vary tremendously between districts: Lower Merion (\$100,000) versus North Star (\$48,000). This is also true locally (Philly SD \$69,000 next to Lower Merion).

PENNSYLVANIA'S SCHOOL DISTRICTS AND INTERMEDIATE UNITS



PENNSYLVANIA'S INTERMEDIATE UNITS

Key - IU Name

- 01 - Intermediate Unit 1
- 02 - Pittsburgh - Mt. Oliver IU 2
- 03 - Allegheny IU 3
- 04 - Midwestern IU 4
- 05 - Northwest Tri - County IU 5
- 06 - Riverview IU 6
- 07 - Westmoreland IU 7
- 08 - Appalachia IU 8

Key - IU Name

- 09 - Seneca Highlands IU 9
- 10 - Central IU 10
- 11 - Tuscarora IU 11
- 12 - Lincoln IU 12
- 13 - Lancaster - Lebanon IU 13
- 14 - Berks County IU 14
- 15 - Capital Area IU 15
- 16 - Central Susquehanna IU 16

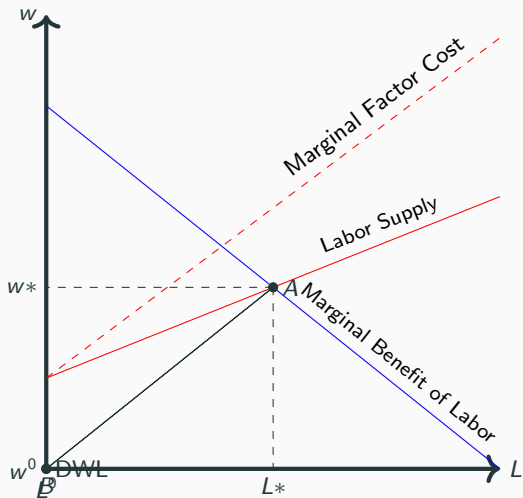
Key - IU Name

- 17 - Blast IU 17
- 18 - Luzerne IU 18
- 19 - Northeastern Educational IU 19
- 20 - Colonial IU 20
- 21 - Carbon - Lehigh IU 21
- 22 - Bucks County IU 22
- 23 - Montgomery County IU 23
- 24 - Chester County IU 24

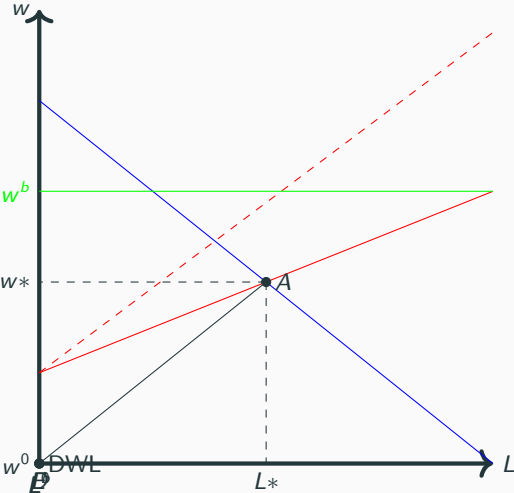
Key - IU Name

- 25 - Delaware County IU 25
 - 26 - Philadelphia IU 26
 - 27 - Beaver Valley IU 27
 - 28 - ARIN IU 28
 - 29 - Schuylkill IU 29
- County Boundary Line

Monoposy Distortion



Bargaining Distortion



1. Nash-in-Nash Bargaining between Schools and Local Teachers Unions on wage (**Wage Setting**).
2. School Districts make offers to teachers conditional on negotiated wages. This combine the Medoff Model and allowing for wages to be too high to clear the market (**Hiring**).
3. Teachers decided whom to work for (**Labor Supply**).

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Preliminary Evidence on Bargaining and oligopsony

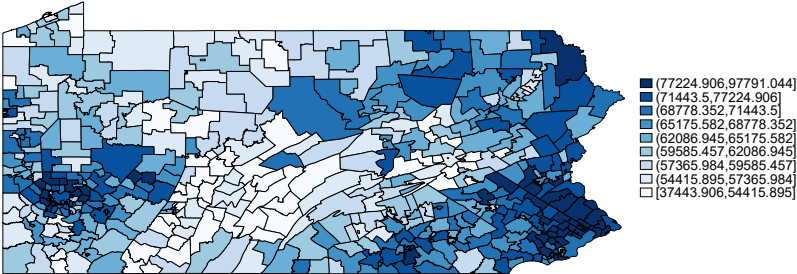
1. Institutional Features.
2. Oligopsony distortion.
3. Charter versus Public School Districts
4. Bargaining and Wage Dispersion.

Institutional Features

1. Teachers are about 1% of the labor force.
2. Teacher training is required for a specific task.
3. Government Dominant Employer.
4. Uniform wage schedule based on years of experience and masters degree:
no wage discrimination issues. We know what a teacher would make in any job.

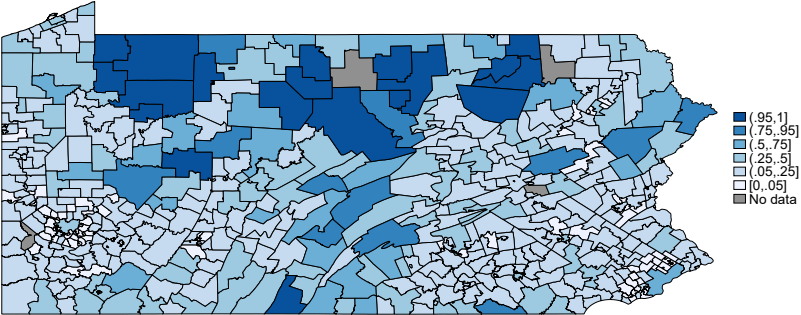
Average Salaries Vary Across Districts

2017-2018 Average Salary By School District

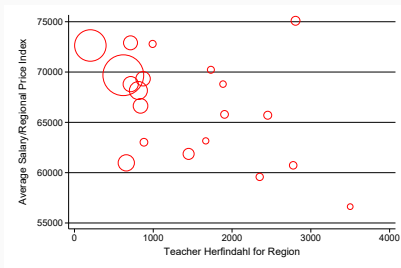


Concentration Varies Across Districts

2017-2018 Share of Teachers in a 10 Mile Radius Employed By School District



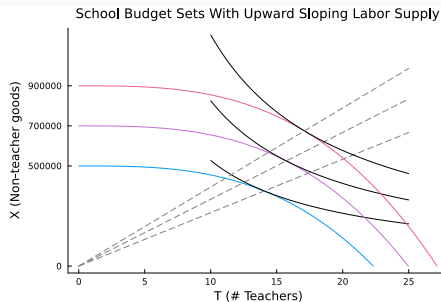
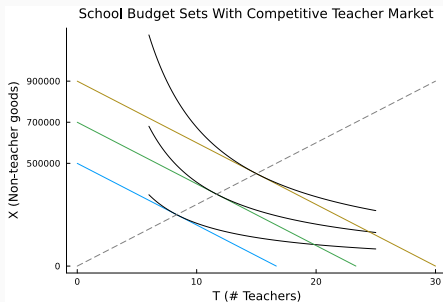
Wage-Concentration: IO's "Forbidden" Regression



	Salary Over Cost of Living Index		
	(1)	(2)	(3)
log(Districts Within 10 Miles)	0.06 (0.01)	0.05 (0.01)	
≤ 5 Districts within 10 Miles			-0.09 (0.02)
> 5 and < 15 within 10 Miles			-0.05 (0.02)
Observations	1087387	1087387	1087387
R^2	0.52	0.54	0.59

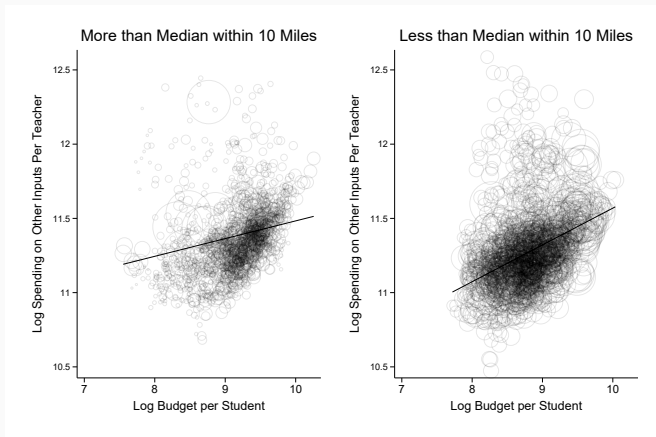
Budget Expansion and Elasticity of Labor Supply to School District

- School District Choosing Teachers T and non-teacher input X — which is a competitive input.



- Engel Curve will be steeper in concentrated markets than competitive markets.

Budget Expansion and Elasticity of Labor Supply to School District



- Charter School teachers rarely unionized.
- 2017-2018 AY Average Annual Salary of Public School Teachers was \$68,631 vs \$50,601 in Charter Schools.
- Compensating differentials have difficulty explaining this: quit rates for charter schools are higher — conditional on salary.

- Similar teachers get very different wages in neighboring school districts.
- No evidence of teacher wages differing on unobservables: when a teacher moves across the state, their arrival school salary rank is not significantly correlated with their departure school rank.

Oligopsony and Collective Bargaining Model

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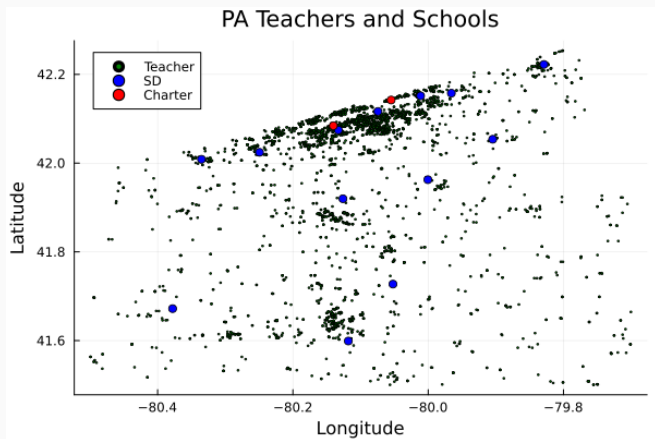
Structural Model

Estimation

Counterfactuals

Three different components:

1. Labor Supply.
2. Labor Demand: School District Hiring.
3. Wage Formation: Nash Bargaining.



- Teachers $i = 1, \dots, N$ receive utility from working in school district $j = 1, \dots, J$ is given by:

$$u_{ij} = \psi w_j - \tau \underbrace{d_{ij}}_{\text{commuting distance}} + x_j \beta_i + \epsilon_{ij}, \quad (1)$$

ϵ_{ij} is a standard logit shock. Each teacher has a reservation utility for working r .

- Teachers choose among their offers ($\sigma_{ij} \in 0, 1$)/not working that yields the highest u_{ij} .

$$s_{ij} = \frac{\exp(\delta_{ij}) \sigma_{ij}}{\exp(r) + \sum_k \exp(\delta_{ik}) \sigma_{ik}} \quad (2)$$

- Nested Logit for the outside option of not teaching with nesting parameter σ .
- Moving to a mixed logit $u_{ij} = \delta_{ij} + \sigma \nu_i + \epsilon_{it}$, where ν_i is a shock to the value of being inside the teaching profession.

Structural Model: Hiring

Schools have an educational production function over teachers T_j and other inputs X_j given by:

$$W(X_j, T_j) = T_j^\gamma X_j^{1-\gamma} = T_j^\gamma (B_j - w_j T_j)^{1-\gamma} \quad (3)$$

Want to equalize revenue share:

$$\frac{\gamma}{1-\gamma} = \frac{w_j T_j}{B_j - w_j T_j} \quad (4)$$

- Send out offers o_{ij} to teachers to hit this target, but notice that you might run out of teachers to hire for a given wage w_j .
- Notice that offers $o_{ij}(\mathcal{O}_{-j})$ depend on offers of other school districts.
- Moving to a CES Production Function: non-unit elasticity of labor demand.

Negotiation over wages between leads to firms maximizing the Nash Product:

$$\mathcal{N}(w_j|w_{-j}) = [W(T^*(w_j, w_{-j}), B_j - w_j T^*(w_j, w_{-j}))]^{\alpha b} [w_j T_j(w_j, w_{-j})]^{1-\alpha b} \quad (5)$$

- Schools care about educational production.
- Unions care about total membership revenue.
- We have also run the model with the union objective function: $w_j - r$.
- Notice that this is conditioned on the wages set by other school districts: Nash-in-Nash.

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Three different sets of parameters to estimate:

1. Labor Supply Parameters ($\beta, \tau, \psi, \sigma$).
2. School District Production Function Parameters (γ): Labor Demand.
3. Nash Bargaining weights α_b by school district: wages.

- Offers $o_{ij} \in \{0, 1\}$ are unknown, yielding an unobserved choice set problem.
- We use the IIA insights in McFadden (1984) that require only to have two choices that are known to be in the choice set: current job versus the outside option (quit decision).
- This works for inside option nest: for outside option we need to estimate the nesting parameter σ and reservation value r by indirect inference.

Labor Supply Estimates

Dependent var: Quit	(1)	(2)
Real Salary (thousands)	-0.00373 (0.00103)	-0.00377 (0.00103)
Commute Time (minutes)	0.00019 (0.00005)	
Commute Time in IQ Range		0.00560 (0.00186)
Commute Time above 75th		0.00787 (0.00211)
Fraction on Free Lunch	0.01270 (0.00587)	0.01265 (0.00591)
Charter	0.02269 (0.00248)	0.02286 (0.00245)
Observations	59480	59480

- MRS between commuting and salary: \$ 76 a hour assuming a 200 day schoolyear.
- Schools with Poor Kids and Charter Schools are disliked.
- Own wage elasticity between 4 and 5.

Parameters pinned down by indirect inference about the outside option:

- Nesting σ 0.8.
- Reservation wage.

Table 1: Erie Elasticities with All Offers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	O
1	5.552	-1.45	-0.011	-0.622	-0.551	-0.539	-0.197	-0.275	-0.026	-0.399	-0.037	-1.008	-0.059	-0.0	-0.0	-0.0
2	-0.609	4.414	-0.007	-0.447	-0.554	-0.501	-0.135	-0.185	-0.017	-0.284	-0.025	-1.277	-0.058	-0.0	-0.0	-0.001
3	-0.083	-0.14	5.005	-0.952	-0.785	-0.499	-0.222	-1.353	-0.123	-1.052	-0.221	-0.268	-0.166	-0.001	-0.002	-0.0
4	-0.162	-0.278	-0.031	4.641	-0.746	-0.566	-0.286	-0.994	-0.092	-0.965	-0.157	-0.364	-0.133	-0.001	-0.002	-0.001
5	-0.167	-0.401	-0.03	-0.869	5.562	-0.575	-0.212	-1.052	-0.094	-0.853	-0.18	-0.492	-0.152	-0.001	-0.002	-0.001
6	-0.227	-0.501	-0.026	-0.912	-0.796	5.188	-0.234	-0.873	-0.079	-0.799	-0.142	-0.565	-0.13	-0.001	-0.001	-0.001
7	-0.204	-0.334	-0.029	-1.135	-0.724	-0.578	5.462	-0.916	-0.084	-0.905	-0.144	-0.401	-0.124	-0.001	-0.001	-0.0
8	-0.062	-0.1	-0.039	-0.865	-0.787	-0.471	-0.201	4.834	-0.135	-0.976	-0.289	-0.246	-0.183	-0.001	-0.002	-0.001
9	-0.066	-0.105	-0.039	-0.892	-0.784	-0.477	-0.207	-1.507	5.375	-1.004	-0.263	-0.248	-0.178	-0.001	-0.002	-0.0
10	-0.11	-0.187	-0.037	-1.023	-0.777	-0.526	-0.241	-1.189	-0.109	5.045	-0.189	-0.297	-0.152	-0.001	-0.002	-0.001
11	-0.048	-0.079	-0.036	-0.785	-0.774	-0.441	-0.181	-1.664	-0.135	-0.894	5.15	-0.211	-0.198	-0.001	-0.002	-0.0
12	-0.429	-1.293	-0.014	-0.593	-0.689	-0.572	-0.165	-0.46	-0.041	-0.456	-0.069	4.993	-0.092	-0.0	-0.001	-0.001
13	-0.097	-0.229	-0.035	-0.845	-0.833	-0.513	-0.199	-1.338	-0.116	-0.911	-0.252	-0.361	4.716	-0.001	-0.002	-0.0
14	-0.107	-0.18	-0.037	-1.028	-0.773	-0.523	-0.243	-1.197	-0.11	-1.068	-0.191	-0.29	-0.152	4.167	-0.002	-0.0
15	-0.074	-0.117	-0.04	-0.929	-0.783	-0.488	-0.216	-1.427	-0.129	-1.035	-0.24	-0.255	-0.171	-0.001	4.995	-0.0
O	-0.0	-0.001	-0.0	-0.001	-0.001	-0.001	-0.0	-0.001	-0.0	-0.001	-0.0	-0.001	-0.0	-0.0	-0.0	0.048

Table 2: Bolded Elasticities emphasize schools that are very close to each other.

Table 3: Erie Elasticities with Restricted Offers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	O
1	0.944	-0.555	-0.016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.185	0.0	-0.001	-0.001	-0.0
2	-0.353	1.562	-0.006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.013	0.0	-0.0	-0.0	-0.001
3	-0.004	-0.002	0.848	-0.008	-0.02	-0.013	-0.032	-0.015	-0.089	-0.094	-0.033	-0.008	-0.074	-0.091	-0.201	-0.003
4	0.0	0.0	-0.05	1.267	0.0	0.0	-1.077	0.0	0.0	0.0	0.0	0.0	0.0	-0.001	-0.002	-0.0
5	0.0	0.0	-0.104	0.0	0.754	-0.13	0.0	0.0	0.0	0.0	0.0	0.0	-0.237	-0.002	-0.005	-0.0
6	0.0	0.0	-0.064	0.0	-0.127	0.341	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.002	-0.003	-0.0
7	0.0	0.0	-0.157	-0.822	0.0	0.0	1.175	0.0	0.0	0.0	0.0	0.0	0.0	-0.005	-0.008	-0.0
8	0.0	0.0	-0.073	0.0	0.0	0.0	0.0	1.683	-0.376	0.0	-0.675	0.0	-0.179	-0.001	-0.005	-0.0
9	0.0	0.0	-0.756	0.0	0.0	0.0	0.0	-0.67	2.747	0.0	-0.492	0.0	-0.57	-0.011	-0.044	-0.0
10	0.0	0.0	-0.158	0.0	0.0	0.0	0.0	0.0	0.0	0.357	0.0	0.0	0.0	-0.004	-0.007	-0.001
11	0.0	0.0	-0.16	0.0	0.0	0.0	0.0	-0.693	-0.283	0.0	1.63	0.0	-0.346	-0.002	-0.01	-0.0
12	-0.137	-1.178	-0.025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.447	0.0	-0.001	-0.001	-0.001
13	0.0	0.0	-0.492	0.0	-0.305	0.0	0.0	-0.25	-0.446	0.0	-0.47	0.0	1.881	-0.008	-0.026	-0.0
14	-0.006	-0.003	-4.013	-0.01	-0.019	-0.015	-0.041	-0.009	-0.055	-0.112	-0.02	-0.008	-0.051	3.891	-0.192	-0.0
15	-0.003	-0.001	-4.164	-0.008	-0.02	-0.012	-0.031	-0.021	-0.108	-0.091	-0.043	-0.008	-0.081	-0.09	4.797	-0.0
O	-0.0	-0.001	-0.003	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.001	-0.0	-0.001	-0.0	-0.0	-0.0	0.059

Table 4: Bolded Elasticities emphasize schools that are very close to each other.

Estimation: Production Function

- If labor supply is not binding then we just have identification from the first-order condition from cost minimization.
- Thus as in Cobb Douglas

$$\frac{\gamma}{1 - \gamma} = \frac{w_j T_j}{B_j - w_j T_j}$$

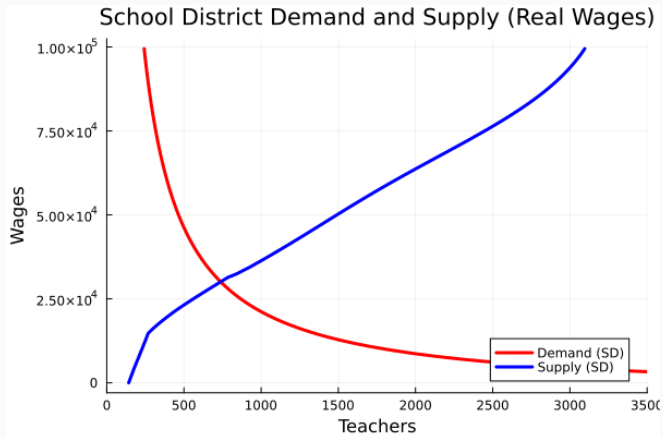
- Note: fringe benefits a huge part of compensation: around \$0.50 for each \$1 in wages: call this fringe inclusive wage \hat{w} .

- But if labor supply is binding (given the wage), then there is upward censoring on the teacher share.
- Use a moment inequality estimator.

$$Q(\gamma) = \sum_j \left(\gamma - \frac{\hat{w}_j T_j}{B_j - \hat{w}_j T_j} \right)^2 1(\text{binding labor supply}_j) \\ + \left(\gamma - \frac{\hat{w}_j T_j}{B_j - \hat{w}_j T \hat{w}_j} \right)^2 1(\text{non-binding labor supply}_j)$$

- Estimate is: $\hat{\gamma} = 0.343$.

Erie Area Supply and Demand

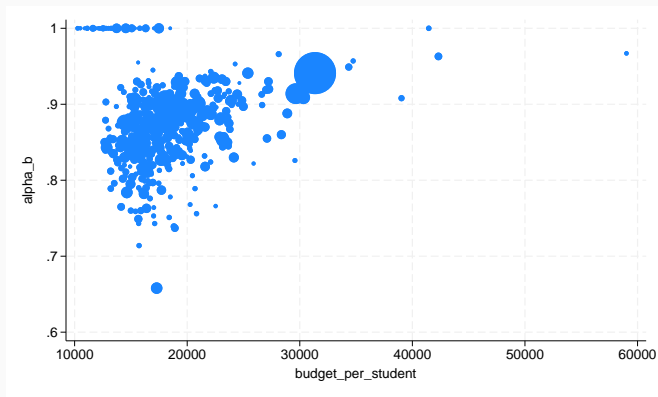


- Maximize Nash Product (conditional on other wages)

$$\mathcal{N}(w_j, w_{-j}) = W(T_j, B_j - w_j T_j)^{\alpha_b} [w_j T_j]^{1-\alpha_b}$$

- Conditional on T_j and w_j , find the α_b by school district that solves the FOC (à la Grennan)
- Fixing the Charter Schools Bargaining Parameters at $\alpha_b = 1$.

Bargaining Parameters



- Top are charter schools pinned to 1.
- Small correlation between budget per student and bargaining parameter.

1. Fix (σ, r) .
2. Estimate Labor Supply Parameters.
3. Estimate Labor Demand Parameters.
4. Estimate Bargaining Parameters.
5. Predict wages $\hat{w}(\sigma, r)_j$ and teachers $\hat{T}(\sigma, r)_j$.
6. Match these to wages and teacher numbers, in particular for charter schools.

Oligopsony and Collective Bargaining Model

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Structural Model

Estimation

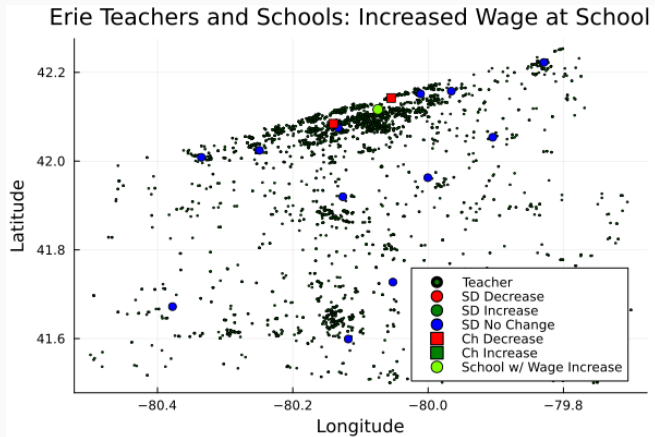
Counterfactuals

- Posted Wages.
- Social Planner.
- Nash Bargaining

	Real	Nash Bargaining	Planner	Posted
Weighted Median Wage	55,326	56,001	50,721	45,001
Number of Teachers	107,591	107,428	120,777	119,233

- Planner wages are always higher than posted wages.
- But this hides a lot of heterogeneity
 - Nash Bargaining wages higher than posted wages in 419 districts, lower in 92 of these.
 - This is strictly due to externalities between districts.
- Reasonable Model fit of the Nash Bargaining model on aggregate.

Do unions raise or lower the wages of non-unionized workers



Thank you!