Growing Together:
The Importance of a Large Early-Life Social Inclusion Program on Neonatal Health Outcomes in Latin America

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Introduction

There is a growing theoretical and empirical literature on the importance of early life investments (e.g., Heckman, Currie, Almond, among many others)

- Investments can be both equity promoting and efficient given dynamic complementarities
- Early-life health programs are increasingly part of the basic social safety net in developing and developed countries
- This paper examines in detail a particular early life health policy explicitly designed to close gaps which emerge early, and perdure during life
Introduction

We examine the program *Chile Crece Contigo* (ChCC), an early life policy which is a flagship of the social safety in Chile

- Many Latin American countries characterised by irregular rather than universally poor, infant health outcomes
- Outcomes are particularly poor in socially isolated groups: low income, rural communities, indigenous communities
- ChCC is a targeted (means tested) program, rolled out from 2007 onwards, now covering nearly 200,000 (of 250,000 births) annually
- Two questions: Is this an equity-promoting policy? Is this an efficient policy?
Basic Trends in Birth Outcomes: 2000-2010

Figure 1: Birth Weight by ChCC Participation and Program Timing

![Graph showing birth weight trends](image)

- **Longer trends**
Chile Crece Contigo

Originally two main pillars: The Program for Support of Newborns (PARN) and The Program to Support Bio-Psycho-Social Development (PADBP)

- Follows children from *in utero* to four years
- Provides a series of basic services: fortified food, reading material, guaranteed medical check-ups and services
- Also provides specialised support for vulnerable families: support for domestic violence, mental health check-ups, outreach beyond community medical clinics
- Increased the time of prenatal check-ups from 20-40 minutes
- A range of neo-natal and post-natal services
- Rolled out in 2007, signed into law in 2008
- Closely linked to academic and policy evidence
ChCC: Also an Emphasis on Diversity, Equality

Images from crececontigo.gob.cl
Identification

We take advantage of two alternative estimation strategies to examine the impact of ChCC:

1. Within mother variation in policy exposure
   - For a subset of mothers we observe births prior to and posterior to the reform
   - We also observe whether they participated or not in ChCC
   - We can thus estimate using maternal FE in a panel to absorb all invariant mother unobservables

2. Variation in timing and intensity of municipal roll-out
   - Variation in exposure in the 346 municipalities in Chile
   - Examine how municipal level averages for outcomes of all births in Chile depend on ChCC coverage
   - Estimate using a flexible difference-in-differences model
Identification

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1. Within mother variation in policy exposure
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2. Variation in timing and intensity of municipal roll-out
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   - Examine how municipal level averages for outcomes of all births in Chile depend on ChCC coverage
   - Estimate using a flexible difference-in-differences model
Individual-Level Data (Mother Fixed Effects)

We estimate the following for each birth $i$ to mother $j$ at time $t$:

\[ \text{InfantHealth}_{ijt} = \beta_0 + \beta_1 \text{ChCC}_{jt} + \mathbf{X}_{ijt} \beta_x + \phi_t + \mu_j + \varepsilon_{ijt} \quad (1) \]

- Parameter of interest is $\hat{\beta}_1$: compare changes in outcomes before and after policy across mothers who did and didn’t receive ChCC
- Identification is driven by mothers with $> 1$ birth
- We also include full mother age, year of birth and child birth order fixed effects $\mathbf{X}_{ijt}$
- Cluster standard errors $\varepsilon_{ijt}$ by mother
We estimate the following difference-in-difference specification for birth outcomes in municipality $c$ and time $t$:

$$\text{InfantHealth}_{ct} = \alpha_0 + \alpha_1 \text{ChCC}_{ct} + W_{ct} \alpha_w + \phi_t + \lambda_c + \eta_{ct}$$ (2)

- We use month by municipality cell averages
- Cells are weighted by the number of births in the municipality
- $\text{ChCC}_{ct}$ is proportion of births in municipality which had participated in ChCC during gestation
- $\hat{\alpha}_1$ captures effect of moving full population into ChCC
- Cluster standard errors $\eta_{ct}$ by municipality
Figure 3: Rollout
We match administrative data on all births in Chile from 2003 to 2010 with an indicator of whether the mother participated in ChCC during gestation

- High quality birth data covering > 99.5% of all births available from Ministry of Health
- Participation in social programs available from Ministry of Social Development (MDS)
- Can only match a sub-set (~50%) of children to mothers using data from the Social Registry (for mother FEs)
- However, can use all births to build municipal averages
- Finally, data on rollout over time provided by MDS
Outcomes

*Ex ante*, outcomes of interest are defined as:

- Birth weight (in grams)
- Gestation (in weeks)
- Size at birth (in cm)
- Prematurity (<37 weeks)
- Low Birth Weight (<2500 grams)

Nonetheless, we are concerned about multiple hypothesis testing. We thus correct using Romano and Wolf step-down testing (fixes FWER), and a single index of outcomes (as defined by Anderson (2008)).

We would like to examine APGAR (measured systematically at 1 and 5 minutes in Chile), however not currently reported in birth data. Currently working to match this variable with administrative data...
## Summary Statistics

**Table 1: Summary Statistics: Birth and Chile Crece Contigo Data**

| Panel A: Individual-Level Data |  |  |  |  |  |
|-------------------------------|---|---|---|---|
| **Mother Ever Participated in ChCC** | 741963 | 0.38 | 0.48 | 0.00 | 1.00 |
| **Birth weight (grams)** | 741072 | 3331.96 | 547.52 | 110.00 | 6500.00 |
| **Low Birth Weight (< 2,500 grams)** | 741072 | 0.06 | 0.23 | 0.00 | 1.00 |
| **Very Low Birth Weight < 1500 grams** | 741072 | 0.01 | 0.10 | 0.00 | 1.00 |
| **Length (cm)** | 740758 | 49.47 | 2.62 | 16.00 | 62.00 |
| **Gestation (weeks)** | 741046 | 38.61 | 1.88 | 16.00 | 44.00 |
| **Premature (< 37 weeks)** | 741046 | 0.07 | 0.25 | 0.00 | 1.00 |
| **Mother’s Age (years)** | 741413 | 26.91 | 6.75 | 14.00 | 49.00 |
| **Surviving Children** | 741918 | 1.96 | 1.14 | 0.00 | 15.00 |

**Panel B: Municipal-Level Data**

|  |  |  |  |  |  |
|-------------------------------|---|---|---|---|
| **Proportion Participating in ChCC** | 31843 | 0.41 | 0.31 | 0.00 | 1.00 |
| **Birth Weight (grams)** | 31805 | 3344.65 | 175.52 | 686.00 | 4868.00 |
| **Low Birth Weight < 2500 grams** | 31805 | 0.05 | 0.07 | 0.00 | 1.00 |
| **Very Low Birth Weight < 1500 grams** | 31805 | 0.01 | 0.03 | 0.00 | 1.00 |
| **Gestation (weeks)** | 31806 | 38.66 | 0.60 | 24.00 | 42.00 |
| **Premature < 37 weeks** | 31806 | 0.06 | 0.08 | 0.00 | 1.00 |
| **Length (cm)** | 31806 | 49.47 | 0.88 | 30.00 | 56.00 |
| **Number of Births** | 31843 | 60.20 | 93.69 | 1.00 | 787.00 |
Main Results (Mother FEs)

Table 2: Estimated Program Effects with Mother Fixed Effects

<table>
<thead>
<tr>
<th></th>
<th>(1) Birth Weight</th>
<th>(2) LBW</th>
<th>(3) VLBW</th>
<th>(4) Size</th>
<th>(5) Gestation</th>
<th>(6) Premature</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChCC Receipt</td>
<td>22.864***</td>
<td>0.003</td>
<td>0.000</td>
<td>0.050**</td>
<td>0.101***</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>[4.671]</td>
<td>[0.002]</td>
<td>[0.001]</td>
<td>[0.023]</td>
<td>[0.016]</td>
<td>[0.002]</td>
</tr>
<tr>
<td>Constant</td>
<td>3073.061***</td>
<td>0.089**</td>
<td>0.030**</td>
<td>48.404***</td>
<td>38.058***</td>
<td>0.124***</td>
</tr>
<tr>
<td></td>
<td>[63.785]</td>
<td>[0.036]</td>
<td>[0.013]</td>
<td>[0.316]</td>
<td>[0.254]</td>
<td>[0.038]</td>
</tr>
</tbody>
</table>

Estimation sample consists of all mothers with greater than one birth, and for whom information on public program enrollment can be matched with vital statistics data of their children. In each case mother fixed effects are used, along with fixed effects for age, birth order and year of birth. Low Birth Weight (LBW) and Very Low Birth Weight (VLBW) refer to binary indicators for a birth being less than 2,500g or 1,500g respectively. Premature is a binary variable referring to births at less than 37 weeks of gestation. Standard errors are clustered by mother. * p<0.10; ** p<0.05; *** p<0.01.
## Main Results (Municipal Roll-out)

**Table 3: Diff-in-Diff Estimates using Municipal Variation in Coverage**

<table>
<thead>
<tr>
<th></th>
<th>(1) Weight</th>
<th>(2) LBW</th>
<th>(3) VLBW</th>
<th>(4) Size</th>
<th>(5) Gestation</th>
<th>(6) Premature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion ChCC coverage</td>
<td>11.998*</td>
<td>-0.006**</td>
<td>-0.000</td>
<td>0.056</td>
<td>0.079***</td>
<td>-0.005*</td>
</tr>
<tr>
<td></td>
<td>[6.906]</td>
<td>[0.003]</td>
<td>[0.001]</td>
<td>[0.042]</td>
<td>[0.026]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>Constant</td>
<td>3350.031***</td>
<td>0.055***</td>
<td>0.011***</td>
<td>49.470***</td>
<td>38.698***</td>
<td>0.065***</td>
</tr>
<tr>
<td></td>
<td>[4.242]</td>
<td>[0.002]</td>
<td>[0.001]</td>
<td>[0.026]</td>
<td>[0.016]</td>
<td>[0.002]</td>
</tr>
<tr>
<td>Observations</td>
<td>31698</td>
<td>31698</td>
<td>31698</td>
<td>31698</td>
<td>31698</td>
<td>31698</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.258</td>
<td>0.051</td>
<td>0.022</td>
<td>0.450</td>
<td>0.279</td>
<td>0.096</td>
</tr>
</tbody>
</table>

Estimation sample consists of all municipal-level averages for each month between 2003 and 2010 for all women. Low birth weight refers to the proportion of births under 2,500 grams, and premature refers to the proportion of births occurring before 37 weeks of gestation. Each cell is weighted using the number of births in the municipality and month, and all specifications include municipality and time (Year × Month) fixed effects. * p<0.10; ** p<0.05; *** p<0.01.
Figure 4: Impacts by Vulnerability Score: Prematurity
Other Results

- If we focus on mother FE only for mothers with multiple births in the +/- 2 years surrounding the reform, results are largely similar.
- When focusing on less educated mothers, the effects of ChCC are much larger than the more educated group (ChCC is a targeted policy).
- Correcting for multiple hypothesis testing does not explain away significant impacts.
- We examine a large number of placebo tests relating to the date of program implementation...
Placebo Test

Figure 5: Placebo (Birth Weight)
Program Efficiency

ChCC is approaching 1% of all fiscal budget expenditures (∼USD 330 Million on ChCC 2010). Hence important to consider efficiency of spending

- Based on program expenditure, and estimates on impacts, “cost” per gram of birth weight is approximately 18 USD
- This value is similar to efficiency of WIC and Food Stamp Program in US
- Using estimates of the impact of birth weight on long term outcomes in Chile, we estimate that 1200 USD invested in ChCC is equivalent to a 1sd increase in school test scores for a single child (back of the envelope)
Conclusions and Future Directions

We find a relatively large impact of participation in a pre-natal support program on birth outcomes in Chile

- An expensive program: results point to large economic returns
- A targeted program: results are largest among most vulnerable
- This program extends beyond birth and up to 4 years.
  - Current work only examines the earliest impacts.
  - We expect larger impacts on longer term outcomes (e.g., education) given on-going investments
  - However, long-term outcomes are follow-up work
Thank you
Appendices
Figure A1: Longer Trend: Average Maternal Age
Figure A2: Longer Trend: Birth weight
Figure A3: Longer Trend: Low Birth Weight
Figure A4: Longer Trend: Gestation
Figure A5: Longer Trend: Number of Births
Figure A6: Longer Trend: Teen Births

![Graph showing a trend in adolescent pregnancies from 1990 to 2015. The proportion of adolescent pregnancies increases and decreases over time, peaking around 2005 and decreasing sharply after 2010.]
Mother FE (Only Those with Births +/- 2 years around reform)

Table A1: Estimated Program Effects with Mother Fixed Effects

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChCC Receipt</td>
<td>17.265*</td>
<td>0.004</td>
<td>0.001</td>
<td>0.009</td>
<td>0.079**</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>[8.922]</td>
<td>[0.004]</td>
<td>[0.002]</td>
<td>[0.044]</td>
<td>[0.033]</td>
<td>[0.005]</td>
</tr>
<tr>
<td>Constant</td>
<td>3090.627***</td>
<td>0.147**</td>
<td>0.049</td>
<td>47.862***</td>
<td>37.661***</td>
<td>0.196**</td>
</tr>
<tr>
<td></td>
<td>[121.755]</td>
<td>[0.067]</td>
<td>[0.031]</td>
<td>[0.653]</td>
<td>[0.543]</td>
<td>[0.079]</td>
</tr>
<tr>
<td>Observations</td>
<td>44775</td>
<td>44775</td>
<td>44775</td>
<td>44714</td>
<td>44687</td>
<td>44687</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.021</td>
<td>0.005</td>
<td>0.004</td>
<td>0.011</td>
<td>0.007</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Estimation sample consists of all mothers with one birth in the two years preceding, and one birth in the two years following the reform, and for whom information on public program enrollment can be matched with vital statistics data of their children. In each case mother fixed effects are used, along with fixed effects for age, birth order and year of birth. Low Birth Weight (LBW) and Very Low Birth Weight (VLBW) refer to binary indicators for a birth being less than 2,500g or 1,500g respectively. Premature is a binary variable referring to births at less than 37 weeks of gestation. Standard errors are clustered by mother. * p<0.10; ** p<0.05; *** p<0.01.
**Table A2: Difference-in-Difference Estimates: loweduc**

<table>
<thead>
<tr>
<th></th>
<th>(1) Weight</th>
<th>(2) LBW</th>
<th>(3) VLBW</th>
<th>(4) Size</th>
<th>(5) Gestation</th>
<th>(6) Premature</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proportion of ChCC coverage</strong></td>
<td>15.584**</td>
<td>-0.007**</td>
<td>-0.000</td>
<td>0.050</td>
<td>0.088***</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>[6.872]</td>
<td>[0.003]</td>
<td>[0.001]</td>
<td>[0.040]</td>
<td>[0.026]</td>
<td>[0.003]</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>3344.111***</td>
<td>0.055***</td>
<td>0.011***</td>
<td>49.457***</td>
<td>38.662***</td>
<td>0.065***</td>
</tr>
<tr>
<td></td>
<td>[4.799]</td>
<td>[0.002]</td>
<td>[0.001]</td>
<td>[0.029]</td>
<td>[0.019]</td>
<td>[0.002]</td>
</tr>
</tbody>
</table>

Observations: 31184, 31184, 31184, 31182, 31184, 31184
R-Squared: 0.225, 0.047, 0.020, 0.423, 0.235, 0.078

Estimation sample consists of all municipal-level averages for loweduc women each month between 2003 and 2010. Refer to notes in table 3 for additional details. * p<0.10; ** p<0.05; *** p<0.01.
### Table A3: Difference-in-Difference Estimates: higheduc

<table>
<thead>
<tr>
<th></th>
<th>(1) Weight</th>
<th>(2) LBW</th>
<th>(3) VLBW</th>
<th>(4) Size</th>
<th>(5) Gestation</th>
<th>(6) Premature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of ChCC coverage</td>
<td>-10.224</td>
<td>-0.002</td>
<td>-0.001</td>
<td>0.024</td>
<td>0.097***</td>
<td>-0.008*</td>
</tr>
<tr>
<td></td>
<td>[8.442]</td>
<td>[0.004]</td>
<td>[0.002]</td>
<td>[0.041]</td>
<td>[0.031]</td>
<td>[0.004]</td>
</tr>
<tr>
<td>Constant</td>
<td>3374.313***</td>
<td>0.052***</td>
<td>0.011***</td>
<td>49.529***</td>
<td>38.827***</td>
<td>0.064***</td>
</tr>
<tr>
<td></td>
<td>[8.662]</td>
<td>[0.004]</td>
<td>[0.001]</td>
<td>[0.047]</td>
<td>[0.030]</td>
<td>[0.004]</td>
</tr>
<tr>
<td>Observations</td>
<td>29525</td>
<td>29525</td>
<td>29525</td>
<td>29525</td>
<td>29525</td>
<td>29525</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.076</td>
<td>0.027</td>
<td>0.019</td>
<td>0.151</td>
<td>0.090</td>
<td>0.048</td>
</tr>
</tbody>
</table>

Estimation sample consists of all municipal-level averages for higheduc women each month between 2003 and 2010. Refer to notes in table 3 for additional details. * p<0.10; ** p<0.05; *** p<0.01.
## Table A4: Adjusting For Multiple Hypothesis Testing

<table>
<thead>
<tr>
<th>Index</th>
<th>Birth Weight</th>
<th>LBW</th>
<th>VLBW</th>
<th>Birth Size</th>
<th>Weeks Gestation</th>
<th>Premature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson Index</td>
<td>0.0236</td>
<td>0.0553</td>
<td>0.4499</td>
<td>0.2010</td>
<td>0.0007</td>
<td>0.0956</td>
</tr>
<tr>
<td><strong>Corrected p-value</strong></td>
<td><strong>0.7800</strong></td>
<td><strong>0.0891</strong></td>
<td><strong>0.1683</strong></td>
<td><strong>0.3960</strong></td>
<td><strong>0.0040</strong></td>
<td><strong>0.2277</strong></td>
</tr>
</tbody>
</table>

**Panel A: Individual-Level Analysis**
- *p*-value (Original)
- *p*-value (Corrected)

**Panel B: Municipal-Level Analysis**
- *p*-value (Original)
- *p*-value (Corrected)

**Notes:** Corrected *p*-values based on original variables are calculated using the Romano Wolf technique to control the Family Wise Error Rate of hypothesis tests. The Anderson (2008) index converts the multiple dependent variables into a single dependent variable (index) giving more weight to variables which provide more independent variation.
Figure A7: Impacts by Vulnerability Score: Birth Weight

Quintile of Social Protection Score

Point Estimate 95% CI
Figure A8: Impacts by Vulnerability Score: LBW

Impact of ChCC

Quintile of Social Protection Score

Point Estimate 95% CI

1 2 3 4 5 6 7 8 9 10

Quintile of Social Protection Score

Point Estimate 95% CI

1 2 3 4 5 6 7 8 9 10
Figure A9: Impacts by Vulnerability Score: Size
Figure A10: Impacts by Vulnerability Score: Gestation Weeks

![Figure A10: Impacts by Vulnerability Score: Gestation Weeks](image-url)
Figure A11: Placebo: Gestation
Figure A12: Placebo: Prematurity
Figure A13: Placebo: LBW

[Graph showing the relationship between Placebo and lbw with 95% CI]
Figure A14: Placebo: VLBW
Figure A15: Placebo: Length at Birth