# Evaluating Early Childhood Policies: An Estimable Model of Family Child Investments

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February 3rd, 2017

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    - Use a novel dataset of early childhood development from Chile to estimate the model

### **Research Questions**

- How do families make decisions about investments in their children?
  - Time
  - Income
  - Differences in preferences
- What policies are most effective in closing skills gap?
  - Cash transfers
  - Daycare subsidies
  - In-kind transfers

#### This paper:

- Estimate a dynamic technology of skill formation nested within a collective model of household behavior
  - Parents care about children's skills
  - Invest in their skills: time, money, childcare
  - Parents with different preferences  $\rightarrow$  bargaining power
- Use novel dataset from Chile to estimate the model
  - Detailed information about investments in children and child outcomes
  - $\blacktriangleright$  Detailed information about female empowerment and gender roles  $\rightarrow$  bargaining power
  - Geocoded dataset matching preschool providers and households

- Evaluate effects of policies on gaps in skills between rich and poor children
  - 1. Cash transfers:
    - > Parents choose investments, might not allocate all to children
    - Mothers are the recipients in families with children
    - 40% of households receive transfers from government
    - Basic transfer  $\approx$  3% of median income ; \$20.00 usd-month
  - 2. Preschool subsidies:
    - Liberates time resources, potentially enhance skills for children
    - Massive expansion of preschool services in Chile: 450% increase in 2006-2010
  - 3. In-kind transfers
    - "Chile Grows with you" Transfer of goods for skill promotion (e.g. books, toys, puzzles, parenting manuals)

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  - Parental investments (Time, money, childcare)
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  - Household members' characteristics (skills of parents, members in the household)
- Final allocation depends on Pareto weight (bargaining power) of each member

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- Simulate policy counterfactuals
  - Effect on gaps in skills of increase in cash transfers

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- Household Behavior and Child outcomes: Bernal (2008), Bernal & Keane (2011), Del Boca, Flinn & Wiswall (2014, 2016), Gayle et. al (2015)
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#### Contribution

 Empirically evaluate effect of in-kind transfers, cash transfers and childcare subsidies on skills gaps

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  - Implement particle filtering algorithm in estimating model of household behavior with continuous and unobserved state space

### Preview of results

- $\blacktriangleright$  Gaps in skills between five years old children in highest and lowest income quintile is  $\approx$  60% of sd
- In-kind transfers: most cost-effective way to close gaps in skills
- $\blacktriangleright$  Childcare services: attendance to centers increase skills  $\approx 1\%$  of sd
- ▶ Cash transfers: 1USD transfered to mother (father)  $\rightarrow$  9 (8) cents of effective investments in children





## 2 Economic model





## Data

### 1. Longitudinal Survey of Early Childhood Development Chile

- ▶ 15,175 Nationally representative of families with children under 4
- 2 waves -2010, 2012
- Standard household survey +
  - Early Childhood Development Component
  - Interactions of parents and children Interaction data
  - Primary caregiver: emotional and cognitive skills Caregiver data
  - Information on female empowerment and gender roles Empowerment data
  - Detailed information of investment in children Investment data

Evaluating Early Childhood Policies: An Estimable Model of Family Child Investments Data & reduced form evidence

#### 2. National registry of childcare and preschool services providers



Figure: Example of distribution of childcare providers. City of "La Serena", Chile. Details

## 3. Household Survey Data (CASEN, 2011)

- Unemployment gender ratio
- Wage gap
- 4. Census data (2002)
  - Sex ratio in cities for 15-65 years old group
# What can we learn about the skill formation process in children from the data?

1. Gaps in multiple dimensions of skills are evident when children are five years old

1. Gaps in skills emerge early in life

Test scores and parental assessment at age 5



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- 1. Gaps in multiple dimensions of skills are evident when children are five years old
- 2. Parental investments and child outcomes

### Parental investments and child outcomes

(1)	
Vocabulary Score age 5	
0.07**	
(0.03)	
0.12**	
(0.05)	
0.12* <sup>*</sup>	
(0.05)	
0.26***	
(0.02)	
0.05* <sup>*</sup>	
(0.02)	
1,237	
0.36	
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Parents activities, vocabulary score and extraversion score standardized to be mean zero, variance=1.

Other controls: activities performed by parents, parental non-labor and labor income, child's age, maternal cognitive and personality test scores, fathers and mothers schooling and gender

Other tests and investments Descriptive statistics

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- 1. Gaps in multiple dimensions of skills are evident when children are five years old
- 2. Parental investments and child outcomes
- 3. Mothers spend more time in each activity than fathers do
- 4. Negative relationship between labor supply and time investments See here

- 5. Childcare providers and investments in children See here
  - Attending preschool negatively correlated with distance to preschool
  - Supply of childcare services in neighborhood positively correlated with child investments
- 6. Female empowerment and child outcomes See here
  - Families where woman controls income have better child outcomes
  - Share of income earned by woman positively correlated with investments in children



Data & reduced form evidence







## Model Features

Collective model of household behavior (Chiappori, 1992)

- Household with two agents (mother, father) and child
- Utility depends on:
  - Consumption
  - Leisure
  - Child skills
- Families make decisions for two periods of childhood
  - Labor supply
  - Consumption
  - Childcare
  - Investments in children (effort and money)
  - Final decisions depend on Pareto weight (bargaining power) assigned to each member

Household populated by two agents (j = m, f) making decisions for two periods

$$u_{t}^{j}(c_{t}^{j}, h_{t}^{j}, e_{t}^{j}, s_{t}, a_{t}) = \alpha_{1,t}^{j} \ln(c_{t}^{j}) + \alpha_{2,t}^{j} \ln(s_{t}) - \alpha_{3,t}^{j}(h_{t}^{j})$$

$$-\alpha^{j}_{4,t}\boldsymbol{e}^{j}_{t}-\alpha^{j}_{5,t}\boldsymbol{e}^{j}_{t}\boldsymbol{h}^{j}_{t}-\alpha^{j}_{6,t}\boldsymbol{h}^{j}_{t}(1-\boldsymbol{a}_{t})+\epsilon^{j}_{d,t}\boldsymbol{q}^{j,d}_{t}$$

- Private consumption  $(c_t^j)$ ;
- Child's skills level (s<sub>t</sub>)
- Work  $(h_t^j \in \{0,1\});$
- Effort exerted for the child  $(e_t^j \ge 0)$
- ▶  $a_t \in \{0, 1\}$ ; childcare/preschool services
- ▶  $q_t^{j,d} \in \{0,1\}$ . Takes value of 1 if alternative *d* is chosen by *j*.
- $D_t = \{(h_t, a_t) : h_t\{0, 1\}; a_t \in \{0, 1\}\}$
- ▶ Preference shock  $\epsilon_{d,t}^j \sim f_{\epsilon_{d,t}^j}$ : work and child-care decision

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$$\alpha_{4,t}^j = \alpha_{4,t,0}^j - \alpha_{4,t,1}^j HM_t$$

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- $\alpha_{4,t}^j = \alpha_{4,t,0}^j \alpha_{4,t,1}^j HM_t$
- HM<sub>t</sub>=1 if someone in the household helping with household chores

$$r_t = e \times p \left( \delta_0 + \delta_1 \tau_t + \delta_2 a_t + \delta_{3,t} P G + \delta_4 \text{Members}_t + \eta_{s,t} \right)$$

Total Factor Productivity

$$\mathbf{e}_{t} = \underbrace{\left[\gamma_{f}\left(\tilde{\mathbf{e}}_{t}^{f}\right)^{\phi} + (1 - \gamma_{f})\left(\tilde{\mathbf{e}}_{t}^{m}\right)^{\phi}\right]^{1/\phi}}_{\mathsf{T} \leftarrow \mathsf{I}}$$

Total effort in child

$$s_t = r_t s_{t-1}^{\theta_0} \tilde{I}_t^{\theta_1} e_t^{\theta_2}$$

- $\tau_t$ : Age in months of child
- $a_t \in \{0, 1\}$ ; childcare/preschool services
- Skills of primary caregiver (Mother) (PG)
- Members<sub>t</sub> Number of people living in the household
- Heterogeneity  $\eta_{s,t} \sim f_{\eta_{s,t}}$
- ▶ Skills in t 1,  $(s_{t-1})$ ;  $(s_0) \rightarrow$  health at birth
- Monetary investments (I<sub>t</sub>)

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Total effort in child

$$s_t = r_t s_{t-1}^{\theta_0} \tilde{I}_t^{\theta_1} e_t^{\theta_2}$$

- $\tau_t$ : Age in months of child
- $a_t \in \{0, 1\}$ ; childcare/preschool services
- Skills of primary caregiver (Mother) (PG)
- Members<sub>t</sub> Number of people living in the household
- Heterogeneity  $\eta_{s,t} \sim f_{\eta_{s,t}}$
- ▶ Skills in t 1,  $(s_{t-1})$ ;  $(s_0) \rightarrow$  health at birth
- Monetary investments (I<sub>t</sub>)

$$r_t = exp\left(\delta_0 + \delta_1 \tau_t + \delta_2 a_t + \delta_{3,t} PG + \delta_4 \text{Members}_t + \eta_{s,t}\right)$$

Total Factor Productivity

$$e_{t} = \underbrace{\left[\gamma_{f}\left(\tilde{e}_{t}^{f}\right)^{\phi} + (1 - \gamma_{f})\left(\tilde{e}_{t}^{m}\right)^{\phi}\right]^{1/\phi}}_{\text{T} = 1}$$

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$$\max_{\{a_1,\{l_t,\{c_t^{f},e_t^{f},h_t^{f}\}_{j=m,f}\}_{t=1,2}\}} \mu_1 u_1^f(c_1^f,h_1^f,e_1^f,s_1,a_1) + (1-\mu_1)u_1^m(c_1^m,h_1^m,e_1^m,s_1,a_1) + \\ + \beta\mu_2 u_2^f(c_2^f,h_2^f,e_2^f,s_2) + \beta(1-\mu_2)u_2^m(c_2^m,h_2^m,e_2^m,s_2)$$

### • $\mu_t$ : Pareto weight (Bargaining power)

- Production technology  $s_t$
- ► Budget constraint  $c_t^f + c_t^m + P_{I,t}I_t + P_{a,t}a_t = y_t^f + y_t^m + w_t^m h_t^m + w_t^f h^f + \Xi_t$
- $\blacktriangleright I_t, c_t^f, c_t^m, e_t^f, e_t^m \geq 0$
- ▶  $h_t^f, h_t^m \in \{0, 1\}$
- ▶  $a_1 = \in \{0, 1\}; a_2 = 1$

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$$\mu_t = \mu(E_t) = \left(\frac{\exp(\Lambda' E_t + \eta_{\mu,t})}{1 + \exp(\Lambda' E_t + \eta_{\mu,t})}\right)$$

Et includes:

- $\omega_t^f / \omega_t^m$  :Ratio of wage offers Details
- $\blacktriangleright Y_t^f / (Y_t^f + Y_t^m)$
- ▶ age<sup>f</sup> age<sup>m</sup>
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- Gender ratio (in city)
- Unemployment gender ratio (in region)
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#### Female empowerment and child outcomes

- Claim: cash in the hands of women translate into better child outcomes than cash in the hands of men
  - To what extent women have stronger preferences for children than fathers?
  - To what extent cash transfer can effectively empower women?
  - > To what extent cash transfers are translated into child investments?
  - How sensitive is labor supply to cash transfers?
  - How does marginal willingness to pay for child-skills compare to marginal benefits in consumption or leisure?

Evaluating Early Childhood Policies: An Estimable Model of Family Child Investments Economic model

## Time investments in children

- Mothers invest more time with children than fathers do
  - Productivity?
  - Preferences?
  - Public good: less empowered member contributes more to the provision of public good?

Set of unobserved latent variables in the model:

$$K = \{\{\ln(s_t), \ln(e_t^f), \ln(e_t^m), \ln(I_t), \mu\}_{t=1}^2, \ln(PG), \ln(s_0)\}$$

For each latent variable k ∈ K we observe a set of {Z<sub>m</sub><sup>k</sup>}<sub>m=1</sub><sup>N<sub>k</sub></sup> measures with measurement error ε<sub>m</sub><sup>k</sup>:

#### Measurement System:

$$Z_m^k = \iota_{m,0}^k + \iota_{m,1}^k k + \varepsilon_m^k ext{ for } m = 1...N_k, ext{ for } k \in K$$

- Skills at birth so data
- Skills in childhood st data
- Skills of Mother PG data

- In-kind investments in children Investment data
- Effort in children <sup>data</sup>
- Pareto weight (Bargaining power) <sup>µ data</sup>

## Likelihood Function

Observed elements Ot

$$O_0 = \{\{z_m^{PG}\}_{m=1}^{N_{PG}}, \{z_m^{S_0}\}_{m=1}^{N_{S_0}}\}$$
$$O_t = \{h_t^f, h_t^m, a_t, \mathcal{Z}_t\} \cup \underbrace{\{w_t^f\}}_{\text{if } h_t^f > 0} \cup \underbrace{\{w_t^m\}}_{\text{if } h_t^m > 0} \text{ for } t = 1, 2$$

Likelihood function:

$$\int_{D} f_{0}(O_{0}, K_{0}|X; \Phi) dK_{0} \times \int \int_{D} f_{1}(O_{1}, K_{1}, K_{0}|O_{0}, X; \Phi) dK_{1} dK_{0} \int \int_{D} f_{2}(O_{2}, K_{2}, K_{1}|O_{1}, X; \Phi) dK_{2} dK_{1} dK_{1}$$

 $f_t()$  for t=0 given by:

- density of measurement system
- density of latent factors

 $f_t()$  for t=1,2 given by:

- density of wages
- density of measurement system
- density of latent factors
- Utility: CDF of  $\epsilon$  shocks

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See details of f<sub>1</sub>(.

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density of measurement system

(

density of latent factors

 $f_t()$  for t=1,2 given by:

- density of wages
- density of measurement system
- density of latent factors
- Utility: CDF of  $\varepsilon$  shocks

High dimensional integral with no closed form solution  $\rightarrow$  maximum simulated likelihood.



High dimensional integral with no closed form solution  $\rightarrow$  maximum simulated likelihood.



- Model estimated in sample of 950 households with two parents, and only one child in a five years age group between 4 and 6 years of age in 2012.
- Estimation through Maximum Simulated Likelihood
- Assume preference shocks (ε), measurement error (ε), heterogeneity
   (η) are Gaussian
- Wages: Mincer equation

Details of sample used

Summary statistics

### Identification

#### Measurement System

- $Z_m^k = \iota_{m,0}^k + \iota_{m,1}^k k + \varepsilon_m^k$  for  $m = 1...N_k$ , for  $k \in K$
- Covariance of measures identify coefficients in measurement system after normalization. Standard arguments

$$\blacktriangleright \quad Cov\left(Z_m^k, Z_{m'}^{k'}\right) = \iota_{m,1}^k \iota_{m',1}^{k'} Cov(k,k') + Cov\left(\varepsilon_m^k, \varepsilon_{m'}^{k'}\right)$$

Ratio of covariances identify factor loadings u<sup>k</sup><sub>m,1</sub>

## Identification

#### Density of factors

- Density  $f(\{\ln(s_t), \ln(e_t^f), \ln(e_t^m), \ln(I_t), \mu_t\}_{t=1}^2, \ln(PG), \ln(s_0))$
- Schennach (2004). Non-parametric constructive identification of density f(K).
- Use already-identified measurement system
- Variation in multiple measures used for the same latent variable are informative of the distribution of that latent variable.
- e.g. Two measures for skills at birth:
  - $Z_1^{\ln(s_0)} = \iota_{1,0}^k + \iota_{1,1}^{\ln(s_0)} \ln(s_0) + \varepsilon_1^{\ln(s_0)}$
  - $Z_2^{\ln(s_0)} = \iota_{2,0}^k + \iota_{2,1}^{\ln(s_0)} \ln(s_0) + \varepsilon_2^{\ln(s_0)}$
  - Observed  $(Z_1^{\ln(s_0)}, Z_2^{\ln(s_0)})$  identify distribution of latent variable  $\ln(s_0)$

Details

#### Technology of skills formation

- Once density  $f(\{\ln(s_t), \ln(e_t^f), \ln(e_t^m), \ln(I_t), \mu_t\}_{t=1}^2, \ln(PG), \ln(s_0))$ identified, we can obtain
- $E \left[ \ln (s_{t+1}) | \ln (s_t), \ln (e_{t+1}^f), \ln (e_{t+1}^m), \ln (I_{t+1}), \mu_{t+1}, \ln (PG) \right]$
- Matzkin (2007). Heterogeneity additively separable → skills production identified from density of factors f(.):
- $\ln(s_{t+1}) =$

 $E\left[\ln\left(s_{t+1}\right)|\ln\left(s_{t}\right),\ln\left(e_{t}^{f}\right),\ln(e_{t}^{m}),\ln(I_{t}),\ln(PG),\ln(s_{0})\right]+\eta_{s,t+1}$ 

Details

## Identification

- $\mu(X)$  Pareto weight function
  - Distribution factors: Affect choices only through Pareto weight
  - $\blacktriangleright$  Variation in responses to questionnaires due to distribution factors  $\rightarrow$  Identify Pareto weight function
  - e.g. Discontinuities in cash transfers handed to women used as source of variation for proportion of income earned by women



## Identification

#### • $\alpha$ Preference parameters

- Normalize  $e^{f,*}(\mu = 0.5, h^f = 1) = 1$
- ► Variation in effort levels due to distribution factors → preference for children of fathers and mothers
- ▶ Normalize  $I^*(\mu = 0.5; d = 10) = 1$  investments for families with 10 providers within 5k
- ► Variation in investment due to to availability of providers → Identify price of investments *PI*
- Variation in investment due to distribution factors
  - $\rightarrow$  preferences for consumption

#### Outline

Data & reduced form evidence







Evaluating Early Childhood Policies: An Estimable Model of Family Child Investments Results

#### Results: Inequalities in skills

With technology of skills, we can compute the distribution of skills for five year olds using test scores in all periods  $f(s_2|Z_0, Z_1, Z_2)$ 



Difference between richest and poorest: 60% of sd Inequality explained by:

- Material investments
- Parental skills

## Signal to noise Ratio $SNr_m^k$ - Mother's effort



$$\mathbf{z}_m^k = \iota_{m,0}^k + \iota_{m,1}^k k + \varepsilon_m^k$$

$$SNr_{m}^{k} = rac{\left(\iota_{m,1}^{k}
ight)^{2}Var(k)}{\left(\iota_{m,1}^{k}
ight)^{2}Var(k)+Var(\varepsilon_{m}^{k})}$$

# Signal to noise Ratio $SNr_m^k$ - Child investments



### Main Results

- ▶ Preschool services have a positive but small effect on skills: ≈0.01 SD.
  - Literature has found both positive and negative effects on child outcomes in Latin America
  - This is effect of attending to preschool by itself as opposed to reduce form estimates
  - Noboa-Hidalgo & Urzua (2014): Negative effects on memory and interactions with adults
  - ▶ Bernal et. al (2009): Negative effects on health outcomes

- Mothers stronger preferences for child development
- ▶ Fathers time is less productive than mothers time (50%)
  - Del Boca, Flinn, Wiswall (41%)
  - $\blacktriangleright$  Gross substitutes  $\rightarrow$  substitution pattern in labor force participation

#### Model fit

#### Demand for childcare

	Predicted	Observed
Working mothers	67.71	68.41
Not working mothers	42.97	41.64

## Model fit: Labor supply 2012 by education

#### Labor force participation



# Model fit: Mothers wages (log) 2010 - Weekly CLP

	Predicted	Observed
Mean	10.86	10.83
SD	0.78	0.80



# Model fit: Mothers wages (log) 2010 - Weekly CLP

	Predicted	Observed
Mean	10.90	10.89
SD	0.47	0.75



# **Policy Simulations**

Policies for families in the lowest quintile of the income distribution:

- Cash transfers:
  - Currently 40% of families receive transfers from central government
  - In 2010, monthly cash transfer for family with child was \$14,000 CLP (\$20.00 USD)
  - Amount increased  $\approx$  80% today and expected to keep increasing
  - What is the effect on skills gap if monetary transfer amount doubled?
- Cash transfers to fathers
  - What if recipient assigned to be father?
- Free childcare services
- In-kind transfer
  - Use the resources rather for in-kind transfers ("Chile grows with you" program)

Initial gap  $\rightarrow$  60% of sd



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Cash transfers

Initial gap  $\rightarrow$  60% of sd



#### Cash transfers

 1 USD transferred to mother (father) translates into 9 (8) cents of effective investment

Initial gap ightarrow 60% of sd



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- 1 USD transferred to mother (father) translates into 9 (8) cents of effective investment
- Reduction of less than 0.5% in labor force participation

Initial gap  $\rightarrow$  60% of sd Change in gap in skills (percentage points) Cash transfer to Father Cash transfer to Mother Childcare Subsidy In-kind Transfer -8-

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#### In-kind transfers
Effects of policies on gap in skills between rich (5th quintile) and poor (1st quintile) children

Initial gap  $\rightarrow$  60% of sd



### Cash transfers

- 1 USD transferred to mother (father) translates into 9 (8) cents of effective investment
- Reduction of less than 0.5% in labor force participation

### Childcare subsidy

 $\blacktriangleright$  Childcare attendance leads to  $\approx 1\%$  of a standard deviation increase in skills

### In-kind transfers

 Most effective policy to stimulate skills formation process for children in disadvantage



### Effects on female labor force participation

• Cash transfers: decreases gap by two percentage points

- Effect through increase in monetary investments
- Negligible effect on labor market and effort Details
- Effect of cash transfers in the literature (Paxson & Schady, 2007; Macours et al. 2012)
  - Effects on cognitive outcomes for poor children
  - Increase in nutritional outcomes
- Not likely to be the case of Chile
- ▶ Low prevalence of wasting of stunting (0.3% and 1.8%)

- Childcare subsidy: decreases skills gap between rich and poor children by two percentage points
  - Effect mostly coming from childcare participation
  - ▶ Modest (1%) increase in Female labor force participation
    - Decrease in time investments with children
    - Increase in monetary investments
  - Fixed capacity assumption
  - Limits to scale up
  - General equilibrium effects...

# Cost of policies

Counterfactual	Expenditure per capita (USD)
Transfers to Mother	449.59
Transfers to Father	449.59
Childcare Subsidy*	221.64
In-kind transfers	449.59

\*Considers fixed infrastructure



## Outline

Data & reduced form evidence

### 2 Economic model

3 Results



- Gaps in skills emerge early in life
  - What policies are most effective in reducing such gap?
  - How do families react to such policies?

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- $\blacktriangleright$  Household behavior by collective approach  $\rightarrow$  identity of recipient matters
- $\blacktriangleright$  Latent factor and particle filtering  $\rightarrow$  circumvents identification and estimation challenges

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  - $\blacktriangleright$  Cash transfers:  $\approx 8\%$  of effective investments in children
  - Childcare services: effect of 1% of a sd on skill formation
- Estimate which variables accurately measure factors (skills, effort, money investments)
- Empirical and methodological contribution

### Distortion in parental effort

 $(e^{f,H^*},e^{m,H^*})$  solution to household's problem

Centralized problem 1:

 $\max_{\{e^{f}, e^{m}\}} S(e^{f}, e^{m}, .) \text{ s.t. } e^{f} + e^{m} = e^{f, H^{*}} + e^{m, H^{*}}$ 

Centralized problem 2:

$$\max_{\{e^{f}, e^{m}\}} S(e^{f}, e^{m}, .) \text{ s.t. } c^{f}(e^{f}) + c^{m}(e^{m}) = c^{f}(e^{f, H^{*}}) + c^{m}(e^{m, H^{*}})$$

In both cases 
$$\frac{\left(\frac{e^{f,C^*}}{e^{m,C^*}}\right)}{\left(\frac{e^{f,H^*}}{e^{m,H^*}}\right)} \propto \left(\frac{1-\mu}{\mu}\right)^{1/(1-\phi)}$$

Using the same amount of total effort (or total cost derived from the effort exerted) a different combination of parental time can be used that will increase child's skills

 $(e^{\boldsymbol{f},\boldsymbol{H}^{*}},e^{\boldsymbol{m},\boldsymbol{H}^{*}})$  solution to household's problem

# Measures of female empowerment and gender roles in the household (subset)

Question	
It is better to have a bad marriage than to remain single*	
(Father) Women should no work and devote all their time to household chores	
A woman who is in charge of most part of tasks of the household has no time to work*	
Both spouses should contribute to household income*	
It is better for everyone if the man goes to work and the woman stays home*	
Men should assume a more active role in household chores*	
If my spouse earned enough there is no reason for me to work*	
After having children, the best for a woman is to develop her carreer*	
Taking into account the pros and cons, it is very important for me to have a paying job*	
Having a payed job is the best way for a woman to become independent*	
Who administers income in the household	

\*: For each question the woman provides an answer between 1 to 5 with the following scale: Disagrees very much; disagrees; doesn't know; agrees; agrees very much.



### Women's opinion about marriage

"It is better to have a bad marriage than to remain single" (% of responses)





Dataset description Factor system

### Men's opinion on gender roles

"Which statement do you agree mostly with?" (% of responses)



Women should only do household chores Women should work only if enough time after chores Women should work full time and delegate childcare Men are better at childcare than women

### Information about investments in children 2012

Investment
Consumption of different items*
Toys to learn colors and shapes
Puzzles
Music device for chidIren's music
Toys for free expressions (tools, customes)
Toys to learn numbers
Books for children
Books for adults
Adequacy of household for children
Number of people child shares bed with
Number of people with whom child shares bedroom
*: The possible answers are 1: never, 2: one to two times a month; 3: one to three times a

4: four to six times a week; 5: once a day; 6: two or more times a day.

Dataset description

Information about skills of mother

Test
WAIS-Numerical test
WAIS-Vocabulary test
BFI-Agreeableness
BFI-Openness
BFI-Extroversion
BFI-Neuroticism
BFI-Conscientiousness
All test scores are standardized to be mean zero and variance one.



### Information on time investments into children

Activity
Reads Children's storybooks or drawing books
Tells her stories
Sings to child
Takes her to parks
Takes her to museums, zoos, libraries or other cultural activities
Spends time with her chatting or drawing
Invites her to participate in household chores
Takes her to the supermarket
Shares a meal with her
Teaches the animals and their sounds
Teaches her the colors
Goes with her to visit friends or family members
Teaches her the numbers and how to count
Teaches her words

For each question parents reply how often, during the last seven days, they perform each activity. The possible answers are: Never, 1-3 times, 4-6 times.



Information on Skills at birth

#### Measure

Pregnancy conditions (Anemia,Preeclampsi,Anxiety disorder ...) Cigarrettes consumed during pregnancy Cigarrettes consumed during the first six months of life of child Alcohol consumption during pregnancy Substance abuse during pregnancy Child was born pre-term Weight at birth (grams) Height at birth (cm)

Dataset description

### Information on Skills of children in 2012

Test TADI-Cognitive subdomain TADI-Motor skills subdomain TEPSI-Motor skills subdomain TADI-Language subdomain Battelle-I Battelle-II Battelle-III Battelle-IV Battelle-V Battelle-T PPVT-Vocabulary Test

All test scores are standardized to be mean zero and variance one.

Dataset description

### Information on Skills of children in 2010

lest
TEPSI-Coordination subdomain
TEPSI-Language subdomain
TEPSI-Motor skills subdomain
CBCL-Emotional intelligence
CBCL-anxiety -depression
CBCL-somatic complaints
CBCL-Isolation
CBCL-Sleeping disorder
CBCL-Attention deficit
CBCL-Aggressive behavior
All test scores are standardized to be mean zero and variance

All test scores are standardized to be mean zero and variance one.



Back to background

### Gaps in skills of children

Test scores for 5 years old children



### Gaps in skills of children

Test scores for 4 and 5 years old children



Back to data

### Gaps boys and girls







# Working parents



Parental effort: Frequency of activities in last seven days: Never, 1-3 times;4-6 times;everyday. Households where both parents are present.

### Not working parents



Parental effort: Frequency of activities in last seven days: Never, 1-3 times;4-6 times;everyday. Households where both parents are present.

### Labor force participation

1. Female labor force participation

Only 45% of mothers work. Unemployment does not explain this pattern.



Main reason to be inactive: not having someone with whom to leave children or not trusting available childcare services Reduced form evidence

# Labor force participation

### 2. Intensive margin.



Reduced form evidence
## Mother's time with children

	(1)	(2)	(3)	
VARIABLES	Reads books	Tells stories	Sings to child	
Hours worked mother	-0.02***	-0.02***	-0.02***	
	(0.00)	(0.00)	(0.00)	
Hours worked father	0.01**	0.01	0.02***	
	(0.01)	(0.01)	(0.01)	
Observations	4,531	4,531	4,531	
Adjusted R-squared 0.35 0.30 0.28				
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Frequency of activities standardized to be mean zero, variance one.

 $X_i$ : includes: education of both parents, age of child, household size, age of both parents and activities performed by father, Wais-digits, Wais-Vocabulary and BFI test scores.



	(1)	(2)		
VARIABLES	$\Delta$ Effort father	$\Delta$ Effort mother		
$\Delta$ Hours worked mother	0.03***	-0.02***		
	(0.01)	(0.01)		
$\Delta$ Hours worked father	-0.03***	0.01**		
	(0.01)	(0.01)		
$\Delta$ Effort mother	0.37***			
	(0.01)			
$\Delta$ Effort father	. ,	0.36***		
		(0.01)		
Observations	4,531	4,531		
R-squared	0.14	0.15		
*** p<0.01, ** p<0.05, * p<0.1.				
Standard error in parentheses.				

 $\Delta \text{Effort parent}_i = \beta_0 + \beta_1 \Delta \text{Hours worked mother}_i + \beta_2 \Delta \text{Hours worked father}_i + \beta_3 X_i + \varepsilon_i$ 

 $\Delta X = X_{2012} - X_{2010}$ 

Effort: one factor extracted from principal component analysis of questionnaire of activities parents perform with their children. Normalized to be mean zero, variance

one. See details Back to data

	1	2	3	4	5
VARIABLES	T: Language	T: Motor	T:Cognitive	T: Total	B: Cognitive
Mother's income Father's income	0.01* (0.00)	0.02*** (0.00)	0.03* (0.01)	0.04*** (0.01)	0.01* (0.01)
Observations	4796	4789	4797	4756	4760
R-squared	0.74	0.66	0.51	0.16	0.55

 $y_i$ : Test score. Standard deviations above the mean. "The higher the better"

 $x_i$ : Additional controls. Years of schooling of parents, total income of the household, age of child, big-five personality traits; verbal test score of mothers; math test score of mothers; stress level of mothers; age of parents; race; number of siblings.

Reduced form evidence Distribution factors

	7	8	9	10	11
VARIABLES	B: Psoc	B: Total	PCA C dev	CBC: Emotional	CB: AnxD
Mother's income	0.01**	0.01***	0.01***	0.02***	0.02**
Father's income	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
Observations	4760	4765	4543	4156	4156
R-squared	0.31	0.61	0.73	0.17	0.14

Reduced form evidence

$$\Delta y_i = \beta_0 + \beta_1 \Delta \left( \frac{\text{Mother's income}}{\text{Father's income}} \right) + \beta_2 X_i + \varepsilon_i$$

	(1)	(2)	(3)	(4)
VARIABLES	$\Delta$ B. Adaptative	$\Delta$ B. Personal-social	$\Delta B.$ Total	$\Delta$ PPVT
$\Delta\left(\frac{\text{Mother's income}}{\text{Father's income}}\right)$	0.17**	0.34***	0.63**	0.30*
	(0.07)	(0.10)	(0.32)	(0.16)
Observations	1,595	1,595	1,596	2,369
R-squared	0.36	0.26	0.32	0.01

Reduced form evidence

When mother decides how to spend resources, investment in children is higher:

$$y_i = \beta_0 + \beta_1$$
 Mother decides  $+ \beta_2 X_i + \varepsilon_i$ 

	1	2	3	4
VARIABLES	Owns 2 or more toys	Shares room	Fruits and vegetables	Juices
Mother decides	0.03** (0.01)	-0.02** (0.01)	0.07** (0.03)	0.10*** (0.04)
Observations	5376	5552	5551	5551
R-squared	0.05	0.13	0.03	0.06

 $y_i$ : Investment in children. For food items, dependent variable is frequency of consumption: 1: never, 2: 1-2 times a month; 3: 1-3 times a week;4: 4-6 times a week;5: everyday; 6 or more times a day

Less likely to share a bedroom, more likely to have toys, consumption of fruits, vegetables, juices and cookies and candies increase

Mother decides=1 if mother manages household finances

Reduced form evidence

Wages observed with measurement error

$$\ln(w^{j}) = \beta_{0}^{j} + \beta_{1}^{j} yrschool^{j} + \beta_{2}^{j} age^{j} + \beta_{3}^{j} (age)^{2} + \varepsilon_{wj}$$

with

$$\omega^{j} = \beta_{0}^{j} + \beta_{1}^{j} \textit{yrschool}^{j} + \beta_{2}^{j} \textit{age}^{j} + \beta_{3}^{j} (\textit{age}^{j})^{2}$$

$$\varepsilon_w^j \sim N(0, \varepsilon_{w^j})$$

васк	

- $\Phi := \{\alpha, \beta, \sigma_w, \gamma, \theta, f_{\mathcal{K}}(), f_{\varepsilon_d}(), f_{\varepsilon}(), \iota_{\mathcal{K}}, \Lambda, P_I, P_a\}$ 
  - $\blacktriangleright \ \alpha : {\sf Utility \ parameters}$
  - ▶  $\beta, \sigma_w$  Wage equation
  - $\theta, \gamma, \phi$  : Skills production function
  - $f_K$  : distribution of latent factors
  - $f_{\varepsilon_d}$  : distribution of preference shocks
  - $f_{\varepsilon}, \iota_k$  : Measurement system
  - $\Lambda$  : Pareto weight parametrization
  - ▶ P<sub>I</sub>, P<sub>a</sub> : Price of in-kind investments and childcare services

Back to Likelihood function

### Χ

- $\alpha$  : Utility parameters
- ▶  $\beta, \sigma_w$  Wage equation
- $\theta, \gamma, \phi$  : Skills production function
- ► *f<sub>k</sub>* : distribution of latent factors
- $f_{\varepsilon_d}$  : distribution of preference shocks
- $f_{\varepsilon_k}, \iota_k$ : Measurement system
- $\Lambda$  : Pareto weight parametrization
- ▶ P<sub>1</sub>, P<sub>a</sub> : Price of in-kind investments and childcare services

Back to Likelihood function

### Details of likelihood in t=0

$$\int_{D} f_{0}(O_{0}, K_{0}|X; \Phi) dK_{0} =$$

$$\int_{D} f_{\varepsilon_{k}}(O_{0}|K_{0}, X; \Phi) f_{K}(K_{0}|X; \Phi) dK_{0}$$

$$\int_{D} f_{\varepsilon_{k}}(\mathcal{Z}_{0} - \iota_{0}K_{0}|, X; \Phi) f_{K}(K_{0}|X; \Phi) dK_{0}$$

$$E_{f_{K_{0}}(K_{0}|X; \Phi)} [f_{\varepsilon_{k}}(\mathcal{Z}_{0} - \iota_{0}K_{0}|, X; \Phi)]$$

$$\sum_{rr=1}^{RR} f_{\varepsilon_{k}}(\mathcal{Z}_{0} - \iota_{0}K_{0}^{\{rr\}}|X; \Phi)$$

Where  $\{K_0^{rr}\}_{rr=1}^{RR}$  draws from  $f_{K_0}(K_0|X;\Phi)$ 

Back to Likelihood function

$$\int \int_{D} f_{1}(O_{1}, K_{1}, K_{0}|O_{0}, X; \Phi) dK_{1} dK_{0}$$
$$\int \int f(O_{1}|K_{1}, X; \Phi) f(K_{1}|K_{0}, X; \Phi) f_{K_{0}}(K_{0}|O_{0}, X; \Phi) dK_{1} dK_{0}$$
$$\int f_{K_{0}}(K_{0}|O_{0}, X; \Phi) \left[ \int f(O_{1}|K_{1}, X; \Phi) f(K_{1}|K_{0}, X; \Phi) dK_{1} \right] dK_{0}$$
$$E_{f_{K_{0}}(K_{0}|X; \Phi)} \left[ \int f(O_{1}|K_{1}, X; \Phi) f(K_{1}|K_{0}, X; \Phi) dK_{1} \right]$$

Where  $\{K_0^{rr}\}_{rr=1}^{RR}$  draws from  $f_{K_0}(K_0|X;\Phi)$ 

Back to Likelihood function More details of  $f_1()$ 

## Details of likelihood in t=1[2]

$$f(O_1|K_1,X;\Phi)f(K_1|K_0,X;\Phi) =$$

$$f(h_t^f, h_t^m, a_t, \mathcal{Z}_t, w_t^f, w_t^m | \mathcal{K}_1, X; \Phi) f(\mathcal{K}_1 | \mathcal{K}_0, X; \Phi) =$$

$$f(\mathcal{Z}_t|K_1, X, h_t^f, h_t^m, a_t; \Phi) \times f(h_t^f, h_t^m, a_t|w_t^f, w_t^m, K_1, X; \Phi) \times$$

$$f(w_t^f, w_t^m | X; \Phi) f(K_1 | K_0, X; \Phi)$$

Contains:

- pdf of wages See likelihood of wages
- CDF of preference shocks See details
- pdf of measurement system See likelihood of measurement system





$$f(O_1|\mathcal{K}_1, X; \Phi)f(\mathcal{K}_1|\mathcal{K}_0, X; \Phi) =$$

$$f(h_t^f, h_t^m, a_t, \mathcal{Z}_t, w_t^f, w_t^m | \mathcal{K}_1, X; \Phi)f(\mathcal{K}_1|\mathcal{K}_0, X; \Phi) =$$

$$f(\mathcal{Z}_t|\mathcal{K}_1, X; \Phi) \times f(h_t^f, h_t^m, a_t | w_t^f, w_t^m, \mathcal{K}_1, X; \Phi) \times$$

$$f(w_t^f, w_t^m | X; \Phi)f(\mathcal{K}_1|\mathcal{K}_0, X; \Phi)$$

Back to Likelihood function

See details of  $f(K_1|K_0, X; \Phi)$ 

$$f(\mathcal{K}_1|\mathcal{K}_0, X; \Phi) = f(\ln(s_t)|\ln(\tilde{e}_t^f), \ln(\tilde{e}_t^m), \ln(\tilde{l}_t), \mu, \ln(s_{t-1}), X; \Phi) \times$$

$$f(\ln(\tilde{e}_t^f)|X;\Phi) \times f(\ln(\tilde{e}_t^m)|X;\Phi) \times f(\ln(\tilde{I}_t)|X;\Phi) \times f(\mu|X;\Phi)$$

$$f_{\varepsilon_{w}}(\ln(w_{t}^{j}) - \beta_{0}^{j} - \beta_{1}^{j}yrschool - \beta_{2}^{j}age_{t}^{j} - \beta_{3}age_{t,j}^{2}) = \frac{1}{\sigma_{w}^{j}}\phi\left(\frac{(\ln(w_{t}^{j}) - \beta_{0}^{j} - \beta_{1}^{j}yrschool - \beta_{2}^{j}age_{t}^{j} - \beta_{3}age_{t,j}^{2})}{\sigma_{w}^{j}}\right)$$

•  $\phi()$  standard normal distribution

$$P_{(\varepsilon_{d,t}^{f},\varepsilon_{d,t}^{m})}\left[W(h_{t}^{f,*},h_{t}^{m,*},a_{t},.) = \max_{\{h_{t}^{f},h_{t}^{m},a_{t}\}}W(h_{t}^{f,*},h_{t}^{m,*},a_{t},.)|K_{1},\Theta,X\right]$$

• W welfare function: weighted utilities according to Pareto weight  $\mu$ 

Likelihood of measures given by the distribution of measurement error  $\varepsilon_k$ 

$$f_{\varepsilon_k}\left(\mathcal{Z}_k-\iota'_kk\right)$$

Where:

 $\mathcal{Z}_{k} = \{z_{1}^{k}, z_{2}^{k}, \dots z_{N_{k}}^{k}\}$  $\mathcal{E}_{k} = \{\varepsilon_{1}^{k}, \varepsilon_{2}^{k}, \dots \varepsilon_{N_{k}}^{k}\}$  $\mathcal{L}_{k} = [\iota_{1}^{k}, \iota_{2}^{k}, \dots \iota_{N_{k}}^{k}]'$ 

Likelihood of factors composed by five terms given by  $f_{\eta_k}()$ 

- $\blacktriangleright \text{ Skills: } f_{\varepsilon_{\eta_s}}\left(s_t, s_{t-1}, \tilde{l}_t^{\theta_1}, \tilde{e}_t^{\theta_2}\right)$
- Pareto weight:  $f_{\varepsilon_{\eta_{\mu}}}(\mu_t, \mu(E_t))$

Investment and effort optimal decisions: f<sub>\varepsilon\ \vert\_k}(k\_t^\*, \vec{k}\_t)</sub>

# Estimator $f_k(K)$

Once the factor loadings  $\iota_{m,1}^k$  are identified, we can define the following system:

• 
$$ME_j = \left\{\frac{Z_j^k}{\iota_{j,1}^k}\right\}_{k \in K}$$
  
•  $me_j = \left\{\frac{\varepsilon_j^k}{\iota_{j,1}^k}\right\}_{k \in K}$ 

Schennach (2004). So long as two transformed measures satisfy:

1. 
$$E[me_1|K, me_2]=0$$

there is a mapping between the Fourier transformation of the distribution of such measures and the distribution of latent factors

$$p(K) = \frac{\int_{-\infty}^{\infty} e^{-i\chi K} e^{\left(\int_{0}^{\chi} \frac{E\left[iME_{1}e^{i\psi ME_{2}}\right]}{\left[e^{i\psi ME_{2}}\right]}d\psi\right)} d\chi}{2\pi}$$
(1)

We can obtain

$$p\left(\ln(s_t)|\ln(s_{t-1}),\ln(\tilde{e}_t^f),\ln(\tilde{e}_t^m),\ln\left(\tilde{I}_t\right),\ln(PG),\mu_t\right).$$

- Production of skills is characterized by additional argument or unobserved heterogeneity: η<sub>sr</sub>.
- Matzkin (2007): η<sub>st</sub> enters additively in the production of skills ln(st) enough to secure identification of the system

Back

### Bootstrap fit - Childcare demand

### Working mothers

	Predicted	Observed
Mean	67.95	67.71
95% CI	[ 67.76 , 68.35 ]	-

### Non-working mothers

	Predicted	Observed
Mean	41.41	42.97
95% CI	[ 41.16 , 41.66 ]	-

#### Results using 200 bootstrap simulations

## Bootstrap fit: Demand for childcare

#### Working mothers

	Predicted	Observed
Mean	67.95	67.71
95% CI	[ 67.76 , 68.35 ]	-

### Non-working mothers

	Predicted	Observed
Mean	41.41	42.97
95% CI	[ 41.16 , 41.66 ]	-



#### Results using 200 bootstrap simulations

### Bootstrap fit - Labor supply 2012

#### Mothers

	Predicted	Observed
Mean	63.4	62.63
95% CI	[ 62.81 , 63.53 ]	-

### Fathers

	Predicted	Observed
Mean	96.31	93.26
95% CI	[ 96.23 , 96.59 ]	-

#### Results using 200 bootstrap simulations

### Bootstrap fit - Labor supply 2010

### Mothers

	Predicted	Observed
Mean	56.78	60.32
95% CI	[ 56.56 , 57.12 ]	-

#### Fathers

	Predicted	Observed
Mean	93.97	91.47
95% CI	[93.86,94.18]	-

Results using 200 bootstrap simulations Back to model fit

## Model fit: Labor supply 2012 by education



## Model fit: Labor supply 2010 by education





## Model fit: Labor supply 2012 by age



Fathers





— Predicted - - - 95% CI

## Model fit: Labor supply 2010 by age





## Model fit: Mothers' wages 2010



### Model fit: Mothers wages 2012



# Model fit: Fathers' wages 2010



# Model fit: Fathers' wages 2012



## Smoothing algorithm

$$p(K_t|O_{0:2}) = p(K_t|O_{0:t}) \int \left(\frac{p(K_{t+1}|O_{0:2})p(K_{t+1}|\theta_t)}{\int p(K_{t+1}|\theta_t)p(K_1|O_{0:t})dK_t}\right) dK_{t+1}$$

And then we can approximate this distribution by  $\hat{p}(\theta_t|O_{0:2})$  with:

$$\hat{p}(K_t|O_{0:2}) = \sum_{rr=1}^{RR} w_{t|T}^{(rr)} \delta_{K_t^{(rr)}}(K_t)$$

where  $\delta_{\mathcal{K}_t^{(rr)}}(\mathcal{K}_t)$  is the Dirac distribution and

$$w_{t|T}^{(mm)} = w_{t}^{(mm)} \left[ \sum_{rr=1}^{RR} w_{t+1|T}^{(rr)} \left( \frac{p\left(K_{t+1}^{(rr)} | K_{t}^{(mm)}\right)}{\sum_{kk=1}^{KK} w_{t}^{(kk)} p\left(K_{t+1}^{(rr)} | K_{t}^{(kk)}\right)} \right) \right]$$

where  $w_{T|T} = w_T$ 

Back to Results



1. For t=0,1,2 perform the particle filtering to obtain 
$$\{K_t^{rr}, w_t^{rr}\}_{rr=1}^{RR}$$
  
2. Set  $w_{2|2}^{rr} = w_2^{rr}$  for  $rr = 1...RR$   
3. For t=1,0 define  $w_{t|2}^{(mm)} = w_t^{(mm)} \left[ \sum_{rr=1}^{RR} w_{t+1|2}^{(rr)} \left( \frac{p(x_{t+1}^{(rr)}|x_t^{(mm)})}{\sum_{k=1}^{KK} w_t^{(kk)} p(x_{t+1}^{(r)}|x_t^{(kk)})} \right) \right]$ 

Back to Results

### Sample of households used

Number of households	Number of households
Initial sample	18,310
Household not surveyed in 2012	16,033
Household not surveyed in 2010	12,898
Parent not living in household	7,855
Siblings within five years of age in the household	4,718
Children with no weight or height at birth	4,125
Children with incomplete skills questionnaires	2,247
Households with incomplete questionnaires	950

Dataset description

Factor system

## Principal component analysis

Activity	Factor loading
Reads Children's storybooks or drawing books	0.6418
Tells her stories	0.6565
Sings to child	0.706
Takes her to parks	0.4836
Takes her to museums, zoos, libraries or other cultural activities	0.3279
Spends time with her chatting or drawing	0.6703
Invites her to participate in household chores	0.7019
Takes her to the supermarket	0.6827
Shares a meal with her	0.6115
Teaches the animals and their sounds	0.8385
Teaches her the colors	0.8544
Goes with her to visit friends or family members	0.646
Teaches her the numbers and how to count	0.8608
Teaches her words	0.8493

Eigenvalue: 6.78

Back




	2012		
	Predicted	Observed	
Mean	10.88	11.03	
SD	0.81	0.72	
See distribution			

	2012	
	Predicted	Observed
Mean	11.05	11.10
SD	0.44	0.66
	See distribution	n

# Childcare Providers - La Serena



Back to Data

# **Childcare Providers**



Average providers within 1km is 8.86

	(1)	(2)	(3)	(4)
VARIABLES	Cogntive test	Motor skills	Adaptative behavior	Battelle development score
Father: househld chores with child	0.00	-0.01	0.05**	0.02
	(0.01)	(0.02)	(0.03)	(0.02)
Father: takes child to grocery store	0.03**	0.01	0.00	0.01
	(0.02)	(0.03)	(0.03)	(0.02)
Father: visits family/friends with child	0.03*	0.06**	0.07**	0.04**
	(0.02)	(0.03)	(0.03)	(0.02)
Mother: reads stories to child	0.00	0.05*	0.02	0.06***
	(0.02)	(0.03)	(0.03)	(0.02)
Mother: draws with child	0.03*	-0.00	-0.03	-0.00
	(0.01)	(0.03)	(0.03)	(0.02)
Children's books at home	0.05***	0.15***	0.07*	0.10***
	(0.02)	(0.03)	(0.04)	(0.03)
Vocabulary score age 3	0.11***	0.15***	0.11***	0.14***
, ,	(0.01)	(0.02)	(0.02)	(0.02)
Childcare attendance	-0.02	-0.06*	-0.09**	-0.04
	(0.02)	(0.04)	(0.04)	(0.03)
Observations	1,227	1,231	1,231	1,231
R-squared	0.42	0.26	0.23	0.38

Robust standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table:	Summary	statistics
--------	---------	------------

Variable	Mean	(Std. Dev.)	Min.	Max.	N
Music available	0.8	(0.4)	0	1	1237
Father's non-labor income (Weekly-CLP)	779.06	(5626.93)	0	132819.41	1237
Mother's non-labor income (Weekly-CLP)	2609.53	(8139.58)	0	132819.41	1237
Father's wage (Weekly-CLP)	101038.3	(132215.07)	4427.31	2988436.75	1237
Mother's wage (Weekly-CLP)	80522.29	(87334.48)	2846.13	996145.5	1237
Childcare attendance	0.68	(0.47)	0	1	1237
Music available	0.8	(0.4)	0	1	1237
Mother's schooling	12.18	(2.8)	0	21	1237
Father's schooling	11.68	(3)	0	20	1237

VARIABLES	(1) Toys FE	(2) Toys FE	(3) Toys FE	(4) Toys FE	
Within 1km	1.09				
Within 2km	(0.01)	0.55** (0.28)			
Within 5km			0.12** (0.05)		
Within 10km				0.03** (0.01)	
Observations Adjusted R-squared	4,827 0.29	4,827 0.29	4,827 0.29	4,827 0.29	
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1					

## Alternative specifications for density of preschool providers

1,000 of childcare providers within specified distance.

Additional controls: grades of schooling of both parents, WAIS verbal and numerical test scores for the mother, big-five personality traits test score for the mother, age of child, number of members living in the household, age of both parents, total income, activities that parents perform with their children and other investments done by parents

(1)         (2)         (3)         (4)           VARIABLES         Within 1km         Within 2km         Within 5km         Within 10km           Grades of schooling (mother)         0.05         0.04         -0.25         -0.95           Grades of schooling (mother)         0.01         0.09         0.40         0.18           Grades of schooling (father)         0.01         0.09         0.40         0.18           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         0.00         -0.00         -0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.00         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)	T TESCHOOT	provision		lates	
VARIABLES         Within 1km         Within 2km         Within 5km         Within 10km           Grades of schooling (mother)         0.05         0.04         -0.25         -0.95           Grades of schooling (father)         0.01         0.09         0.40         0.18           Grades of schooling (father)         0.01         0.09         0.40         0.18           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         0.00         0.00         0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.000         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00<		(1)	(2)	(3)	(4)
Grades of schooling (mother)         0.05         0.04         -0.25         -0.95           Grades of schooling (father)         0.01         0.09         0.40         0.18           (0.04)         (0.09)         0.40         0.18           (0.04)         (0.09)         (0.25)         (0.58)           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00           Mother's weekly wage (CLP)         0.00         0.000         (0.00)           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)	VARIABLES	Within 1km	Within 2km	Within 5km	Within 10km
Grades of schooling (mother)         0.05         0.04         -0.25         -0.95           (0.04)         (0.10)         (0.27)         (0.65)           Grades of schooling (father)         0.01         0.09         0.40         0.18           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         0.00         0.00         0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.00         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         -0.00         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         -0.00         -0.00         -0.00         -0.00           (0.00)         (0.00)					
(0.04)         (0.10)         (0.27)         (0.65)           Grades of schooling (father)         0.01         0.09         0.40         0.18           (0.04)         (0.09)         0.40         0.18           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         (0.00)         (0.00)         (0.00)           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.00         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         -0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)	Grades of schooling (mother)	0.05	0.04	-0.25	-0.95
Grades of schooling (father)         0.01         0.09         0.40         0.18           (0.04)         (0.09)         (0.25)         (0.58)           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         (0.00)         (0.00)         (0.00)           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.000         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)		(0.04)	(0.10)	(0.27)	(0.65)
(0.04)         (0.09)         (0.25)         (0.58)           Father's wage (Weekly-CLP)         -0.00         -0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         0.00         0.00         0.00           Mother's weekly wage (CLP)         0.00         0.00         -0.00         0.00           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.000         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         0.00         0.00         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)	Grades of schooling (father)	0.01	0.09	0.40	0.18
Father's wage (Weekly-CLP)         -0.00         -0.00         <		(0.04)	(0.09)	(0.25)	(0.58)
(0.00)         (0.00)         (0.00)         (0.00)           Mother's weekly wage (CLP)         0.00         0.00         -0.00         0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.000         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.000         (0.00)         (0.00)         (0.00)           Observations         4.161         4.161         4.161         4.161         4.161	Father's wage (Weekly-CLP)	-0.00	-0.00	0.00	0.00
Mother's weekly wage (CLP)         0.00         0.00         -0.00         0.00 <t< td=""><td></td><td>(0.00)</td><td>(0.00)</td><td>(0.00)</td><td>(0.00)</td></t<>		(0.00)	(0.00)	(0.00)	(0.00)
(0.00)         (0.00)         (0.00)         (0.00)           Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00           Mother's non-labor income (Weekly-CLP)         (0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Observations         4.161         4.161         4.161         4.161	Mother's weekly wage (CLP)	0.00	0.00	-0.00	0.00
Father's non-labor income (Weekly-CLP)         -0.00         -0.00         -0.00         -0.00         -0.00         -0.00         -0.00         -0.00         -0.00         (0.00) </td <td></td> <td>(0.00)</td> <td>(0.00)</td> <td>(0.00)</td> <td>(0.00)</td>		(0.00)	(0.00)	(0.00)	(0.00)
(0.00)         (0.00)         (0.00)         (0.00)           Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00         -0.00           (0.00)         (0.00)         (0.00)         (0.00)         (0.00)         (0.00)           Observations         4.161         4.161         4.161         4.161	Father's non-labor income (Weekly-CLP)	-0.00	-0.00	-0.00	-0.00
Mother's non-labor income (Weekly-CLP)         0.00         0.00         -0.00		(0.00)	(0.00)	(0.00)	(0.00)
(0.00) (0.00) (0.00) (0.00) Observations 4.161 4.161 4.161 4.161	Mother's non-labor income (Weekly-CLP)	0.00	0.00	-0.00	-0.00
Observations 4 161 4 161 4 161 4 161		(0.00)	(0.00)	(0.00)	(0.00)
Observations 4.161 4.161 4.161 4.161					
	Observations	4,161	4,161	4,161	4,161
Adjusted R-squared 0.46 0.70 0.91 0.95	Adjusted R-squared	0.46	0.70	0.91	0.95

## Preschool provision and covariates

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Additional controls: grades of schooling of both parents, WAIS verbal and numerical test scores for the mother, big-five personality traits test score for the mother, age of child, number of members living in the household, age of both parents, total income, activities that parents perform with their children and other investments done by parents  $1 \text{ USD} \rightarrow 670 \text{ CLP}$ .

## Heterogeneity in Pareto weight

 $\eta^i_{\mu,t} = \delta_1 \ln(PG)^i + \delta_0 \text{Household income}^i_t + \nu^i_{\mu,t}$ 



## Heterogeneity in skills

$$\eta_{\mu,s}^{i} = \delta_{0,\mu} gender + \eta_{t,s}^{i}$$



## Sample selected for estimation

Filter	Number of households
Initial sample	18,310
Household not surveyed in 2012	16,033
Household not surveyed in 2010	12,898
Parent not living in household	7,855
Siblings within five years of age in the household	4,125
Children with incomplete skills questionnaires	2,247
Households with incomplete questionnaires	950

Measurement system

$$Z_m^k = \iota_{m,0}^k + \iota_{m,1}^k k + \varepsilon_m^k$$
 for  $m = 1...N_k$ , for  $k \in K$ 

- Measurement system is not identified from data
- Normalizations and assumptions are necessary
  - Set  $E[k] = c_k$
  - $\iota_{1,1}^k = 1$  for every k
  - $E[\varepsilon_m^k|k] = 0$  for every *m* for every *k*
  - ►  $\varepsilon_m^{\ln(s_0)} \perp \varepsilon_{m'}^{k'}$  for every m measure of  $\ln(s_0)$ , for every m' measure of any other  $k' \neq \ln(s_0)$

# Identification

$$Z_m^k = \iota_{m,0}^k + \iota_{m,1}^k k + \varepsilon_m^k$$
 for  $m = 1...N_k$ , for  $k \in K$ 

Note that:

• 
$$Cov(Z_m^k, Z_1^{\ln(s_0)}) = \iota_{m,1}^k Cov(k, \ln(s_0))$$
  
•  $Cov(Z_1^k, Z_1^{\ln(s_0)}) = Cov(k, \ln(s_0))$ 

Then:

$$\blacktriangleright \ \frac{Cov(Z_m^k,Z_1^{\ln(s_0)})}{Cov(Z_1^k,Z_1^k)} = \iota_{m,1}^k$$
 Back

Schennach (2004)

- If there are two measures for each factor satisfying a strong form of independence, we can non-parametrically identify the density f<sub>k</sub>(K)
- We can identify conditionals f<sub>(I |μ)</sub> (I | μ); Marginals f<sub>I</sub> (I) and joint distributions f<sub>I,μ</sub> (I, μ)

Optimal level of log-investments for a family

- 1.  $\ln(I) = g^{I}(\mu, \eta_{I}; \Phi)$
- 2. Policy function is separable in  $\eta_I$

$$\ln(I) = g_1^I(\mu; \Phi) - \eta_I$$

- 3. We know the conditional density is identified  $f_{(\ln(I) \mid \mu)}(\ln(I) \mid \mu)$
- 4. We can identify  $g_1'()$  function

Take expectations with respect to  $f_{(\ln(I)|\mu)}$ 

 $E[\ln(I)] = E[g_1^I(\mu; \Phi)] = g_1^I(\mu; \Phi)$ 

Separately identify elements of  $\boldsymbol{\Phi}$ 

• 
$$g_1^I(\mu; \Phi) = g_1^I(\mu, \alpha_2^f, \alpha_2^m, P_I)$$

- Distribution factors:
  - Ratio of female to male non-labor income
  - Gender ratio
  - Age differences
- Number of childcare providers in neighborhood

	(1)	(2)
VARIABLES	Woman administers income	Woman administers income
Father's non-labor income share	-0.08***	-0.05**
	(0.02)	(0.02)
Age difference (Father-Mother)	-0.00***	0.00
	(0.00)	(0.00)
Difference in schooling (Father-Mother)	-0.00	-0.01***
	(0.00)	(0.00)
Sex ratio (Men/Women)	0.03	-0.07
	(0.11)	(0.11)
Unemployment ratio (Men/Women)	0.07	0.15**
	(0.07)	(0.07)
Wage ratio (Men/Women)	-0.05	0.08
	(0.12)	(0.12)
Observations	6,863	6,863
Adjusted R-squared	0.02	0.09
Controls	NO	YES
Observations Adjusted R-squared Controls	6,863 0.02 NO	6,863 0.09 YES

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Woman administers income: 1 if yes, 0 if no. Additional controls include maternal schooling, number of members in the household, personality and cognitive test scores for the mother, labor force participation and labor income.

Alternative specifications Reduced form Evidence

	(1)	(2)
VARIABLES	Female empowerment index	Female empowerment index
Father's non-labor income share	-0.66***	-0.10**
	(0.05)	(0.05)
Age difference (Father-Mother)	-0.00*	0.00***
	(0.00)	(0.00)
Difference in schooling (Father-Mother)	-0.00*	-0.06***
,	(0.00)	(0.00)
Sex ratio (Men/Women)	1.32***	0.06
	(0.21)	(0.20)
Unemployment ratio (Men/Women)	0.13	0.25*
	(0.14)	(0.13)
Wage ratio (Men/Women)	-0.65***	0.02
,	(0.23)	(0.20)
Observations	6,863	6,863
Adjusted R-squared	0.05	0.23
Controls	NO	YES
Pobuct	standard errors in parentheses	

Robust standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Woman administers income: 1 if yes, 0 if no. Additional controls include maternal schooling, number of members in the household, personality and cognitive test scores for the mother, labor force participation and labor income

Female empowerment index constructed by Principal Component analysis to the questions about female empowerment and gender roles.

## Table: Summary statistics in 2012

Variable	Mean	(Std. Dev.)
Mother's age	34.52	(6.94)
Father's age	37.41	(7.96)
Mother's years of schooling	11.27	(2.97)
Father's years of schooling	10.72	(3.13)
Mother's hours of work (week)	24.22	(21.34)
Father's hours of work (week)	43.2	(16.03)
Mother's weekly wage (1,000 CLP)	49.32	(79.59)
Mother's weekly wage (USD)	98.64	(159.18)
Father's weekly wage (1,000 CLP)	75.88	(83.60)
Father's weekly wage (USD)	151.76	(167.2)
Age of child (months)	64.59	(8.4)
- N		950

 $1 \text{ USD} \approx 500 \text{ CLP}$ 

Demand for childcare				
Predicted Observed				
Working mothers 67.71 68.41				
Not working mothers 42.97 41.64				
Bootstrap fit				

#### Labor force supply 2012

	Predicted	Observed
Mothers	61.47	62.63
Fathers	96.53	93.26
Bootstrap fit	t By education	By age

Labor	force supp	ly 2010
	Predicted	Observed
Mothers	57.16	60.32
Fathers	94.00	91.47
Bootstrap fi	t By educat	ion By age

### Wages Mothers

	Predicted	Observed
Mean	10.86	10.83
SD	0.78	0.80
See distribution		
Wages Fathers		
	Predicted	Observed
Mean	10.90	10.89
SD	0.47	0.75

See distribution

# Preschool providers

	(1)	(2)	(3)	(4)
VARIABLES	Attends preschool	Music for childrem	Toys FE	Vegetable Consumption
Childcare providers	0.00	0.01**	0.01**	0.03***
	(0.01)	(0.00)	(0.01)	(0.01)
Distance to childcare	-0.01**	-0.02***	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
01	4 007			1 007
Observations	4,827	4,827	4,827	4,827
Adjusted R-squared	0.25	0.15	0.29	0.12
Robust standard errors in parentheses				
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$				

#### ToysFE: Toys for free expression

Preschool providers: Number of childcare providers within 5km to the household (hundreds)

Vegetable consumption: weekly frequency. Standardized (mean 0, sd 1)

Distance to childcare: Distance to nearest childcare-preschool service provider (km)

Additional controls: grades of schooling of both parents, WAIS verbal and numerical test scores for the mother, big-five personality traits test score for the mother, age of child, number of members living in the household, age of both parents, total income, activities that parents perform with their children and other investments done by parents Summary statistics Alternative specifications Data

## Effects of public policies on Female Employment



# Childcare attendance and child outcomes

	(1)	(2)	
VARIABLES	Tepsi Cognitive test score	Tepsi Cognitive test score	
Childcare attendance	0.15*** (0.02)	0.71*** (0.27)	
Observations Adjusted R-squared	3,682 0.65	3,670 0 59	
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Reduced form evidence

# Frequency of activities performed by parents on a regular week



Parental effort: Frequency of activities in last seven days: Never, 1-3 times;4-6 times;everyday. Households where both parents are present. Back to data Conditional on labor supply