The equilibrium effects of state-mandated minimum staff-to-child ratios

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- Effects on skills of children unexplored Why do we care about skills?

Motivation: Effects on skills?

- Policy rationale: Increase quality of paid childcare
- Empirical evidence: Increases quality, decreases quantity Hotz and Xiao (2011)
  Cross-sectional regressions
- **Aggregate** market-level evidence, hard to map to **individual** effects on skills
  - Who are the children who gain/lose skills?
  - Overall effect on skill distribution?

This Paper

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  - Endogenizes the wages of teachers and childcare workers
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  - Endogenizes the wages of teachers and childcare workers
  - Allows for rich family heterogeneity
- Estimate the model combining individual-level data and state-level data

Model, Overview

- **Families**
  - Heterogeneous in:
    - Household structure (2 Parents vs 1 Parent)
    - Parenting quality
    - Quality and quantity of care by relatives
    - Initial assets and wages
    - Initial skills of children
  - Choose:
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- **Teachers**
  - Two types: Lead teachers and childcare workers, elastic supply

Families, preferences

- Unitary household formed by mother m, child, maybe father f.
- Three periods: When child is 9 months, 2 years, and 4 years old.

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- Unitary household formed by mother m, child, maybe father f.
- Three periods: When child is 9 months, 2 years, and 4 years old.
- In periods $t = 1, 2, 3$ families derive flow utility according to:

$$\log c_t + \delta_l^m \log l_t^m + \delta_l^f \log l_t^f + \delta_\tau^m \log \tau_t^m + \delta_\tau^f \log \tau_t^f + \delta_{\theta,t} \log \theta_t$$

- The continuation utility at period 4 is given by:

$$V_4(a_4, \theta_4) = \delta_a \log a_4 + \delta_{\theta,4} \log \theta_4$$

  - c: Consumption
  - l^j: Leisure of parent j
  - τ^j: Time with child of parent j.
  - θ_t: Cognitive skills of child
  - a_t: Assets

Families, constraints

- Budget constraint

$$P^D(q_t^P, \tau_t^P) + c_t + a_{t+1} = w^f n_t^f + w^m n_t^m + a_t(1 + r)$$

- Paid care is center or home-based

$$D \in \{CB, HB, N\}$$

- Time use constraint for parents

$$l^j + \tau^j + n^j = \overline{T}$$

- Supervision constraint for child

$$\tau^m + \tau^f + \tau^r + \tau^P = \overline{T}$$

Families, Production Function of skills

- Child skills produced according to:

$$\log \theta_{t+1} = \log A_t + \gamma_{\theta,t} \log \theta_t + \gamma_{m,t} \frac{\tau_t^m}{\overline{T}} \log q^m$$
$$+\gamma_{f,t} \frac{\tau_t^f}{\overline{T}} \log q^f + \gamma_{P,t} \frac{\tau_t^P}{\overline{T}} \log q_t^P + \gamma_{r,t} \frac{\tau_t^r}{\overline{T}} \log q^r + \eta_{t+1}$$

- In the previous expression:
  - q: Quality
  - A_t: Time varying TFP
  - η_{t+1}: Skill accumulation shock
- Quality of parental time and care by relatives exogenous and heterogeneous across families
- Quality of paid care is endogenous and purchased on the market

Families, utility costs

- Stochastic cost o_t^D of using paid care $D = HB, CB$.
- Drawn in each period by each family
- o_t^{HB} and o_t^{CB} independent from each other and their own leads/lags
- $o_t^D \sim \exp(\lambda_t^D)$

Providers, Production function of quality

- Quality of care produced according to:

$$q_t^D = A_t^D \left(\frac{E_t}{k_t}\right)^{\alpha_{E,t}^D} \left(\frac{C_t}{k_t}\right)^{1-\alpha_{E,t}^D}$$

- Where
  - E: Efficiency units of the lead teacher
  - C: Number of caregivers (includes the lead teacher)
  - k: Children in the classroom, "kids"

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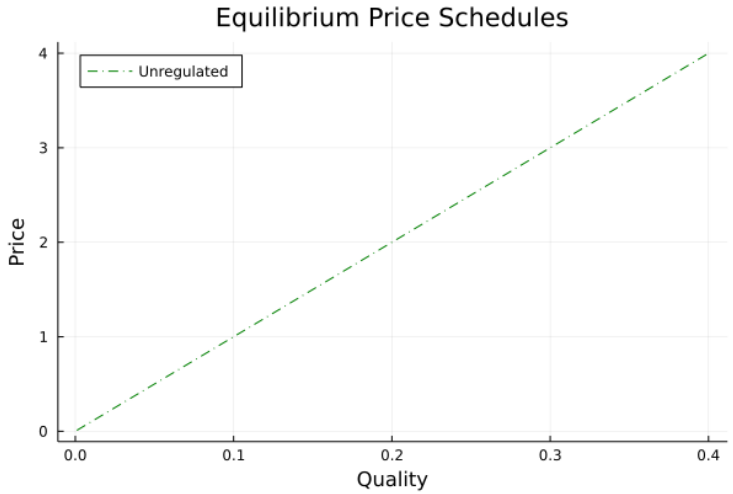
- Where
  - E: Efficiency units of the lead teacher
  - C: Number of caregivers (includes the lead teacher)
  - k: Children in the classroom, "kids"
- Regulations: Staff-to-child ratio cannot be below minimum regulated:

$$\frac{C_t}{k_t} \geq \underline{R_t^D}$$

Providers, pricing schedule



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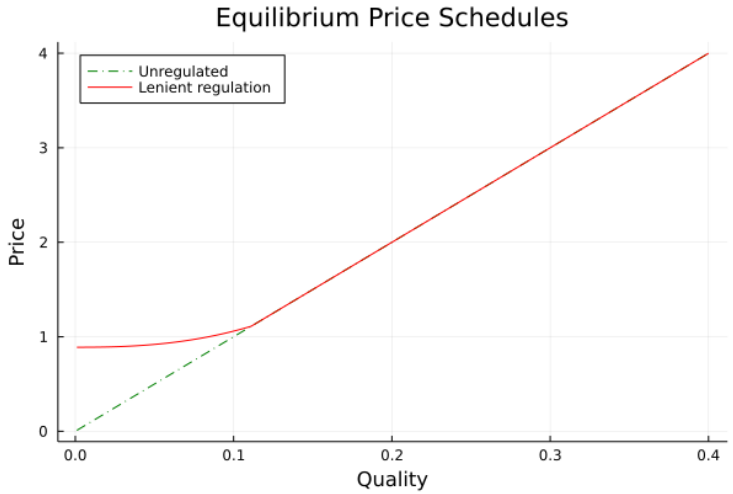

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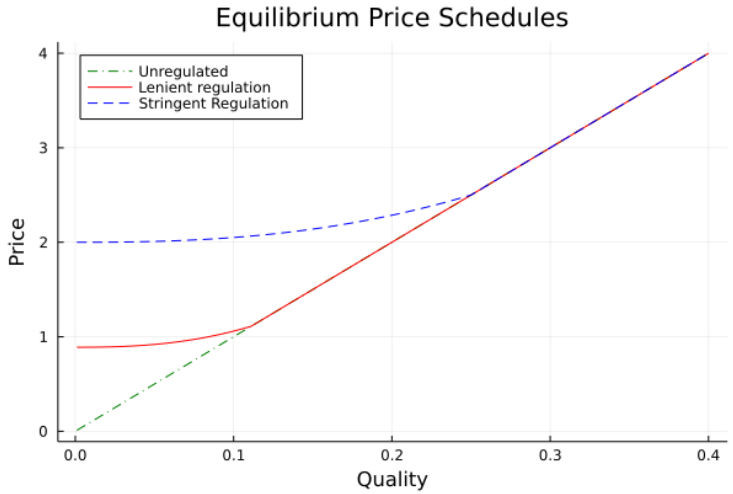

Labor supply of teachers

- Constant elasticity of labor supply
- Potentially different elasticity for lead teachers and childcare workers

Identification overview

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  - Data on regulations, wages and employment of teachers

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- PF of quality
  - Share of lead-teacher talent: Bill shares for undistorted providers
- Supply of teachers
  - Elasticity: Cross-state, employment and wages. Lagged fertility as IV for demand

Some interesting estimation results

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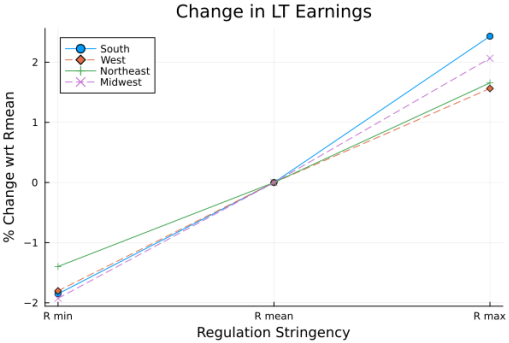
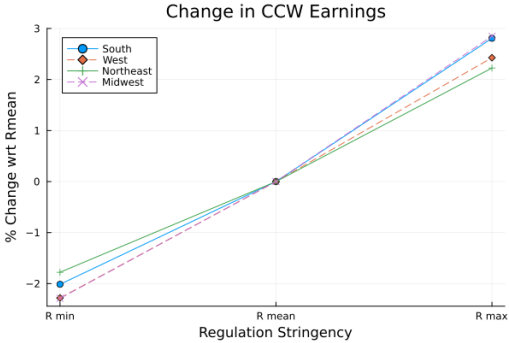
- Quality of care provided by relatives very correlated with parental care quality
- Mothers care more about time with their child than fathers

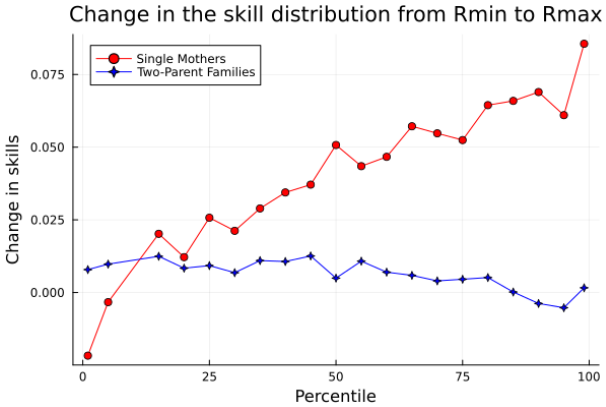
Effects on teachers' wages (GE effect)





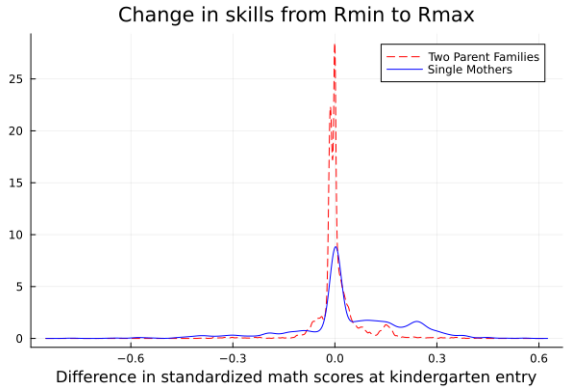
- $\uparrow$ stringency $\implies$ $\uparrow$ teacher's wages (quantitative, not theoretical result).
- Not negligible impact ($\sim$ 1.5 %-3% in either direction)
- Some heterogeneity by region (due to different family heterogeneity).

Effects on the skill distribution



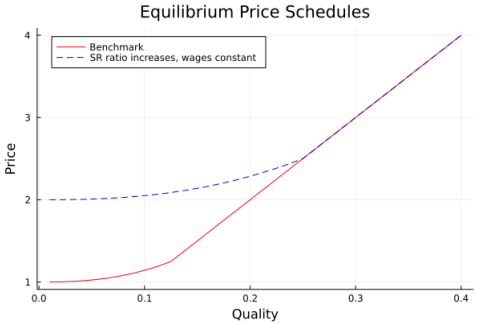
- With more stringent staff-to-child ratios:
  - Two-parent families: Skill distribution better overall
  - Single Mothers: Skill distribution better at the top, worse at the bottom

Skill gainers and losers



- Children of Single mothers more affected by change in stringency
- Large gains for some children, large losses for others

Price schedule and problem of the family



- ↑ Price $\Longrightarrow$ families reduce paid care $\Longrightarrow$ skill losses
- Flattening of price schedule $\Longrightarrow$ families that stay buy higher quality $\Longrightarrow$ skill gains
- Response depends on substitution possibilities: Availability of relative care and assets
- Poorer families buy lower quality $\Longrightarrow$ more exposed

Family characteristics of skill gainers and losers (SM families)

- Largest effects for children born to poor families (largest gains and losses)
- Whose children gain and lose depends on substitution possibilities
- $\uparrow$ substitution possibilities $\Longrightarrow$ large skill losses
  - More care by relatives available
  - More initial assets
- Large skill redistribution within children of poor families
  - Large skill gains: At least 30 % of a standard deviation in math test score
  - Large skill loss: At least 30 % of a standard deviation in math test score

	Big skill gains	Skill gains	Skill losses	Big skill losses
Mother's wage ($/hour)	8	10	10	7
Available relative care (hrs/week)	38	77	90	96
Initial net worth ($)	8,000	26,000	65,000	33,000

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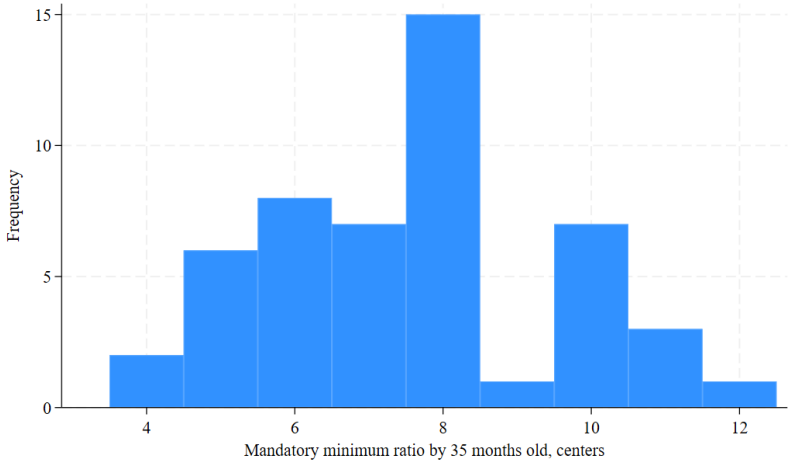
  - Mostly positive effects on the skill distribution...
  - ... but negative at the left tail of children born to SM
  - Largest skill gain and losses concentrated among poor children
    - Skill gainers have less relative care available and assets
    - Skill losers have more relative care available and assets

Thank You!

Regulations across states



Back

Market failures

- Incomplete markets
  - Borrowing constraints against future parental income
    - Caucutt and Lochner; Lee and Seshadri (2019); Daruich(2018)
  - Borrowing constraints against future income of child
    - Loury (1981); Baland and Robinson (2000) ; Daruich (2018)
- Externalities:
  - Innovation
    - Bell, Chetty, Jaravel, Petkova and Van Reenen
  - Crime
    - Cunha, Heckman, and Schennach (2010); Attanasio, Cardona Sosa, Medina, Meghir, Posso-Suárez (2021)
- Inaccurate parental beliefs
  - Cunha, Elo, Culhane; Attanasio, Boneva, and Rauh (2020)

Back

Price constant expressions

$$\overline{P} = \left[w^E \left(\frac{\alpha_E}{1-\alpha_E} \frac{w^C}{w^E} \right)^{1-\alpha_E} + w^C \left(\frac{1-\alpha_E}{\alpha_E} \frac{w^E}{w^C} \right)^{\alpha_E} \right] \frac{1}{A}$$

$$\underline{P} = w^E \left(\frac{1}{\underline{R}_I} \right)^{\frac{1-\alpha_E}{\alpha_E}} \left(\frac{1}{A} \right)^{\frac{1}{\alpha_E}}$$

Back

Details parental quality measures

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- For mother, survey questions and objective measure available
  - **Survey questions**: Used book on parenting (+), hits child (-), etc
  - Objective measure: Two-Bag score: Ratings of play style of mother with child on
    - Cognitive development, Emotional support (+)
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- For father, only survey questions
  - Read books to child (+), Spank child (-), Feel trapped by parenthood (-), etc

Back

Identification of Arnett score factor loading

- Remember the Production Function of quality for paid providers:

$$q_t^P = A_t^P \left(\frac{E_t}{k_t}\right)^{\alpha_{E,t}^P} \left(\frac{C_t}{k_t}\right)^{1-\alpha_{E,t}^P}$$

- Taking logs and substituting the measurement system in:

$$ARNETT = \mu^j + \alpha^j \log A_t^P + \alpha^j \left(\alpha_{E,t} \log\left(\frac{E_t}{k_t}\right) + (1-\alpha_{E,t}) \log\left(\frac{C_t}{k_t}\right)\right) + \epsilon_t$$

- Intuition: Cobb-Douglass + constant returns to scale $\implies \frac{\Delta \log q}{\Delta \text{Inputs}} = 1$
- If $\frac{\Delta Arnett}{\Delta \text{Inputs}} = 2 \implies \frac{\Delta Arnett}{\Delta \log q} = 2$

Back

Regulation stringency

Table: Least, average, and most stringent regulations across ages and types of care

	18 months old	3 years old	4 years old
Least stringent, Centers	9	15	20
Least stringent, Homes	10	15	18
Average, Centers	5.28	10.7	12.41
Average, Homes	4.60	6.90	7.07
Most stringent, Centers	3	7	8
Most stringent, Homes	2	3	3

- I report child-to-staff instead to staff-to-child for ease of interpretation
- Regulations become less stringent with age.

Back

Identification $\lambda^{CB}, \lambda^{HB}$

- The probability of not choosing paid care is given by:

$$\mathbb{P}(D_t = N|a_t, H) = e^{-\lambda_{CB}(\tilde{V}_t^{CB}(a_t,H)-\tilde{V}_t^{N}(a_t,H))} e^{-\lambda_{HB}(\tilde{V}_t^{HB}(a_t,H)-\tilde{V}_t^{N}(a_t,H))}$$

- It can be shown that:

$$\frac{\partial \mathbb{P}(D_t = HB|a_t, H)}{\partial \lambda_{HB}} \geq 0$$
$$\frac{\partial \mathbb{P}(D_t = HB|a_t, H)}{\partial \lambda_{CB}} \leq 0$$

- Both inequalities strict if CB, HB strictly preferred to N absent utility costs
- Strict monotoniticty $\implies$ λ_3^{CB}, λ_3^{HB} identified from choice probabilities for CB, HB
- $\lambda_t^{CB}, \lambda_t^{HB}$: Same argument + backward induction

Back

Identification δ_θ

- $\Delta_3^{p,r}$: Change in skills at $t = 4$ when reallocating from relatives to paid care at $t = 3$
- Optimality condition for interior τ^P when care by relatives is interior:

$$\underbrace{\beta\delta_{\theta,4}\Delta_3^{p,r}}_{\text{Gain of reallocating from } \tau^r \text{ to } \tau^P} = \underbrace{\frac{P_3(q_3^P)}{c_3}}_{\text{Cost of reallocating from } \tau^r \text{ to } \tau^P} \quad \text{if } \tau^P > 0, 0 < \tau^r < \overline{T}^r$$

- Re-arranging and taking conditional expectations:

$$\beta\delta_{\theta,4} = \frac{\mathbb{E}[\tilde{P}_3 | \tau^P > 0, 0 < \tau^r < \overline{T}^r]}{\mathbb{E}[\Delta_3^{p,r}\tilde{c}_3 | \tau^P > 0, 0 < \tau^r < \overline{T}^r]}$$

- $\tilde{P}$ and $\cdot\tilde{c}$ denote noisy measures of prices and consumption

Back

Identification of δ_τ^m

- $\Delta_\theta^{m,r}$: Change in skills when reallocating from relatives to mother
- Optimality condition for maternal care when care by relatives is interior:

$$\underbrace{\frac{\delta_\tau^m}{\tau^m} + \beta \Gamma_{t+1}^\theta \Delta_\theta^{m,r}}_{\text{Benefit of reallocating from relative to mother}} = \underbrace{\frac{\delta_l^m}{l^m}}_{\text{Cost of reallocating from relative to mother}} \quad \text{if } 0 < \tau^r < \overline{T}^r$$

- Γ_t^θ: Reduced form, captures flow + expected discounted value of skills.
- Re-arranging and taking conditional expectations:

$$\frac{\delta_\tau^m}{\delta_l^m} = \mathbb{E}\left[\frac{\tau_{i,t}^m}{l_{i,t}^m} | 0 < \tau_{i,t}^r < \overline{T}_i^r\right] - \frac{\beta \Gamma_{t+1}^\theta}{\delta_l^m} \mathbb{E}[\tilde{\Delta}_{\theta,i,t}^{m,r} \tau_{i,t}^m | 0 < \tau_{i,t}^r < \overline{T}_i^r] \ .$$

- $\tilde{\Delta}_{\theta,i,t}^{m,r}$ denotes a noisy measure of $\Delta_{\theta,i,t}^{m,r}$ Back

Empirical association between regulations and childcare market outcomes

- Outcomes: Price, hours, quality at age 2 for center based care

	Price	Quality	Hours paid care/year
Minimum Ratio for Centers	18.09	1.85	-2304.13
	(4.88)	(0.79)	(584.86)
Minimum Ratio for Homes	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Constant	1.40	0.00	499.92
	(0.44)	(0.07)	(55.43)

- In the cross-section, more stringent regulations associated with:
  - Higher prices paid by families
  - Higher quality purchased by families
  - Less hours of paid care

Back

Labor supply shifters expressions

$$\log\left(\overline{H_{LT}}\,\overline{LT}\right) = \mathbb{E}[\log E^D(w^E, w^C)] - \eta_{LT}\mathbb{E}[\log(w^E + w^C)]$$

$$\log\left(\overline{H_{CCW}}\,\overline{CCW}\right) = \mathbb{E}\left[\log\left(E^D(w^E, w^C) - C^D(w^E, w^C)\right)\right] - \eta_{CCW}\mathbb{E}[\log w^C]$$

Back