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 (eg 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

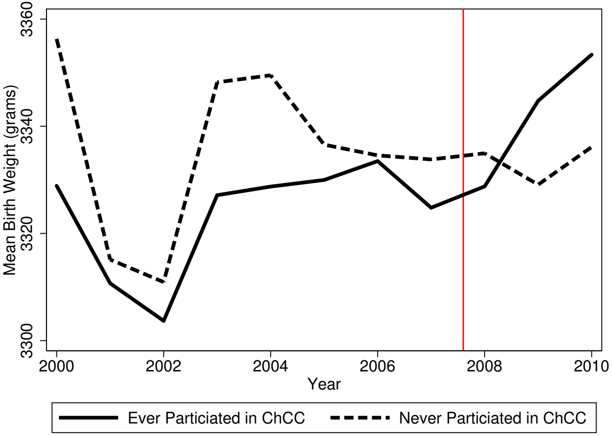
Introduction

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 communites
- 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



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)

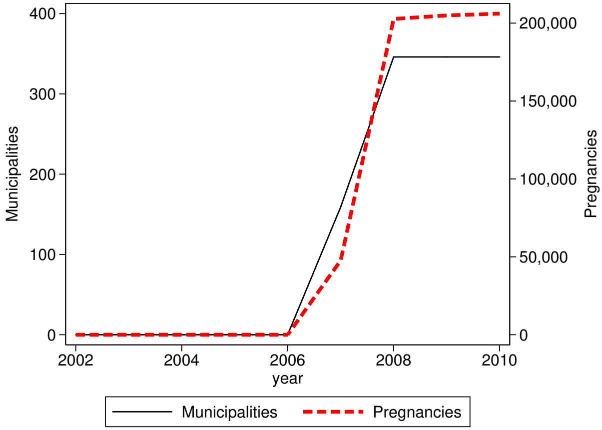
- Follows children from *in utero* to four years
- Provides a series of basic services: fortified food, reading material, guaranteed medical check-ups and services
- Also provides specialised support for vulnerable families: support for domestic violence, mental health check-ups, outreach beyond community 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 in to law in 2008
- Closely linked to academic and policy evidence

ChCC: Also an Emphasis on Diversity, Equality

Images from `crececontigo.gob.cl`

Program Definition and Expansion

Figure 2: Coverage



Note:

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 FEs 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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   - 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:

$$InfantHealth_{ijt} = \beta_0 + \beta_1 ChCC_{jt} + \boldsymbol{X_{ijt}}\boldsymbol{\beta}_x + \phi_t + \mu_j + \varepsilon_{ijt} \quad (1)$$

- Parameter of interest is $\widehat{\beta}_1$: 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 $\boldsymbol{X_{ijt}}$
- Cluster standard errors ε_{ijt} by mother

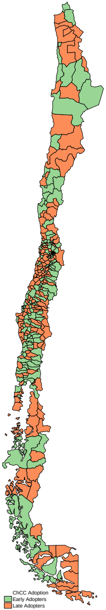
Municipal-Level Rollout (Difference-in-differences)

We estimate the following difference-in-difference specifcation for birth outcomes in municipality c and time t:

$$InfantHealth_{ct} = \alpha_0 + \alpha_1 ChCC_{ct} + \boldsymbol{W_{ct}\alpha}_w + \phi_t + \lambda_c + \eta_{ct} \quad (2)$$

- We use month by municipality cell averages
- Cells are weighted by the number of births in the municipality
- $ChCC_{ct}$ is proportion of births in municipality which had participated in ChCC during gestation
- $\widehat{\alpha}_1$ captures effect of moving full population into ChCC
- Cluster standard errors η_{ct} by municipality

Figure 3: Rollout



Data

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 avalaible from Ministry of Social Development (MDS)
- Can only match a sub-set ($\sim$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 sytematically 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

	N	Mean	Std. Dev.	Min	Max
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

	(1) Birth Weight	(2) LBW	(3) VLBW	(4) Size	(5) Gestation	(6) Premature
ChCC Receipt	22.864***	0.003	0.000	0.050**	0.101***	-0.003
	[4.671]	[0.002]	[0.001]	[0.023]	[0.016]	[0.002]
Constant	3073.061***	0.089**	0.030**	48.404***	38.058***	0.124***
	[63.785]	[0.036]	[0.013]	[0.316]	[0.254]	[0.038]
Observations	739811	739811	739811	739332	739126	739126
R-Squared	0.018	0.002	0.001	0.022	0.012	0.002

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.

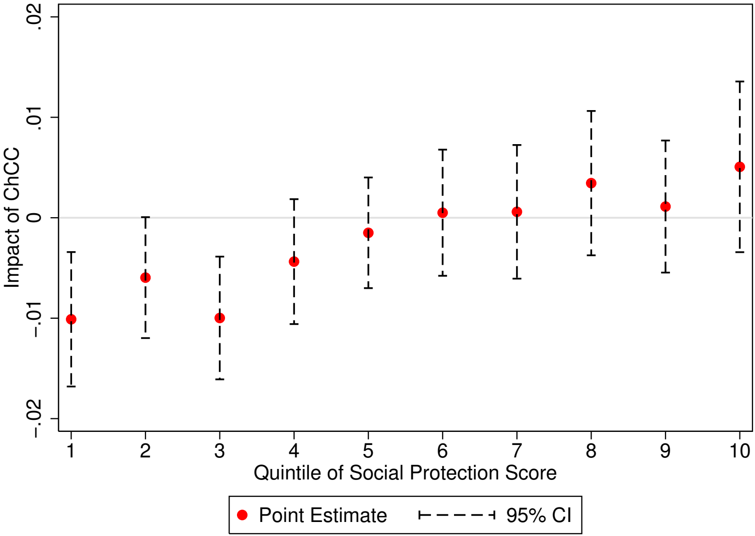
Main Results (Municipal Roll-out)

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

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

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 ocurring 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



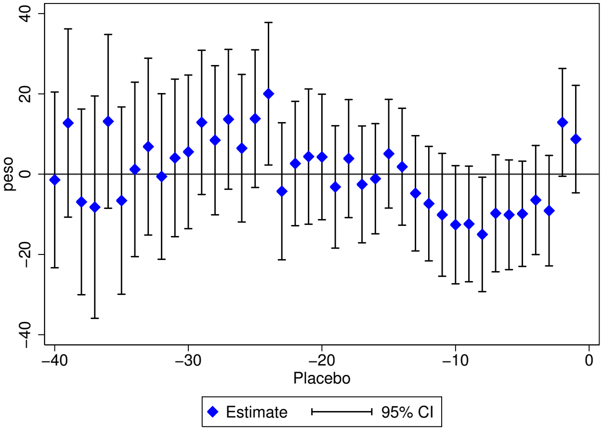
Other outcomes

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)



Full placebo results

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 (eg education) given on-going investments
  - However, long-term outcomes are follow-up work

Thank you

Appendices

Figure A1: Longer Trend: Average Maternal Age

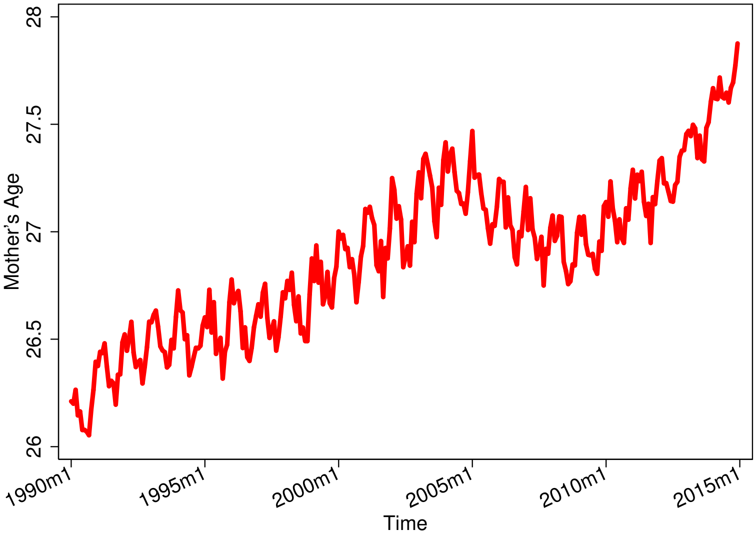


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Figure A2: Longer Trend: Birth weight

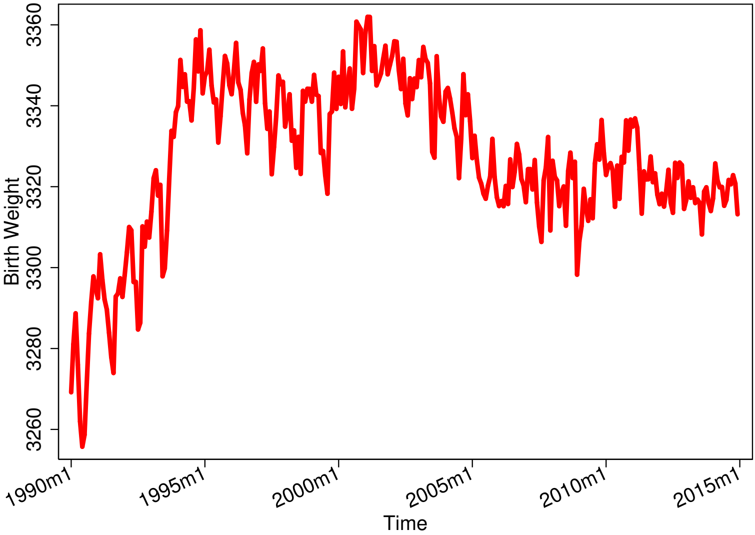

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Figure A3: Longer Trend: Low Birth Weight

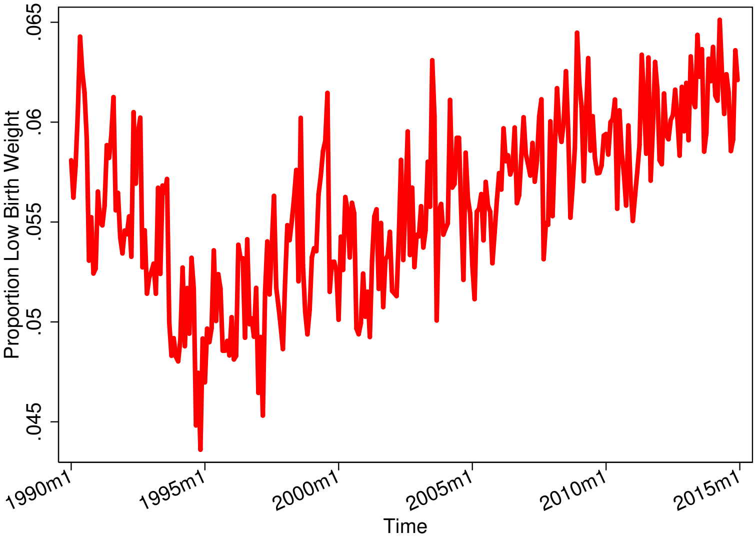

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Figure A4: Longer Trend: Gestation

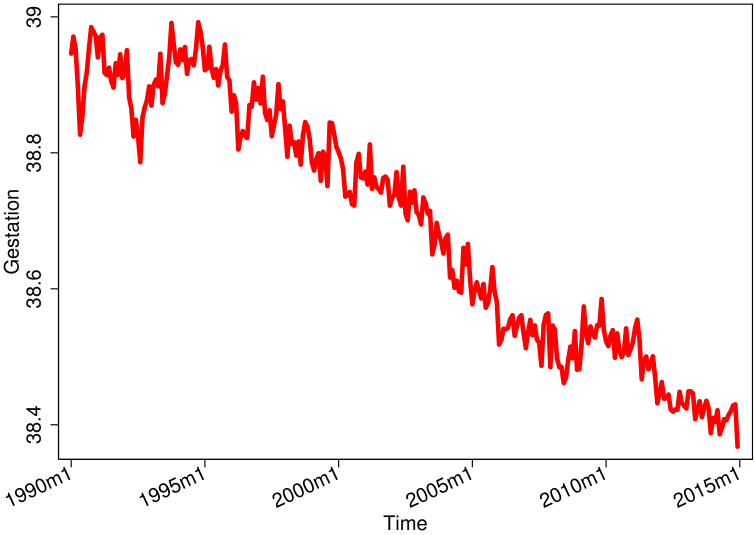

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Figure A5: Longer Trend: Number of Births

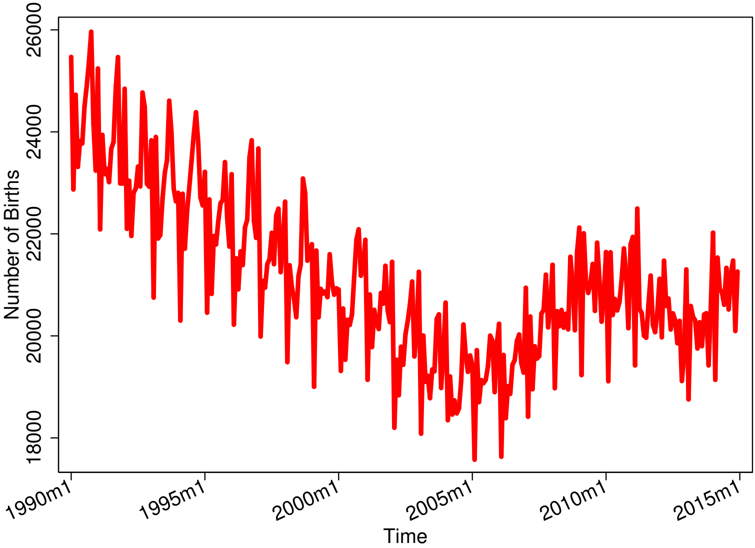

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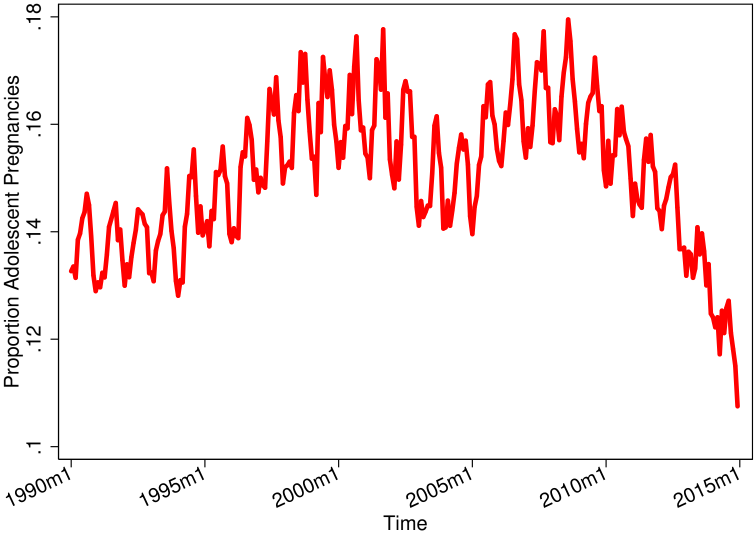
Figure A6: Longer Trend: Teen Births



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Mother FEs (Only Those with Births +/- 2 years around reform)

Table A1: Estimated Program Effects with Mother Fixed Effects

	(1) Birth Weight	(2) LBW	(3) VLBW	(4) Size	(5) Gestation	(6) Premature
ChCC Receipt	17.265*	0.004	0.001	0.009	0.079**	0.003
	[8.922]	[0.004]	[0.002]	[0.044]	[0.033]	[0.005]
Constant	3090.627***	0.147**	0.049	47.862***	37.661***	0.196**
	[121.755]	[0.067]	[0.031]	[0.653]	[0.543]	[0.079]
Observations	44775	44775	44775	44714	44687	44687
R-Squared	0.021	0.005	0.004	0.011	0.007	0.003

Estimation sample consists of all mothers with one birth in the two years precedeing, 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.

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Table A2: Difference-in-Difference Estimates: loweduc

	(1) Weight	(2) LBW	(3) VLBW	(4) Size	(5) Gestation	(6) Premature
Proportion of ChCC coverage	15.584**	-0.007**	-0.000	0.050	0.088***	-0.003
	[6.872]	[0.003]	[0.001]	[0.040]	[0.026]	[0.003]
Constant	3344.111***	0.055***	0.011***	49.457***	38.662***	0.065***
	[4.799]	[0.002]	[0.001]	[0.029]	[0.019]	[0.002]
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.

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Table A3: Difference-in-Difference Estimates: higheduc

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

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.

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Table A4: Adjusting For Multiple Hypothesis Testing

	Index	Original Variables					
	Anderson Index	Birth Weight	LBW	VLBW	Birth Size	Weeks Gestation	Premature
PANEL A: INDIVIDUAL-LEVEL ANALYSIS							
p-value (Original)		0.0236	0.0553	0.4499	0.2010	0.0007	0.0956
p-value (Corrected)	**0.7800**	0.0891	0.1683	0.3960	0.3960	0.0040	0.2277
PANEL B: MUNICIPAL-LEVEL ANALYSIS							
p-value (Original)		0.000	0.1301	0.7530	0.0284	0.0000	0.2883
p-value (Corrected)	**0.0510**	0.0196	0.3725	0.7647	0.1373	0.0000	0.4902

NOTES: Corrected p-values based on original variables are calculated using the Romano Wolf technique to control the Family Wise Error Rate of hypotesis 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.

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Figure A7: Impacts by Vulnerability Score: Birth Weight

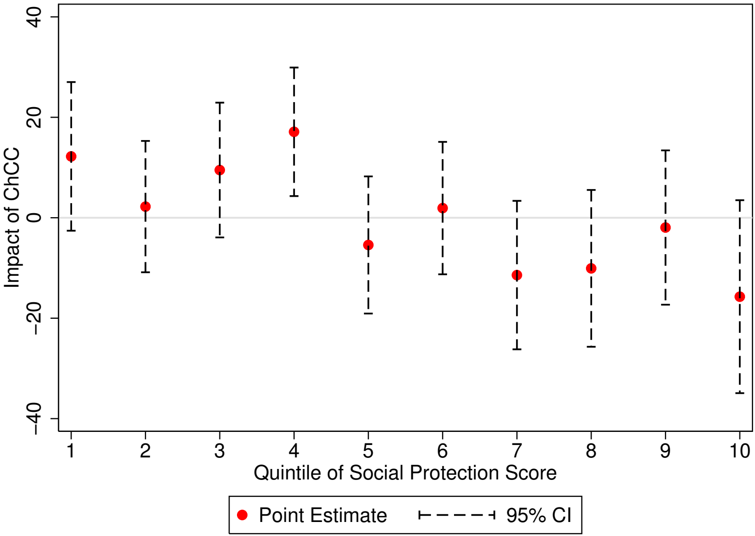

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Figure A8: Impacts by Vulnerability Score: LBW

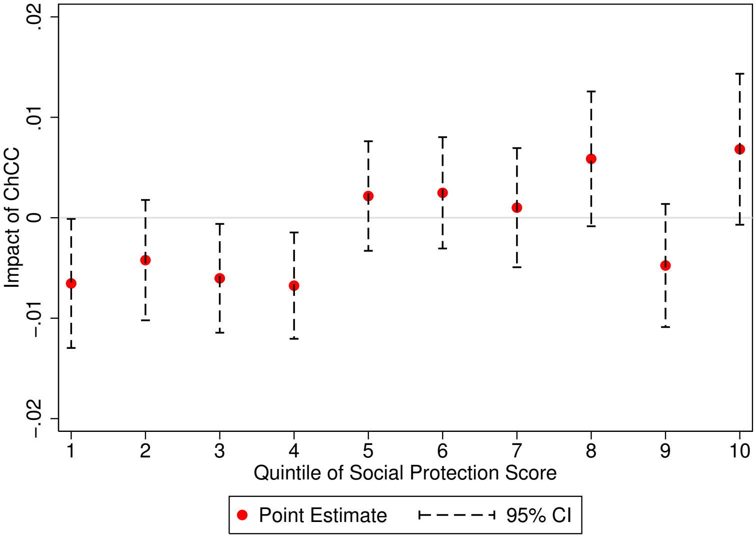

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Figure A9: Impacts by Vulnerability Score: Size

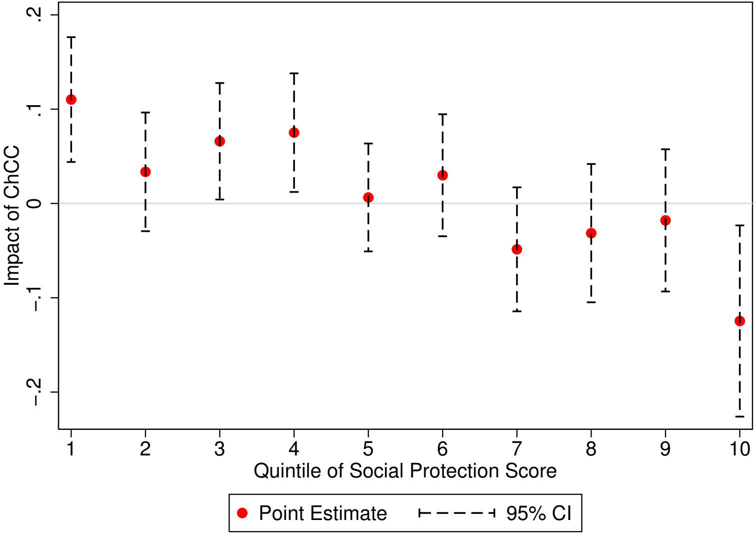

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Figure A10: Impacts by Vulnerability Score: Gestation Weeks

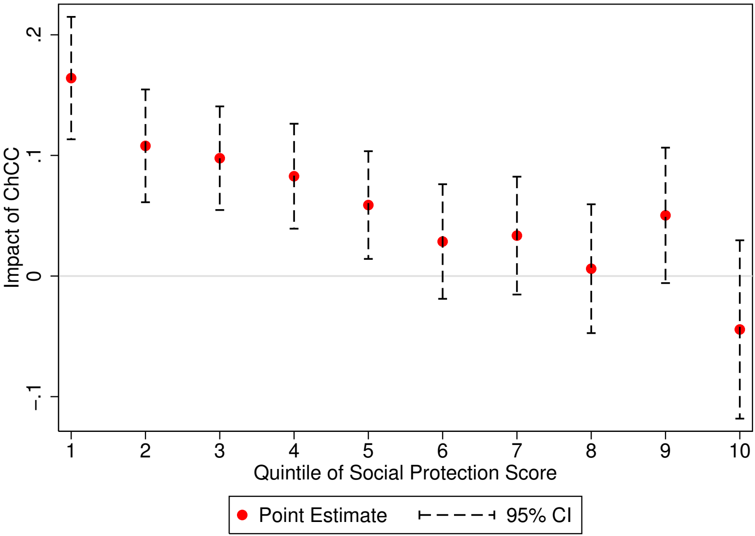

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Figure A11: Placebo: Gestation

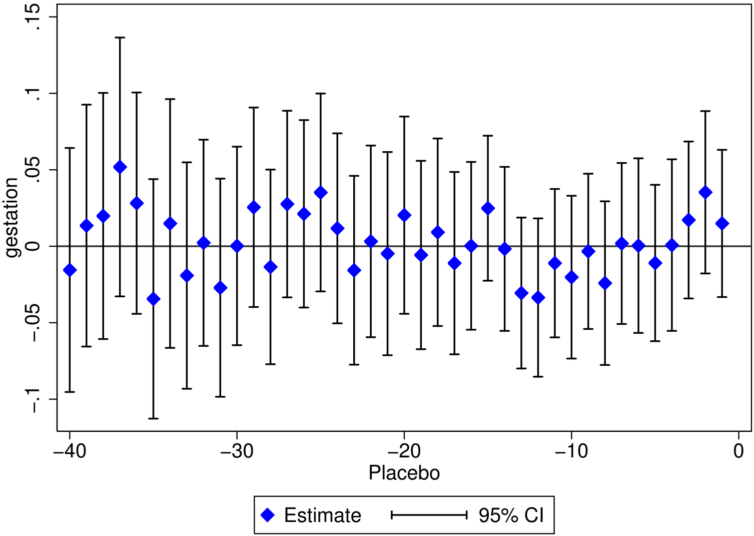

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Figure A12: Placebo: Prematurity

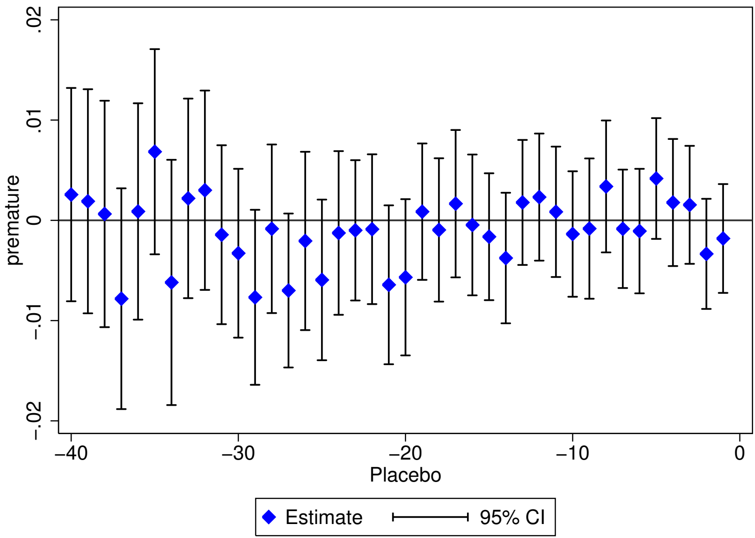

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Figure A13: Placebo: LBW

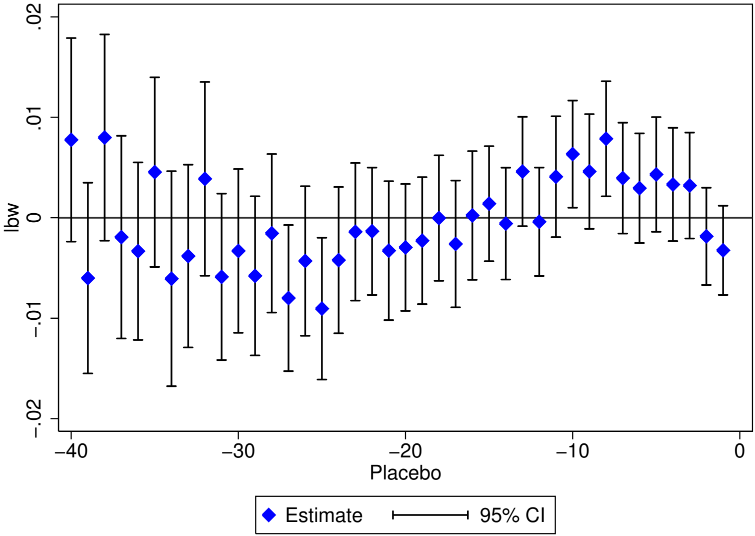

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Figure A14: Placebo: VLBW

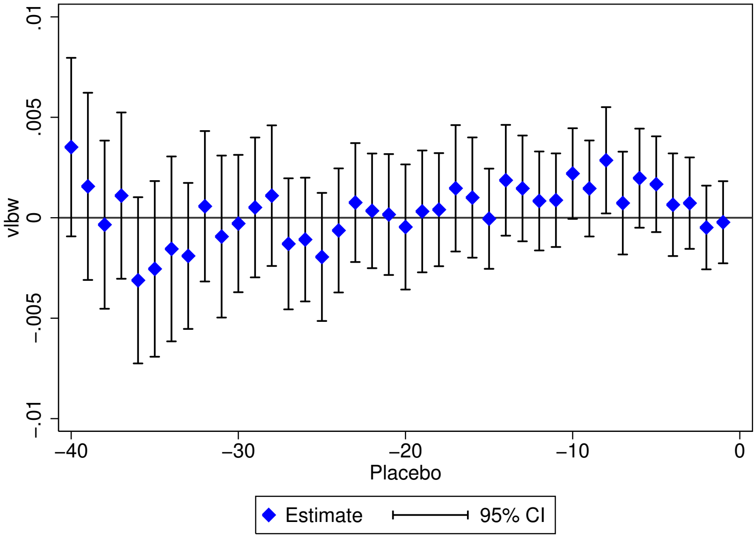

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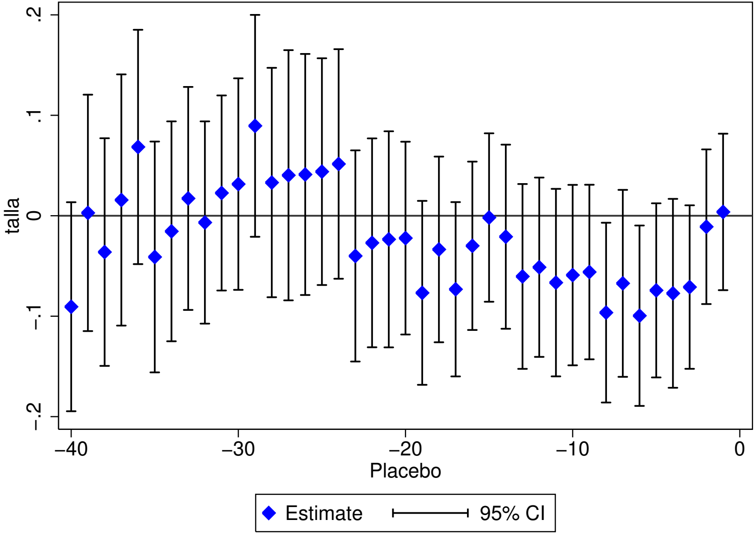
Figure A15: Placebo: Length at Birth



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