Cognitive Skill Formation in Early Childhood

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Outline

• We ask the most of families when they have the least

• The income-based cognitive skill gaps that develop under status quo are not inevitable.

• Aim to improve understanding of how subsidies affect ECE service demand & supply
  – View experimental evidence through theoretical lens that takes quality of child experience seriously.
  – Towards estimates of how supply responds
We ask most when families have least

- Most private responsibility early
- Least resources early

The Disconnect between Resources and Needs when Investing in Children

DECEMBER 22, 2016 AT 10:00 AM ET BY SANDRA BLACK

Summary: New CEA issue brief documents the economic challenges faced by many American families with children under the age of five.
Least public investment in youngest: public expenditure per child

![Bar chart showing per capita expenditure by age group in 2015.](chart)

**Note:** Federal funding includes refundable portions of tax credits but not reductions in taxes. State funding includes state earned income tax credits but no other tax provisions. Source: Edelstein et al. (2016); Edelstein et al. (2012); CEA calculations.
Publicly-financed ECE:
5 hours/child-wk under age 5
Current earning power

Note: Hours worked refers to average hours spent in work-related activities. Hourly wage refers to the median hourly wage.
Source: CPS 2016; American Time-Use Survey 2015; CEA calculations.
Access to future income

Share with a Credit Score of 650 or Above

Parents' Youngest Child Age

No way to do it cheaply & well: parent’s income or another adult

Note: Infant and toddlers encompasses Early Head Start, preschool encompasses Head Start, and college encompasses institutions that predominantly grant certificates or associate or bachelor degrees.

Source: HHS; Department of Education; College Scorecard 2016; CEA calculations
Gaps open early but are not inevitable
Income-based gaps open early & stabilize
Income-based gaps open very early
Is it possible to prevent these gaps from appearing?
The experimental treatment: IHDP

The Infant Health & Development Program (IHDP) recruited a sample at birth and randomly assigned a treatment. [Brooks-Gunn et al, 1994; McCarton et al, 1997; Gross et al, 1997]

Age 0-12 months: offer of weekly home visit from staff

12–36 m: access to child development center (CDC)
  • Free
  • Full-day
  • High-quality, Abecedarian curriculum
  • Free transportation
  • Home visits reduce to monthly
The experimental sample (N = 985)

For experiment, uniquely diverse ethnically & economically

But only included children born:
- Low-birth weight (LBW): ≤ 2500 g = 5.5 lbs
- Premature: ≤ 37 weeks
- In 8 research hospitals around U.S.
- Starting January 7, 1985 until fully enrolled
- Control = 608; Treatment = 377
Among high LBW: little effect on “IQ” at start of child-care intervention

Duncan & Sojourner (2013) *Journal of Human Resources* : using ECLS-B weights
During child-care intervention: enormous effects on IQ measures

![Graph showing treatment effect (SD) vs. child years of age for low-income group]

What do you think effects will be at:
- Age-5?
- Age-8?
- Age-18?

Duncan & Sojourner (2013) *Journal of Human Resources*: using ECLS-B weights
2 years after intervention end: large, positive effect at school-entry

Duncan & Sojourner (2013) *Journal of Human Resources* : using ECLS-B weights
5 years after intervention end: large, positive effect

Duncan & Sojourner (2013) *Journal of Human Resources*: using ECLS-B weights
15 years after intervention end: evidence of persistence for low-income

Treatment effect (SD) vs Child years of age


What do you think effects will be for higher-income?
For **higher-income**, effect on IQ trends much weaker

Duncan & Sojourner (2013) *Journal of Human Resources* : using ECLS-B weights
What drives different effects? Matter for policy and science

• Differences in parental choices
  – Take-up offer of subsidized care
  – Quality and quantity of parental care
  – Quality and quantity of other, non-parental care

• Differences in parental constraints or tastes. Many possible channels. Hard to see in most data.

• IHDP: rich data up to 36 months. Use to get insight into how demand responds to subsidy offer.
Differential effects on allocation of child time?
Effects on child-time allocation: differential crowd out

Chaparro, Sojourner & Huey (forthcoming) Differential effects from access to high-quality early care
Any effects on maternal-care quality? For whom?
Effects on maternal-care quality are large, decline in wage

Chaparro, Sojourner & Huey (forthcoming) Differential effects from access to high-quality early care
Key features of economic model

• Single-period postnatal decisions influence child cognitive skill
  – One child & one mother
  – Child skill depends on initial endowment & post-natal care
  – Child time budget: needs maternal or nonmaternal care
  – Maternal time budget: parenting, earning, or other
  – Maternal and non-maternal care of chosen qualities & quantities
  – Cost of non-maternal care increases in quality & quantity
  – Maternal-care quality depends on given productivity & effort choice
  – Maternal productivity in earnings and parenting correlated
  – Endogenous take-up of offer of “treatment” CDC care

• Represents policy as offer of (quality-quantity-price) of care.

Chaparro, Sojourner & Wiswall (in progress)
Post-natal investments $\equiv$ quality of care

<table>
<thead>
<tr>
<th>Caretaker</th>
<th>Hours of Care</th>
<th>Quality of Care</th>
<th>Effective units of care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Care</td>
<td>Mother</td>
<td>$r$</td>
<td>$q^r$</td>
</tr>
<tr>
<td>Free care (CDC)</td>
<td>$t$</td>
<td>$q^t$</td>
<td>$q^t * t$</td>
</tr>
<tr>
<td>Other care</td>
<td>$n$</td>
<td>$q^n$</td>
<td>$q^n * n$</td>
</tr>
</tbody>
</table>
Model of maternal choices

Max $U(c, l, h, r, e, t)$

<table>
<thead>
<tr>
<th>Utility depends on</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c$</td>
<td>Consumption (+)</td>
</tr>
<tr>
<td>$l$</td>
<td>Leisure (+) = $24 \times 7 - \text{ labor hours} - \text{ parenting hours}$</td>
</tr>
</tbody>
</table>
| $h$                                    | Child’s cognitive skills (+)  
IQ at age-3                                                                 |
| $(r,e)$                                | Parenting quantity & instantaneous effort (?/-)                            |
| $t$                                    | Hours of care in IHDP-treatment-eligible child dev. center (-)              |
## Constraints

Max $U(c, l, h, e, r, t)$

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child’s time</td>
<td>$r + n + t = T_c$</td>
</tr>
<tr>
<td>Mother’s time</td>
<td>$r + L + l = T_p$</td>
</tr>
<tr>
<td>Budget</td>
<td>$c + \pi q^n n = wL + Y$</td>
</tr>
<tr>
<td>Maternal-care quality</td>
<td>$q^r = q^r (m, \omega, e)$</td>
</tr>
<tr>
<td>Maximum CDC time</td>
<td>$t \leq \bar{t}$</td>
</tr>
</tbody>
</table>
| Skill production                         | $h = f [\text{nonmaternal}; \text{maternal}; \text{endowment}; \varepsilon]$
|                                          | $= f [q^n n + q^t t; q^r r ; h_0; \varepsilon]$                       |
| Wage offer                               | $w = w(m, \omega)$                                                     |
# First Order Conditions (FOC)

For each parent, maternal-care quality influenced by effort choice

- **Marginal benefit**: additional human capital
- **Marginal cost**: distaste for effort

<table>
<thead>
<tr>
<th>First-order conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$L^*$</td>
<td>$w = MRS_{l,c}$</td>
</tr>
<tr>
<td>$e^*$</td>
<td>$MRS_{h,c} f_2 q_e^r = -MRS_{e,c}$</td>
</tr>
</tbody>
</table>
Preliminary result: decomposition

Percent of age-3 child cognitive skill gap by maternal education explained by observed gap in each factor

- Nonlabor income
- Maternal wage offer
- Child endowment
- Maternal care productivity
- All these channels
Work in progress: counterfactual policy simulations

• Contrast predicted effects of offers of:
  – Full-time, high-quality care in-kind (IHDP)
  – Part-time, high-quality care in-kind
  – Full-time, modest-quality care in-kind
  – Voucher: allow parent choice of quantity-quality
  – … with quality floor (ELS)
  – Cash

• Allow different predictions for different types
Towards subsidies’ effects on supply

• Measure variation in MN families’ access to ECE services. [Davis, Lee & Sojourner (2018) ECRQ]

• In progress:
  – Measure changes in MN policy Parent Aware, ELS, CCAP, (E)HS, state pre-K, all-day K.

• How do local policy changes relate to changes in local supply and access?
Data sources

• Providers: NACCRRAware database of licensed providers in MN 2011-’17. Includes address, capacity & price by child age.

• Quality rating: ParentAware.

• Families with young children: Census counts & types in small areas.

• Road network, lakes, parks...
Spatial distribution of families and providers used in 2015 analysis
Fig. 1. Spatial distribution of families' access to supply adjusted for local child population in Hennepin and Ramsey Counties, 2015.

Note: The adjusted supply measure is calculated using the E2SFCA method with Gaussian weight beta = 4 assuming a 20-min driving time catchment area around each family location and each ECE provider.
Conclusions

• (Lack of) investment influences child development. Skill gaps are produced by our policy choices as well as parents’.

• Child time is a precious, limited resource. Use it well.

• Policy design demands attention to (differential) parental reactions & providers’ reactions.
The most valuable of all capital is that invested in human beings.

- Alfred Marshall, *Principles of Economics*