Parenthood Timing and Gender Inequality

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Motivation

Gender inequality in Western labor markets emerges when individuals become parents (Goldin, 2014; Blau & Kahn, 2017; Bertrand, 2020; Cortés & Pan, 2023)

Quantifying the causal effects of parenthood is central to understanding gender inequity and designing policies to address it

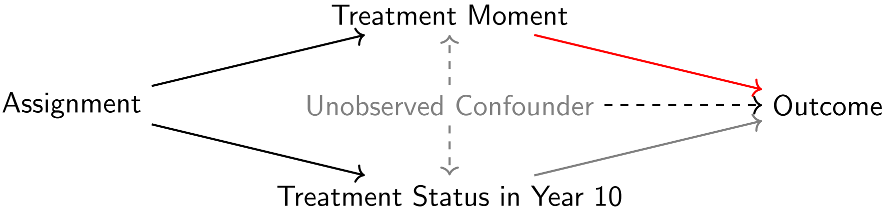
This is challenging for two reasons:

- Parenthood (timing) may be selective: human capital, wealth, health, career prospects
- Effects may depend on parenthood timing: age of children, career stage when becoming a parent

Common Challenge in Applied Economics

We are interested in the effect of being treated for 10 years

1. Quasi-experiment to address selection takes places in year 0
   - 100 assigned treatment
   - 100 assigned control
2. Partial compliance: some individuals in control obtain treatment later
   - Treatment group: 100 treated in year 0
   - Control group: 50 never-treated, 50 treated in year 5



- Instrumental variable estimator biased in presence of dynamic effects
- Equivalent problem for "being treated since year 0" and other definitions

This Paper

How much can we say about the causal effect of parenthood?

- How would labor market outcomes of parents change if they did not have children

1. New approach using assisted conception procedures (ACP)
   - Robust to selective fertility timing and dynamic effects
   - Main feature: women who do not conceive on their first ACP try again
2. Empirical evidence using Dutch data
   - Focus on couples undergoing artificial insemination
3. Assess bias in conventional methods
   - Quantify the extent of selectivity timing and dynamic effects

Preview of Main Results

- Parenthood substantially and persistently lowers women's work hours and income
  - Yearly reductions between 9 and 24 percent
- Parenthood causes a sizable share of post-child gender inequality
  - Between 30 and 60 percent in work hours and up to 50 percent in income
- Both selection and dynamic effects may be of considerable importance
  - Bias as extreme as attributing all or none of gender inequality to parenthood

Literature

Gender inequality in labor market:

- Bertrand (2011); Blau & Kahn (2017) for overview

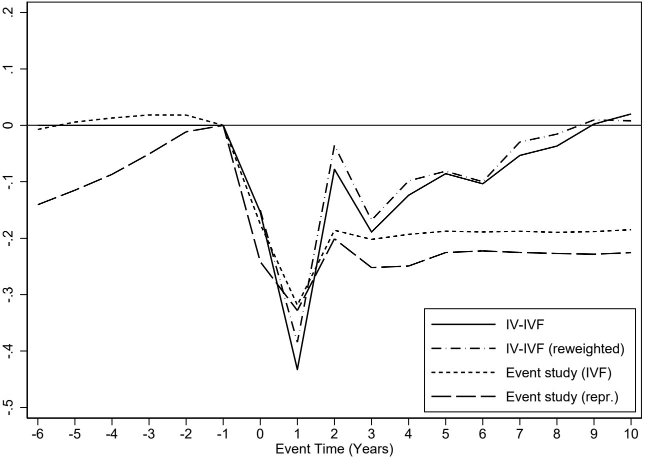
Career impacts of parenthood:

- Selection: Hotz et al. (2005); Agüero & Marks (2008); Cristia (2008); Miller (2011); **Lundborg et al. (2017)**; Brooks & Zohar (2021); Bensnes et al. (2023); Gallen et al. (2023); Lundborg et al. (2024)
- Dynamic effects: Fitzenberger et al. (2013); Angelov et al. (2016); Adda et al. (2017); Chung et al. (2017); Bütikofer et al. (2018); **Kleven et al. (2019)**; Eichmeyer & Kent (2022); Melentyeva & Riedel (2023); Kleven et al. (2024);

Literature:

- Sequential experiments in biostatistics: Hernán & Robins (2020)
- Partial identification of treatment effects: Manski (1989, 1990); Zhang & Rubin (2003); Lee (2009)

Instrumental Variable vs Event Study: Percent Reduction in Earnings



Source: (Lundborg et al., 2024)

- "Naive" comparison with differing sub-populations and treatment definitions

Contribution

1. Estimates robust to selective fertility and dynamic effects
   - Method to quantify IV and ES bias for consistent population and treatment
   - I demonstrate that accounting for these factors can reconcile the conflicting results
2. Methodological approach applicable to various settings
   - Assignment to job training and educational programs, legal settings with assignment to varying leniency "judges", research grant allocation, clinical trials in extension phase
3. External relevance relative to previous studies using ACPs
   - Evidence from a setting with substantially less generous family-friendly policies

Roadmap

1. Assisted conception procedures
2. Statistical model
3. Method
4. Institutions and data
5. Main results
6. Comparison with existing methods and extensions

Assisted Conception Procedures

- Consider couples undergoing ACPs for their first child
- In last procedure stage embryo/sperm is inserted into uterus
- Assume conception from this transfer is as-good-as-random
  - Uncorrelated with past labor market outcomes conditional on age
- Success of first transfer creates plausibly exogenous variation in parenthood
- 75% become mothers after their first ACP fails:

$$\tau_{RF} = \frac{1}{4}\tau_{Parenthood} + \frac{3}{4}\tau_{Timing}$$

$$\tau_{IV} = \tau_{Parenthood} + 3\tau_{Timing}$$

Model: Outcomes

- Moment $t \in \{1, \dots, T\}$ since woman's first ACP
- Outcome when motherhood begins at first ACP:

$$Y_t(1)$$

- Childless outcome:

$$Y_t(0)$$

- Outcome when motherhood begins in period k:

$$Y_t(k)$$

These scenarios involve women trying to conceive through ACPs

- I will first focus on quantifying impacts in these scenarios

To simplify exposition:

- We are at $t = T$
- $Y_T(k) = Y_T(later)$ for all $k > 1$

Counterfactual

Model: Latent Variables and Treatment Effect

Women differ in two unobserved characteristics:

- "Willingness" to undergo ACPs, $W \in \{1, \dots, \overline{w}\}$
  - Would try W times total in case all ACPs fail
- "Reliance" on ACPs, $R \in \{0, 1\}$
  - No child if all ACPs fail, $R = 1$
  - "Reliers" $\supseteq$ "compliers" (no child if first ACP fails)

Average treatment effect for reliers:

$$\tau_{ATR} = \mathbb{E}[Y(1) - Y(0) | R = 1]$$

- Focusing on reliers rather than compliers is not only appealing because they are a more general group but it is also essential for informative results
- As compliers, reliers may change over time, which I will address in extensions

Model: Observables

- ACP j success indicator, Z_j
  - $Z_j = 0$ if failed or did not happen
  - Only ACPs before the first child
- Number of realized ACPs:

$$A = \min\left(\{j : Z_j = 1\} \cup \{W\}\right)$$

- Parenthood indicator:

$$D = Z_A + (1 - Z_A)(1 - R)$$

  - One-sided non-compliance
- Realized outcome:

$$Y = Y(0)(1 - D) + Y(1)DZ_1 + Y(later)D(1 - Z_1)$$

Sequential Unconfoundedness

Assumption (Sequential Unconfoundedness)
$(Y(1), Y(0), R, W) \perp\!\!\!\perp Z_j | A \geq j.$

In words: once sperm/embryo at ACP j are implanted, whether this results in a conception is as-good-as-random

- $Y(1), Y(0), R$ and W can be related
- Main method relaxes to covariate-conditional version

Outline of the Approach

Objective is a clean comparison:

- Women who conceive at first ACP vs similar childless women
- Challenge: selection into parenthood after 1st ACP fails
  1. Conceptions via subsequent ACPs
  2. Conceptions via non-ACP means
- I address 1. by leveraging women's ACP histories; let $e = \Pr(Z_j = 1 | A \geq j)$:

$$\mathbb{E}\left[Y \frac{(1-D)}{(1-e)^{A}}\right] = \mathbb{E}[Y(0)|R=1]\Pr(R=1)$$

$$\mathbb{E}\left[\frac{(1-D)}{(1-e)^{A}}\right] = \Pr(R=1)$$

- Births from 2. may be selective, I bound for the worst-case scenario

$$\mathbb{E}[Y|Z_1 = 1] = \Pr(R=1)\,\mathbb{E}[Y(1)|R=1] + \Pr(R=0)\,\mathbb{E}[Y(1)|R=0]$$

While my method may not achieve point-identification unlike IV, it compensates with greater precision

Simple World: Max 1 ACP, All Reliers

$$W = 1$$

(willing to try once)

Simple World: Max 1 ACP, All Reliers

$W = 1$
(willing to try once)

$Z_1 = 1$

$Z_1 = 0$

Simple World: Max 1 ACP, All Reliers

$W = 1$
(willing to try once)

$Z_1 = 1$

$\mathbb{E}[Y(1)]$

$Z_1 = 0$

$\mathbb{E}[Y(0)]$

Simple World: Max 2 ACPs, All Reliers

$W = 1$
(willing to try once)

$Z_1 = 1$

$Z_1 = 0$

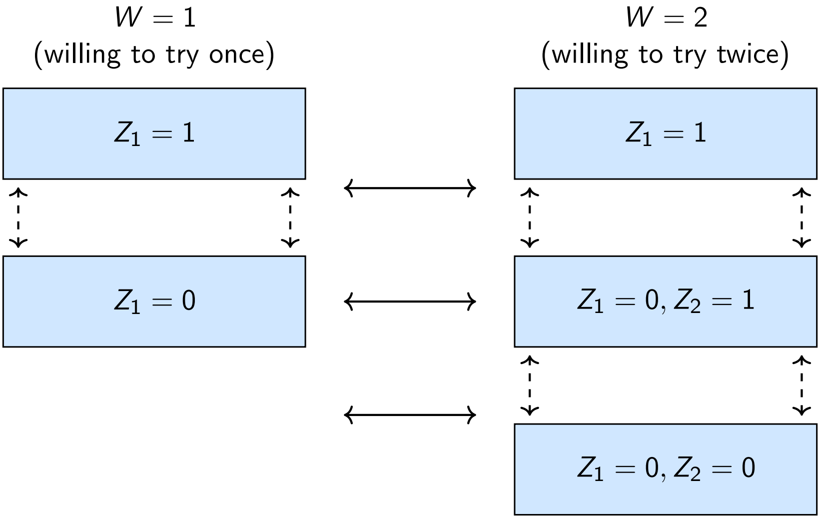
Simple World: Max 2 ACPs, All Reliers

$W = 1$ (willing to try once)	$W = 2$ (willing to try twice)
$Z_1 = 1$	$Z_1 = 1$
$Z_1 = 0$	$Z_1 = 0, Z_2 = 1$
	$Z_1 = 0, Z_2 = 0$

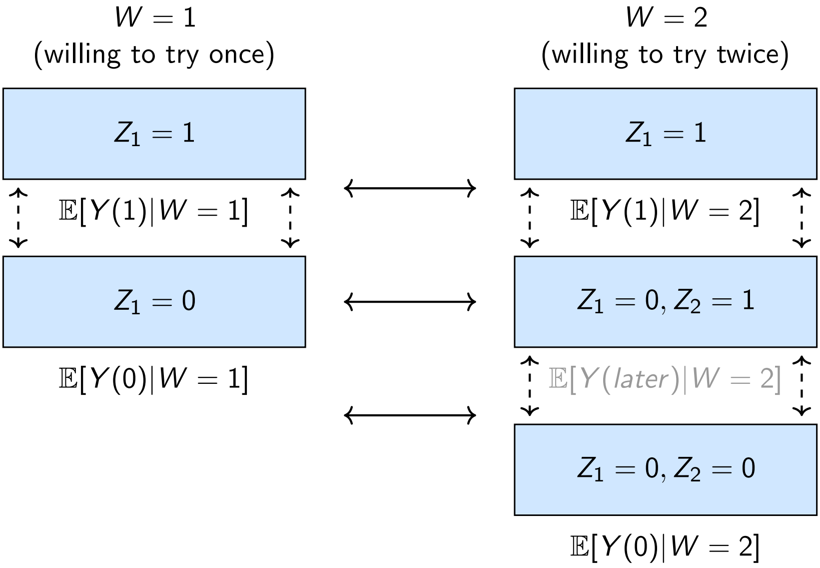
Simple World: Max 2 ACPs, All Reliers

$W = 1$ (willing to try once)		$W = 2$ (willing to try twice)
$Z_1 = 1$	$\longleftrightarrow$	$Z_1 = 1$
$Z_1 = 0$	$\longleftrightarrow$	$Z_1 = 0, Z_2 = 1$
	$\longleftrightarrow$	$Z_1 = 0, Z_2 = 0$

Simple World: Max 2 ACPs, All Reliers



Simple World: Max 2 ACPs, All Reliers



Simple World (Observed): Max 2 ACPs, All Reliers

$W = 1$
(willing to try once)

$W = 2$
(willing to try twice)

$Z_1 = 1$

$Z_1 = 0$

$Z_1 = 0, Z_2 = 1$

$Z_1 = 0, Z_2 = 0$

Simple World (Observed): Max 2 ACPs, All Reliers

$W = 1$
(willing to try once)

$W = 2$
(willing to try twice)

$Z_1 = 1$

$\mathbb{E}[Y(1)]$

$Z_1 = 0$

$\mathbb{E}[Y(0)|W = 1]$

$Z_1 = 0, Z_2 = 1$

$\mathbb{E}[Y(later)|W = 2]$

$Z_1 = 0, Z_2 = 0$

$\mathbb{E}[Y(0)|W = 2]$

Simple World (Observed): Max 2 ACPs, All Reliers

$W = 1$ (willing to try once)	$W = 2$ (willing to try twice)

$Z_1 = 1$

$\mathbb{E}[Y(1)]$

$Z_1 = 0$

$\mathbb{E}[Y(0)|W = 1]$

$Z_1 = 0, Z_2 = 1$

$\mathbb{E}[Y(\mathit{later})|W = 2]$

$Z_1 = 0, Z_2 = 0$

$\mathbb{E}[Y(0)|W = 2]$

Simple World (Observed): Max 2 ACPs, All Reliers

$W = 1$
(willing to try once)

$W = 2$
(willing to try twice)

$Z_1 = 1$

$\mathbb{E}[Y(1)]$

$Z_1 = 0$

$\mathbb{E}[Y(0)|W = 1]$

$Z_1 = 0, Z_2 = 1$

$\mathbb{E}[Y(later)|W = 2]$

$Z_1 = 0, Z_2 = 0$

$\mathbb{E}[Y(0)|W = 2]$

$Pr(W = 1) =$

Simple World: Max 1 ACP with Non-reliers

$R = 1$ (no child if fail)	$R = 0$ (child if fail)

Simple World: Max 1 ACP with Non-reliers

$R = 1$
(no child if fail)

$R = 0$
(child if fail)

$\boxed{Z_1 = 1}$

Simple World: Max 1 ACP with Non-reliers

$R = 1$
(no child if fail)

$R = 0$
(child if fail)

$Z_1 = 1$

$Z_1 = 0, D = 0$

$Z_1 = 0, D = 1$

Simple World: Max 1 ACP with Non-reliers

$R = 1$
(no child if fail)

$R = 0$
(child if fail)

$Z_1 = 1$

Distribution of $Y(1)$

$Z_1 = 0, D = 0$

$\mathbb{E}[Y(0)|R = 1]$

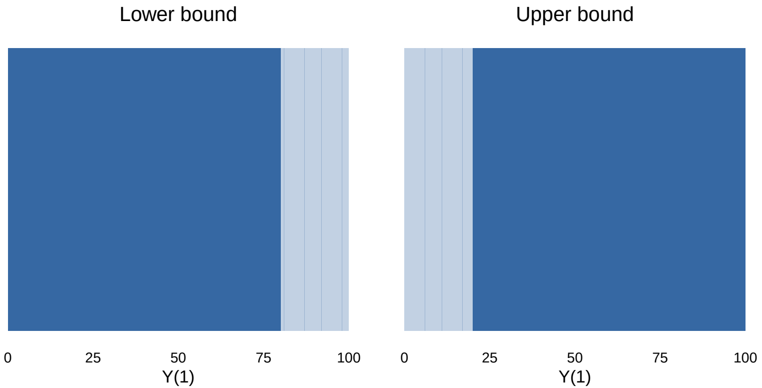
$Z_1 = 0, D = 1$

$\mathbb{E}[Y(later)|R = 0]$

$Pr(R = 1) =$

Intuition: Motherhood Outcome $Y(1)$

1. Treated group is a representative sample but their types are unobserved
2. Identify $\Pr(R = 1) = 0.8$ on control group
3. Assume most extreme distributions of types in treated group
4. Bound $\mathbb{E}[Y(1)|R = 1]$



Technical Details

Formal identification →

- Covariate-conditional sequential unconfoundedness
- Combine the two steps in a semi-parametric moment equation

Using covariates to narrow the bounds →

- The bounds are sharp

Inference complicated by trimming of the outcome distribution →

- Build on a double/debiased machine learning approach by Semenova (2023)

Background and Data

Assisted conception procedures →

- **Intrauterine insemination**: direct sperm injection, minimally invasive, free
- In-vitro fertilization: invasive medical procedure, first 3 free

Dutch family policies similar to OECD average →

- 16 weeks maternity + pregnancy leave, 1 week paternity leave
- Average net childcare cost 10% median household income
- Part-time work more common, average work hours similar to OECD average

Data →

- Hospital records on treatment dates and types: success imputed as birth within 10 months without additional ACPs
- Work hours and income include leave; results for hours corrected for uncertainty
- 15,523 cohabiting opposite-sex couples undergoing intrauterine insemination for their first child between 2013 and 2016
- Balance: ACP success at each attempt uncorr. with past outcomes cond. on age

Details | Balance in 1st ACP first | Balance in later ACPs | Success and willingness | Rep. samp.

Results: Bounds

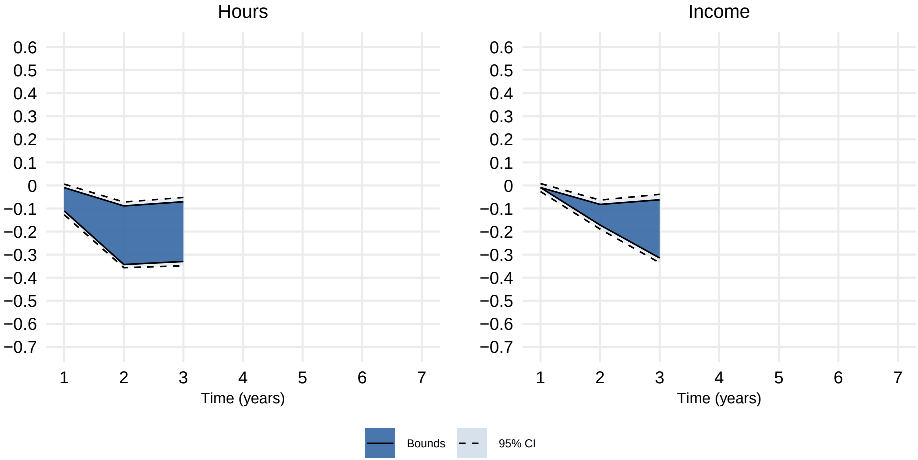


Figure 1: Bounds for women

Results: Bounds

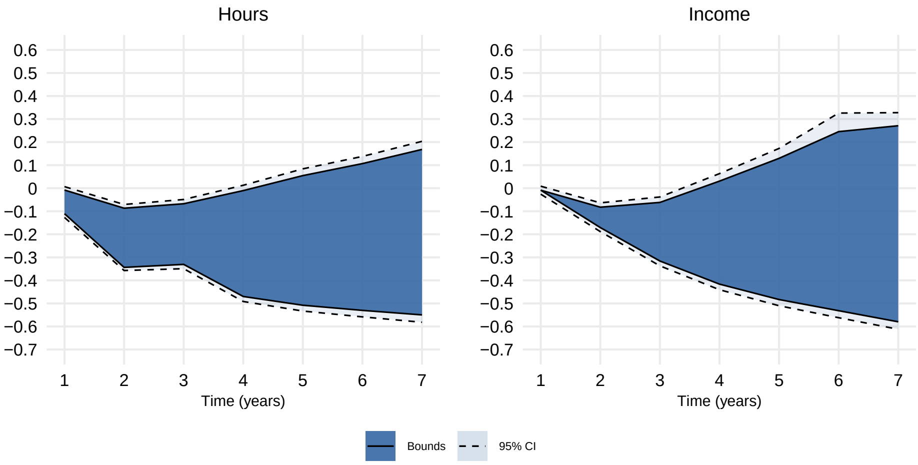
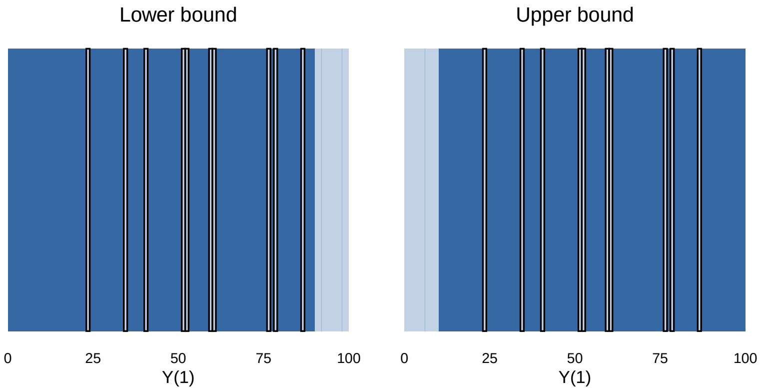


Figure 1: Bounds for women

Narrowing the Bounds Further

Use additional information which on mother are reliers:

- Some women have non-ACP children after ACP succeeds
- May be reasonable to assume they are not reliant on ACPs
- Consistent with being determined to have at least one child
- Reduces uncertainty around which women are reliers



Bounds with Monotonicity

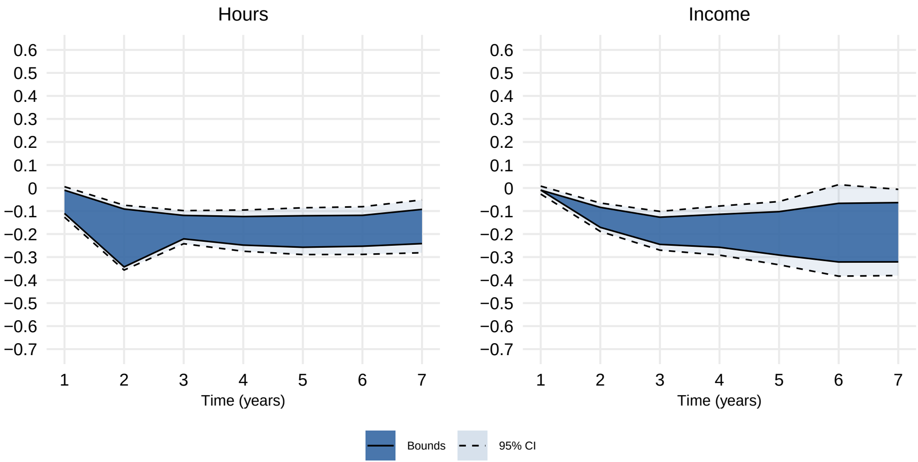


Figure 2: Bounds for women with monotonicity

Bounds for Men

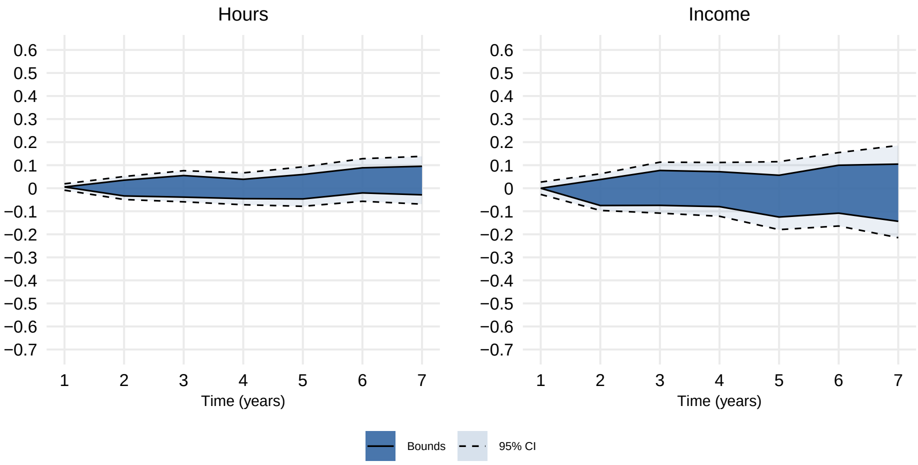


Figure 3: Bounds fo men

Gender Inequality

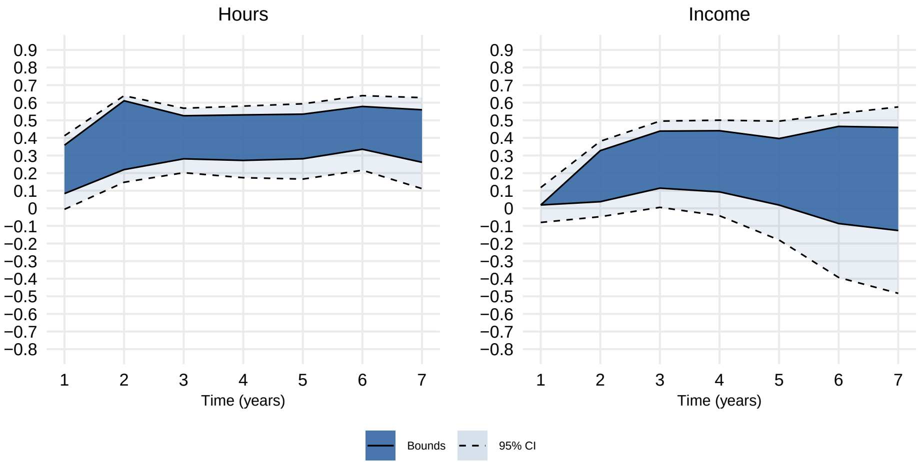


Figure 4: Share of gender inequality caused by parenthood

Extensions

- **Bias in leading methods** Less naive comp. Formal procedure Bias in IV Bias in ES
- **Mental health side effects** Discussion Bounds for non-depresses
- Relation to methodological literature Theoretical comparison Results
- Confidence inveral comparison Confidence intervals
- Inequality correcting for age De-aging partners
- Stable complier group Childless final period
- Estimator without DML Estimates
- Monotonicity Discussion Direction Partnered only Partnership and depression Test
- Testing Bensnes et al. (2023); Gallen et al. (2023) Estimates
- Heterogeneity Willingness to try
- Population imputation* ES pop. Mother. imp. Childless imp. Effect imp.

Conclusion

Method for evaluating the career cost of parenthood:

- Robust to selective fertility and dynamic effects
- Applicable to various settings with sequential treatment assignment and selection

Application to Dutch data:

- Motherhood reduces work hours and income by 9% to 24%
- Parenthood causes up to 50% of post-child gender inequality

Relative to conventional methods:

- Naive: IV might understate the role of parenthood in gender ineq., ES overstates it
- This also holds after after accounting for differences in population and effect definition

Policy:

- Large share of gender ineq. may not be due to parenthood per se
- Family policies may still help by shaping behavior up to parenthood

Bounding τ_{ATR}

Construct the moment:

$$m^L(G,\eta^0) = Y1_{\{Y<q(r(X_1),X_1)\}}\frac{Z_1}{e_1(X_1)} - Y(1-D)\prod_{j=1}^{A}\frac{(1-Z_j)}{(1-e_j(X_j))}$$

- G is the observed data vector
- η^0 contains the following:
  - $e_j(X_j) = \Pr(Z_j = 1|X_j)$
  - $q(r(X_1), X_1)$ is the $r(X_1)$-th quantile of Y given X_1 and $Z_1 = 1$
  - $r(X_1)$ identifies the covariate-conditional relier share

Assumption (Conditional Sequential Unconfoundedness)

$(Y(k), R, W) \perp\!\!\!\perp Z_j \mid X_j$ *for all* j, k, *and* $X_j, A \geq j$.

Theorem (Lower Bound)

Under conditional sequential unconfoundedness and regularity, the sharp lower bound on τ_{ATR} *is* $\mathbb{E}[m^L(G,\eta^0)]/\mathbb{E}[r(X_1)]$.

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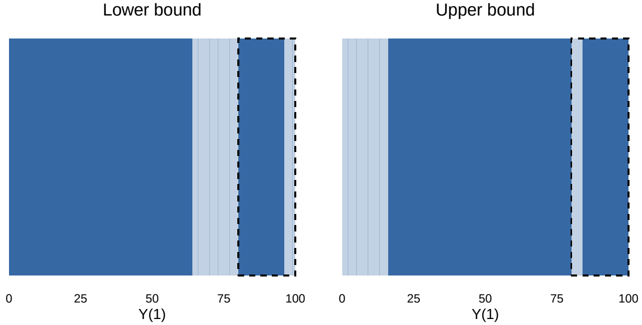
ToC

Intuition: Motherhood Outcome $Y(1)$—Covariates

Pre-ACP covariates can help narrow the bounds:

- Can identify relier share at each covariate value
- Baseline bounds assume extreme scenarios where reliers have highest or lowest treated outcomes
- These distributions of treated outcomes might be inconsistent with conditional relier shares



Estimating the Bounds

Distribution of $m^L(G, \eta^0)$ is complicated by $q(r(X_1), X_1)$

- Semenova (2023) addresses a closely related inference challenge
- Double/debiased machine learning approach
  1. Adjust $m^L(G, \eta^0)$ to make it insensitive to small error in $q(r(X_1), X_1)$
  2. Sample splitting
- Asymptotic inference as if $q(r(X_1), X_1)$ was known

New moment:

$$\psi^L(G, \xi^0) = m^L(G, \eta^0) + corr(G, \xi^0)$$

Identifies same parameter:

$$\mathbb{E}[\psi^L(G, \xi^0)] = \mathbb{E}[m^L(G, \eta^0)]$$

Insensitive to estimation error in $q(r(X_1), X_1)$:

$$\partial_{q(.)} \mathbb{E}[\psi^{L+}(G, \xi_r)|X_1]|_{\xi_r = \xi_r^0} = 0 \ a.s.$$

Back

ToC

Assisted Conception Procedures

- IUI (main procedure): sperm injected into uterus
  - Minimally invasive, primary ACP in most countries
  - "Free" in NL
- IVF (secondary procedure): embryo inserted into uterus
  - Invasive treatment, performed under sedation/anesthesia
  - Eggs retrieved through the vaginal wall using a specialized needle
  - In NL, first 3 free; each subsequent costs between 1000 and 4000 EUR

Back

Institutions

- Dutch family friendly polices similar to OECD average
  - 16 weeks of fully paid pregnancy+maternity leave
  - 1 week of paternity leave
  - Average time in child care similar to OECD average
  - Net child care cost 10% median household income
- Dutch employment intensity similar to OECD average
  - Employment among parents and non-parents relatively high
  - Part time work much more common
  - Approximately 15% two-parent families have both partners working part-time

Back

Data

Administrative data from Statistics Netherlands

- Comprehensive hospital records cover fertility treatments from 2012 to 2017: procedure date and type
  - Success imputed as having child born within 10 months
- Tax records cover work hours and income from 2011 to 2023
  - Include maternity leave and pay
  - Main bounds account for uncertainty around actual work hours
- Birth dates, legal family connections, cohabitation
- Dispensed medication registry

Main sample: cohabiting opposite-sex couples undergoing IUI for their first child between 2013 and 2016: 15,523

Back

Overview of Descriptives

- First and subsequent ACP success uncorrelated with past labor market outcomes condiditional on age Table first Table later
  - Support for independence of Z_j and $(Y(1), Y(0))$
- Success probability stable across ACPs conditional on age Figure
  - Support for independence of Z_j and W
- Representative sample worked less and had lower income before parenthood, but differences relatively small Table
  - ACP sample older before parenthood

Back (summary)

ToC

Balance in 1st ACP

Table 1: First ACP Outcomes and Descriptives

	Success (1)	Fail (2)	Difference (1)-(2)	Dif. cond. age & educ. (1)-(2) cond.
Work (W)	0.882	0.863	0.019	0.008
	[0.323]	[0.344]	(0.009)	(0.009)
Work (P)	0.884	0.865	0.019	0.013
	[0.320]	[0.342]	(0.009)	(0.009)
Hours (W)	1240.315	1207.860	32.455	18.702
	[604.666]	[635.194]	(16.183)	(16.560)
Hours (P)	1474.530	1438.590	35.940	18.579
	[658.231]	[695.692]	(17.713)	(17.870)
Income 1000s € (W)	28.065	27.418	0.647	0.745
	[19.559]	[20.219]	(0.516)	(0.546)
Income 1000s € (P)	37.205	36.952	0.252	0.364
	[26.482]	[29.452]	(0.746)	(0.730)
Bachelor deg. (W)	0.480	0.451	0.029	
	[0.500]	[0.498]	(0.013)	
Bachelor deg. (P)	0.394	0.381	0.013	
	[0.489]	[0.486]	(0.012)	
Age (W)	31.638	32.388	-0.750	
	[4.015]	[4.383]	(0.111)	
Age (P)	34.675	35.461	-0.786	
	[5.513]	[5.996]	(0.152)	
Observations	1,714	13,809		
Joint *p*-val.			0.000	0.928

Note: Labor market outcomes measured year before first ACP. (W) - woman, (P) - partner. Last column uses inverse prbability weights for the first ACP that follow the main specificaition. Standard deviations in brackets. Standard errors in parentheses.

ToC Back (summary) Back (detailed descriptives)

Balance in Subsequent ACPs

Table 2: Balance in Later ACPs

	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}
Work (W)	0.009	-0.004	0.022	0.014	0.039	-0.003	-0.011	0.022	0.030
	(0.010)	(0.011)	(0.011)	(0.012)	(0.012)	(0.017)	(0.018)	(0.019)	(0.024)
Work (P)	0.006	0.016	0.012	0.020	-0.004	-0.004	-0.019	0.017	0.030
	(0.010)	(0.010)	(0.012)	(0.012)	(0.015)	(0.015)	(0.019)	(0.020)	(0.027)
Hours (W)	32.885	-4.482	52.999	41.332	81.957	11.894	-18.836	72.659	24.819
	(18.721)	(20.032)	(21.045)	(22.686)	(25.131)	(31.187)	(32.937)	(38.210)	(48.490)
Hours (P)	21.655	24.730	23.756	38.965	9.666	-6.580	-28.458	30.525	43.722
	(21.018)	(21.089)	(23.574)	(25.255)	(30.585)	(31.513)	(37.976)	(44.856)	(52.821)
Income 1000s € (W)	1.481	-0.015	1.685	1.802	2.086	0.150	-0.043	0.866	-0.444
	(0.615)	(0.624)	(0.767)	(0.830)	(0.913)	(1.000)	(1.092)	(1.234)	(1.629)
Income 1000s € (P)	-0.749	1.002	2.040	0.800	0.774	0.025	0.259	-0.324	0.149
	(0.835)	(0.912)	(1.066)	(1.115)	(1.424)	(1.424)	(1.563)	(1.737)	(2.203)
Observations	12,974	10,774	8,726	6,977	5,411	3,944	2,723	1,850	1,174
Joint *p*-val.	0.175	0.976	0.234	0.303	0.140	1.000	0.956	0.704	0.917

Note: Each column describes the difference in average characteristics between women for whom the respective ACP succeeds and those for whom it fails, among those who undergo the procedure, using inverse probability weights for each ACP following the main specification. Labor market outcomes and age measured year before first treatment. (W) - woman, (P) - partner. Standard errors in parentheses.

ACP histories Back (summary) Back (detailed descriptives)

ToC

Estimated Success Probabilities

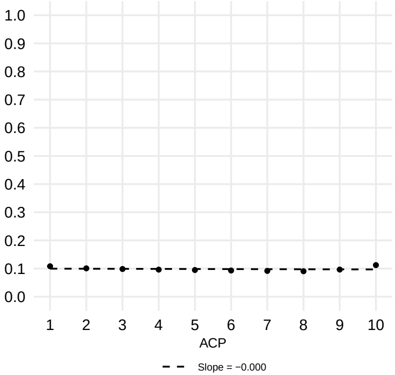


Figure 5: Estimated Success Probabilities

ACP histories
Back (summary)
Back (detailed descriptives)
ToC

Comparison to Representative Sample

Table 3: Full Sample, Reliers, and Representative Sample

	Success (1)	Fail (2)	Reliers (3)	Rep. (4)	Success vs rep. (1)-(4)	Rel. vs rep. (3)-(4)
Work (W)	0.882	0.863	0.820	0.801	0.080	0.019
	[0.323]	[0.344]	[0.333]	[0.399]	(0.010)	(0.005)
Work (P)	0.884	0.865	0.849	0.783	0.101	0.066
	[0.320]	[0.342]	[0.344]	[0.412]	(0.010)	(0.005)
Hours (W)	1240.315	1207.860	1117.711	1076.204	164.111	41.508
	[604.666]	[635.194]	[582.334]	[696.245]	(16.856)	(8.412)
Hours (P)	1474.530	1438.590	1390.699	1250.948	223.582	139.752
	[658.231]	[695.692]	[662.920]	[793.536]	(19.211)	(9.576)
Income 1000s € (W)	28.065	27.418	24.976	21.362	6.703	3.615
	[19.559]	[20.219]	[15.359]	[18.330]	(0.444)	(0.222)
Income 1000s € (P)	37.205	36.952	35.299	28.107	9.098	7.193
	[26.482]	[29.452]	[24.304]	[29.076]	(0.704)	(0.351)
Bachelor deg. (W)	0.480	0.451	0.398	0.411	0.069	-0.012
	[0.500]	[0.498]	[0.411]	[0.492]	(0.012)	(0.006)
Bachelor deg. (P)	0.394	0.381	0.329	0.345	0.049	-0.015
	[0.489]	[0.486]	[0.397]	[0.475]	(0.012)	(0.006)
Age (W)	31.638	32.388	33.480	28.713	2.926	4.767
	[4.015]	[4.383]	[3.897]	[4.658]	(0.113)	(0.056)
Age (P)	34.675	35.461	36.580	28.713	5.962	7.868
	[5.513]	[5.996]	[3.928]	[4.665]	(0.113)	(0.057)
Observations	1,714	13,809	4,882	376,152		

Note: Labor market outcomes measured year before first ACP for main sample and year and 9 months before birth of first child for the represenstative sample. Representative sample is selected to match the main sample by year of conception. Average relier outcomes are based on sample of women who remain childless 7 years after their first ACP with weights described under implementation. (W) - woman, (P) - partner. Standard deviations in brackets. Standard errors in parentheses.

ToC Back (summary) Back (detailed descriptives)

ACP Histories

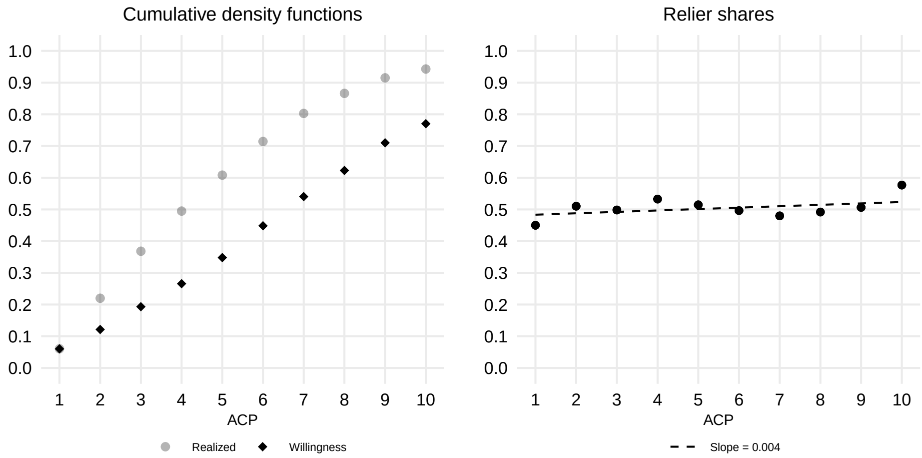


Figure 6: ACP Histories and Reliance

What are the counterfactuals?

Broadly:

- Do not want/plan children
- **Want/plan children**

Motherhood outcome:

- Get immediately
- Get naturally after few attempts
- **Get with medical assistance**

Childless outcome:

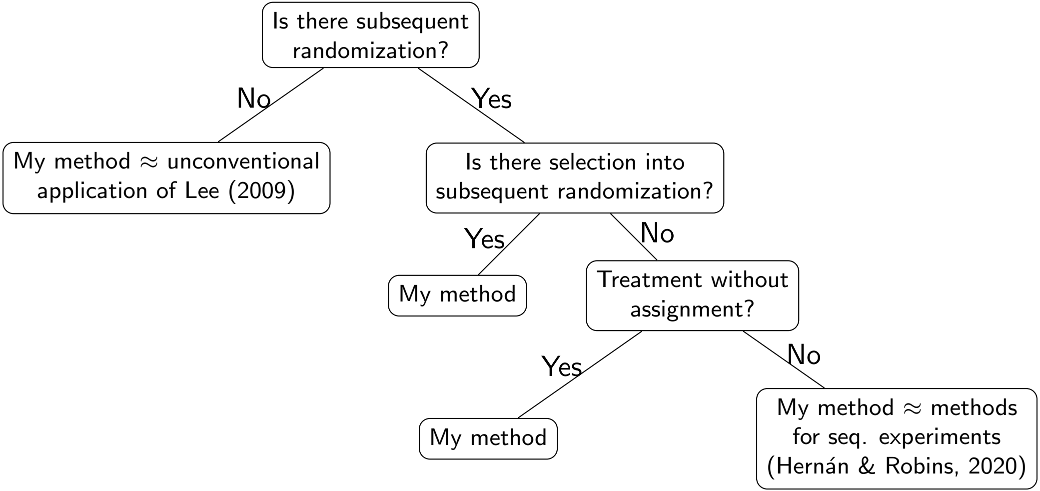
- Do not try
- Try and fail naturally
- **Try and fail with medical assistance (+ naturally?)**

Extrapolation requires carefully addressing mental health consequences of failure (and medical procedures)

Back (model) Back (extensions) Depr. effect Bounds non-depr. Arguments

ToC

Relation to Methodological Literature



Comparison with Lee (2009)

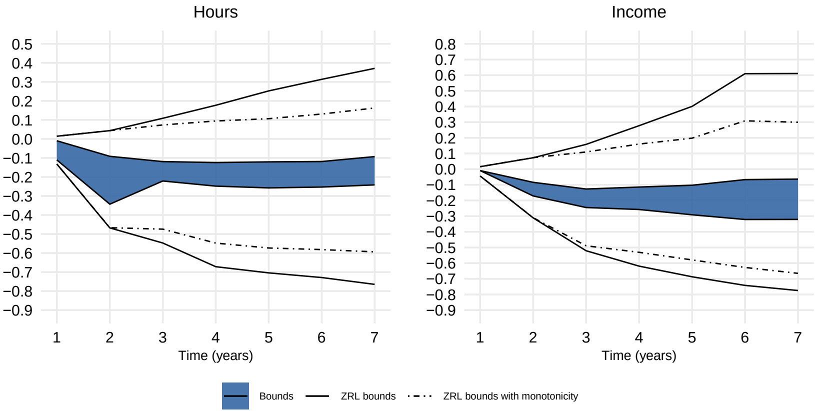


Figure 7: Comparison with Lee (2009) Bounds for Effects on Women

Back (extensions) Conclusion
ToC

Less Naive Comparison to Existing Methods

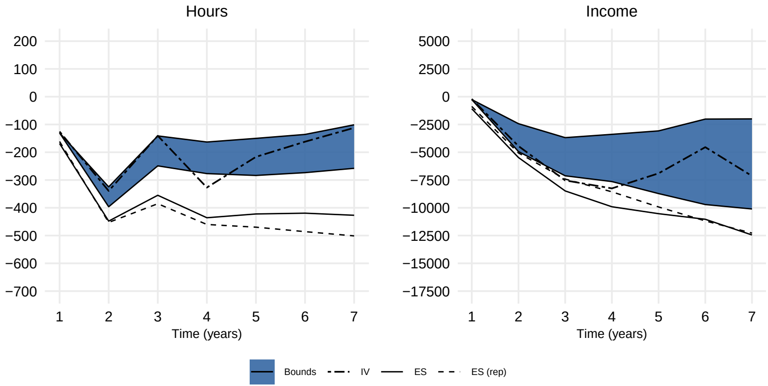


Figure 8: Estimates based on different methods

- Using women whose ACP succeeds for ES makes treatment definition consistent
- The three methods still target different sub-populations

Quantifying Bias in Existing Methods

Instrumental Variable (Lundborg et al., 2017):

- Linear combination: effect of parenthood and effect of delaying parenthood
- I have bounded τ_{ATR}
- I can point-identify τ_{ATR} assuming statis effects
- Bounds on the effect of delaying parenthood

Event Study (Kleven et al., 2019):

- Imputes childless career trajectories from pre-parenthood outcomes of older mothers
- I can construct representative group of childless reliers
- Proxy timing with ACP moment and perform a placebo event study
- Quantify difference in career trajectories between women with different fertility timing in the absence of children

Back (extensions) Conclusion

ToC

Effect of Delaying Motherhood

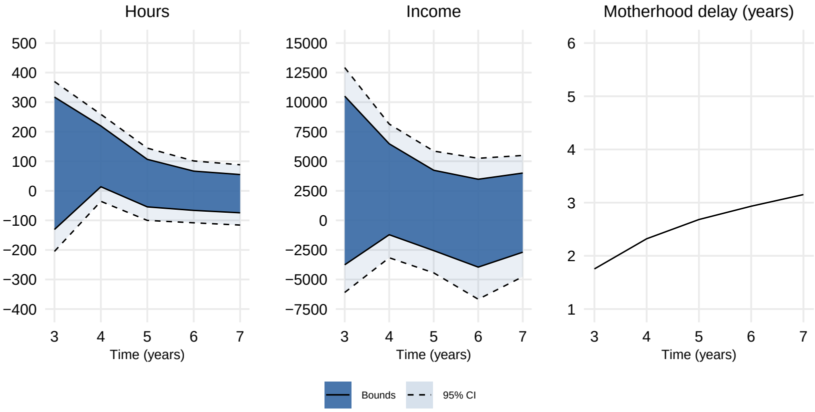


Figure 9: Effect of delaying relative to motherhood at first attempt

$$\tau_{IV} = \tau_{Parenthood} - 3\tau_{Delay}$$

ToC Back (extensions) Conclusion

Placebo Event

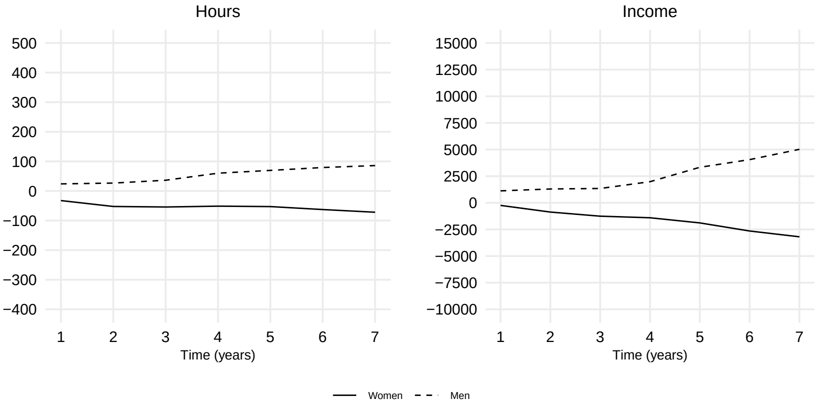


Figure 10: Placebo event study

- Negative selection of early mothers and positive selection of fathers

Back (extensions) Conclusion
ToC

Gender Inquality: Parenthood and Selection

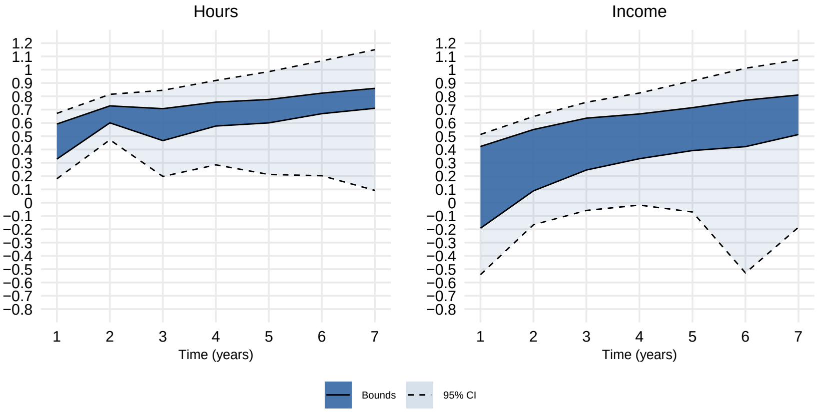


Figure 11: Share of gender inequality explained by section and parenthood

- Consistent with ES estimates attributing almost all gender inequality to parenthood

Back (extensions) Conclusion
ToC

Mental Health and ACPs

Mental health consequences associated with failure to conceive are a part of the story:

- Unmet fertility goals may negatively impact mental health, and in turn, labor market outcomes

There are, however, additional concerns:

- Mental health issues caused specifically by failed conception or ACPs (external)
  - Focusing on artificial insemination helps mitigate this
- Large impacts unique to ACP families (external)
- Worsened mental health by threatening monotonicity (internal)

In practice, these impacts may be small (Lundborg et al., 2024)

Antidepressant uptake | Back (extensions) | Conclusion

ToC

Monotone Bounds for Non-depressed Childless Women

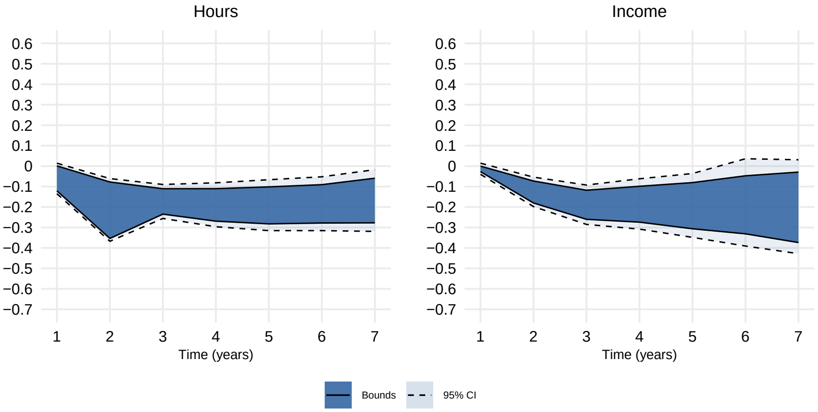


Figure 12: Monotone bounds for women who would not uptake antidepressants if they were to remain childless

Back (extensions) Conclusion

ToC

Confidence Intervals

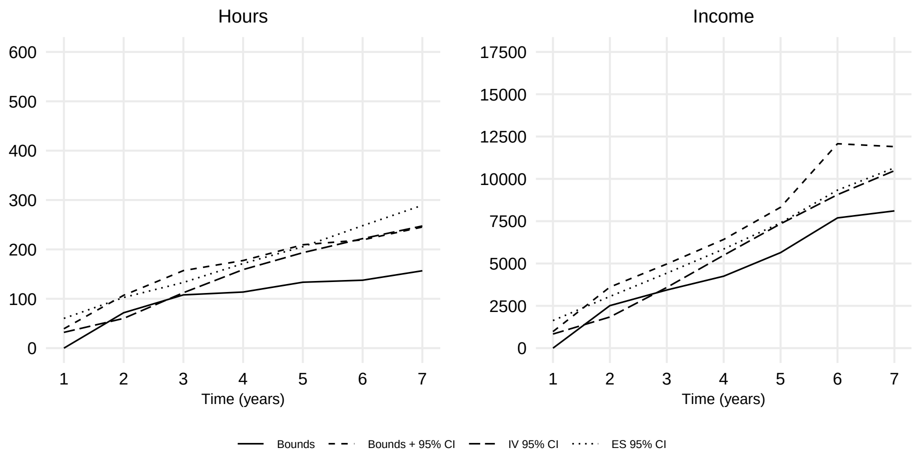


Figure 13: 95% CI for different methods

Monotonicity

Is monotonicity realistic?

- Yes, if families are determined to have at least one child
  - Decreasing marginal returns to children.
  - Stronger sufficient assumption: success cannot increase natural births
- No, if first treatment success increases the likelihood of attempting to conceive naturally
  - Couples may realize they are fertile and try more
  - First child may "save the relationship" resulting in more attempts to conceive

Back

Monotone Bounds: Women who Remain Childless

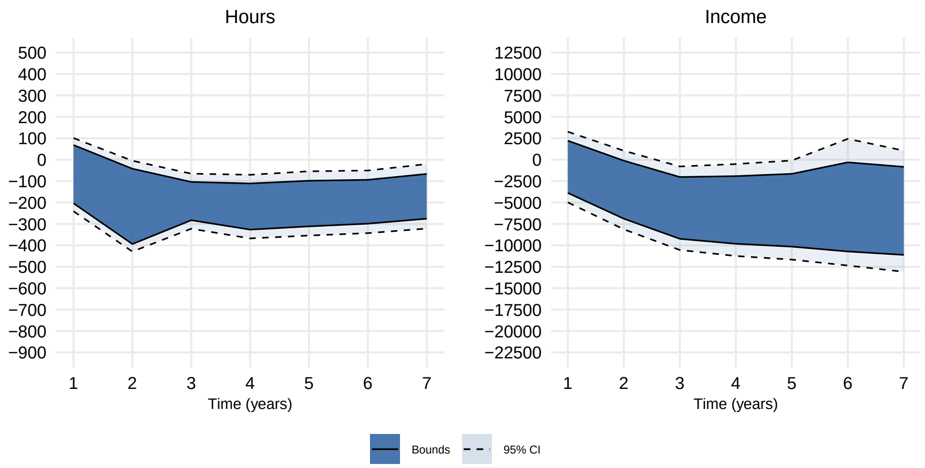
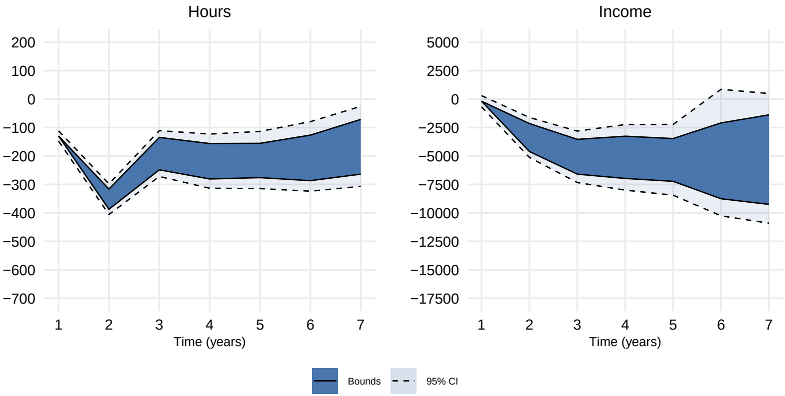


Figure 14: Monotone bounds using final status

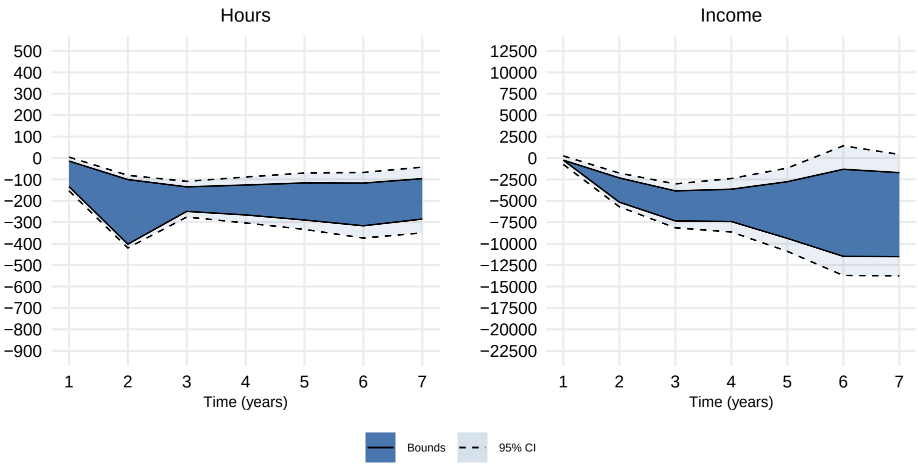
ToC Back

Simple estimator



- $\mathbb{E}[Y(1)|R=1] = \mathbb{E}[g(X_1) + \varepsilon|R=1]$
- $\mathbb{E}[g(X_1)|R=1]$ identified on chillness reliers using baseline method
- Only need to bound $\mathbb{E}[\varepsilon|R=1]$

Relaxing Monotonicity Direction



Back
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Relaxing Monotonicity to Partnered Women

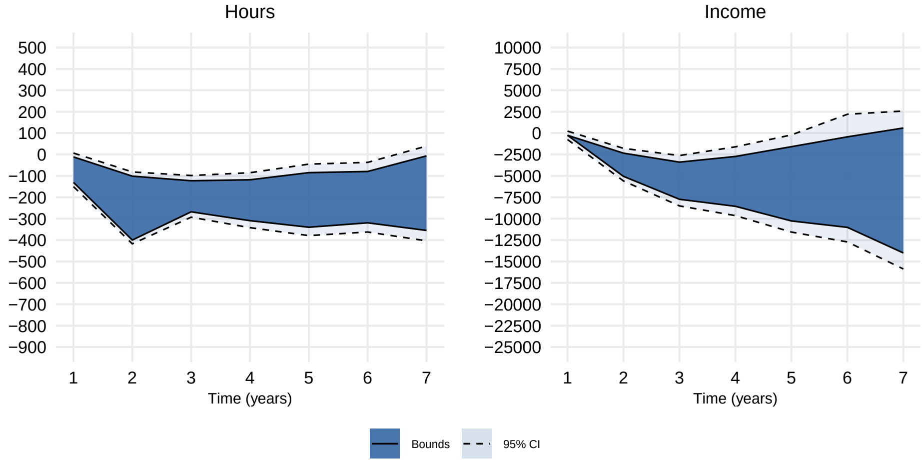


Figure 15: Monotone bounds using women who stay partnered

ToC Back (extensions)

Relaxing Monotonicity for Depression and Partnership

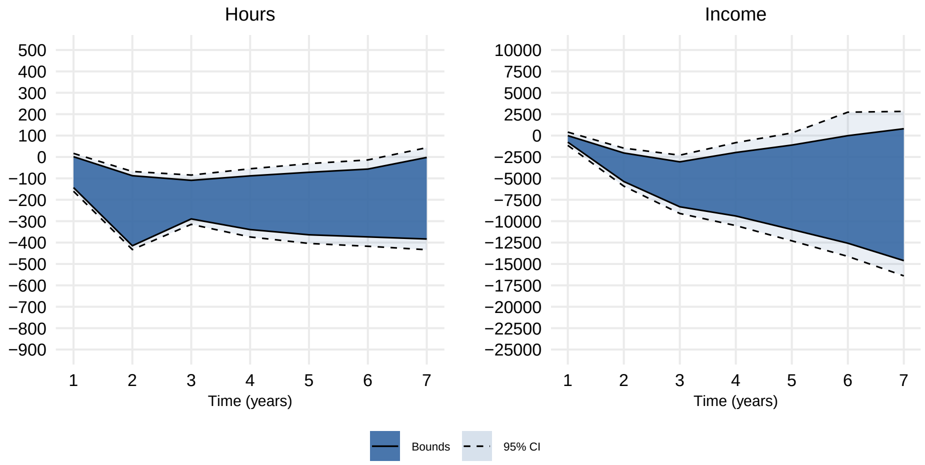
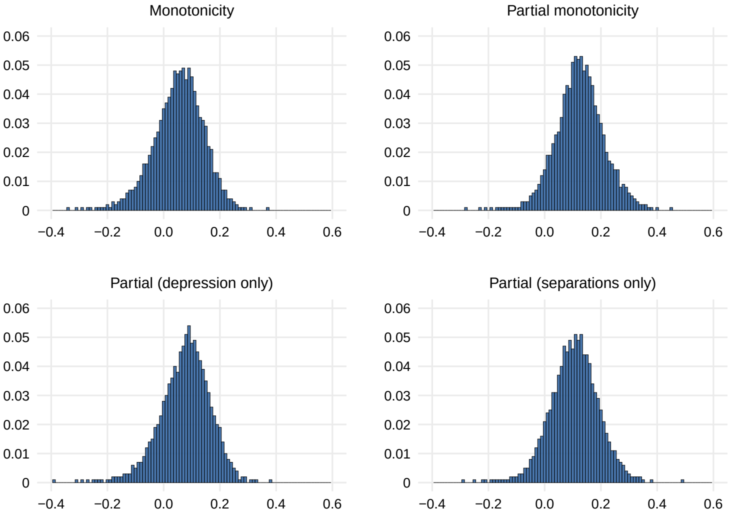


Figure 16: Monotone bounds using women who stay partnered and do not uptake antidepressants

Testing Monotonicity



Heterogeneity by Willingness to Undergo Procedures

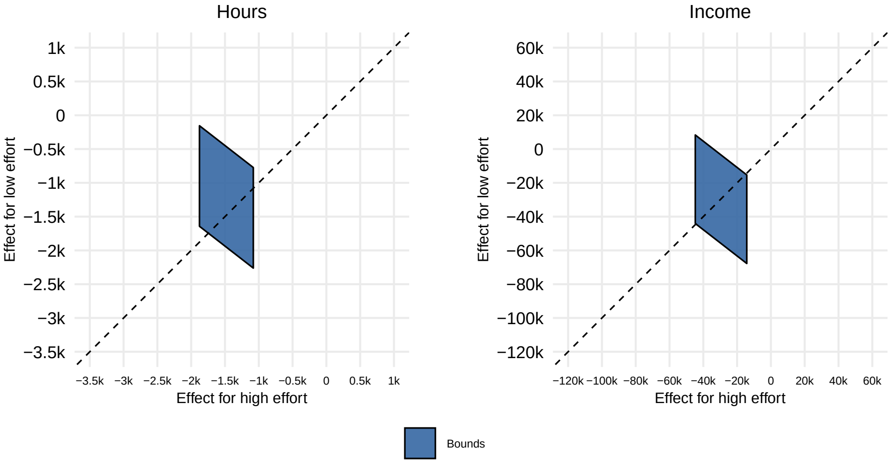


Figure 17: Cumulative outcomes 6 years after, G above or below 6

Monotone Bounds: Excluding Depression

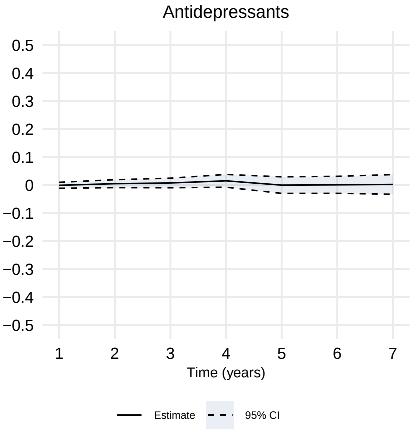


Figure 18: Effect on antidepressant take-up

Monotone Bounds: Correcting for Partner's age

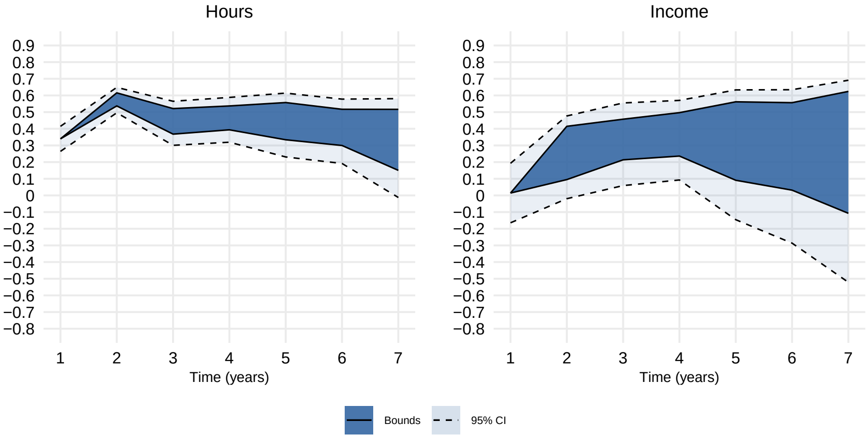


Figure 19: Monotone bounds using male income at same age as female

ToC
Back

Monotone Bounds: Women who Remain Childless

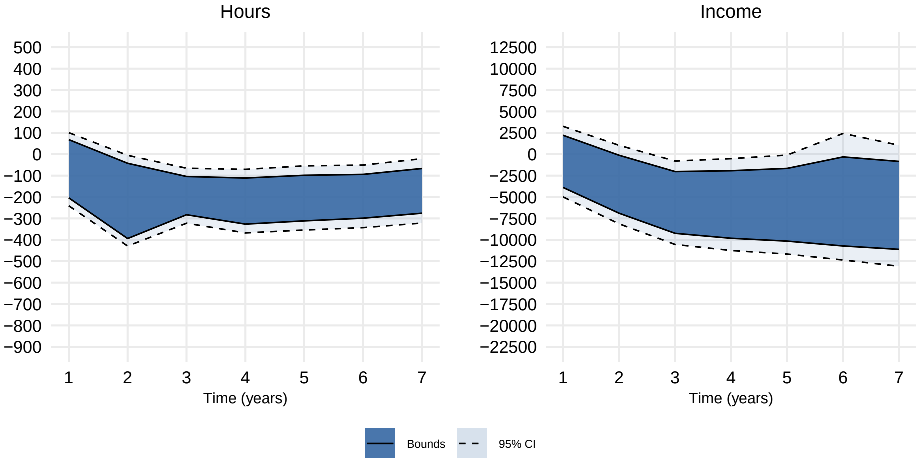


Figure 20: Monotone bounds using final status

Testing the Plug-in Approach

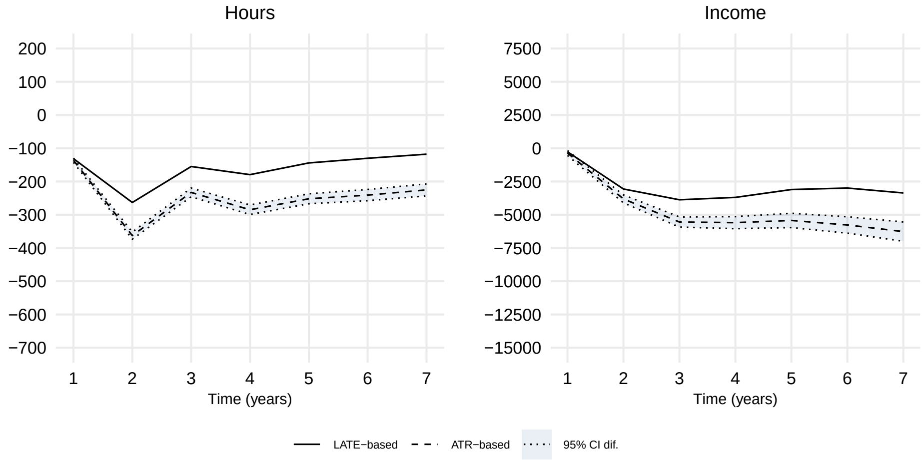


Figure 21: Plug-in estimators exploiting different number of treatments

Event Study: Population vs IUI Sample

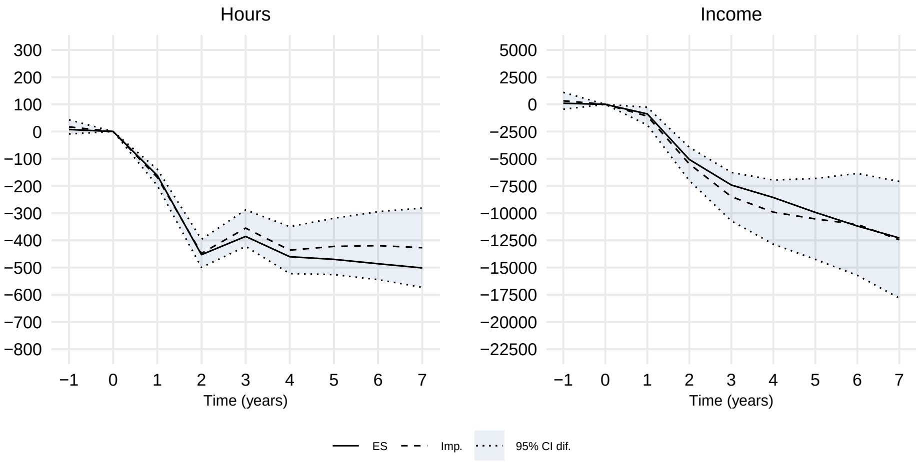


Figure 22: ES for population and women with first IUI success

Imputing Population Motherhood Outcomes Using IUI Sample

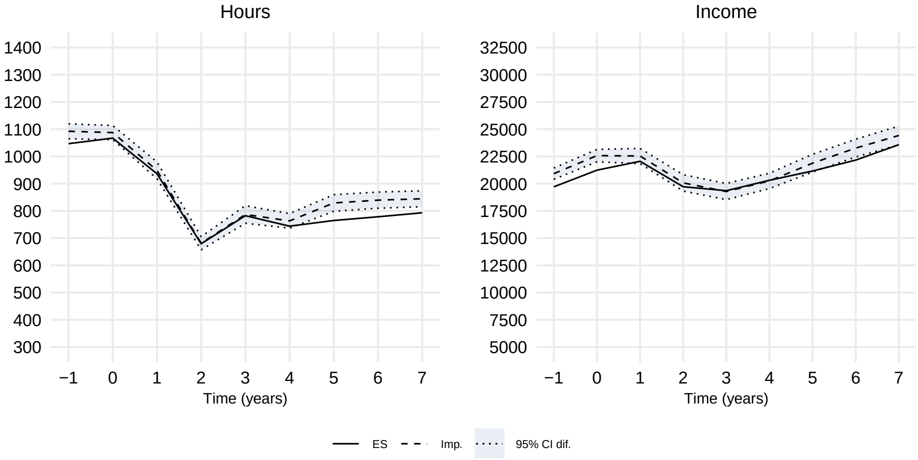


Figure 23: Population Outcomes vs IUI-imputation (age & education)

Imputing Population Childless Outcomes Using IUI Sample

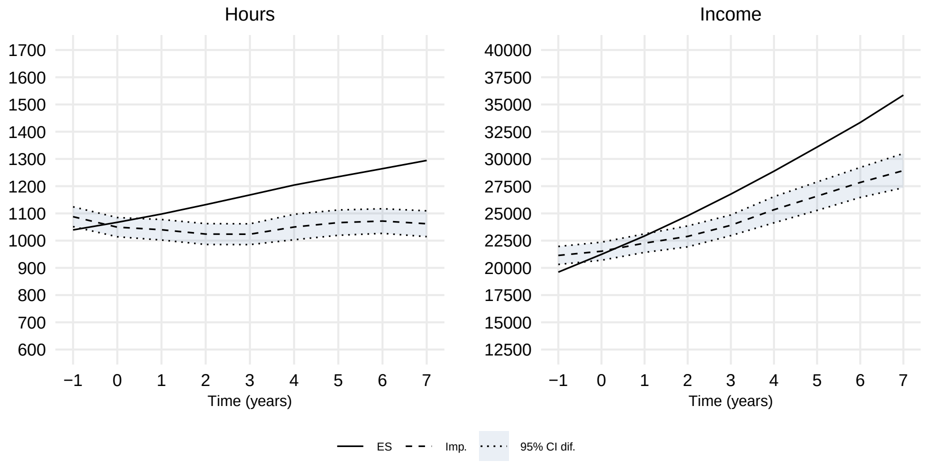


Figure 24: Population Outcomes vs IUI-imputation (age & education)

Event Study vs IUI-imputation for Population

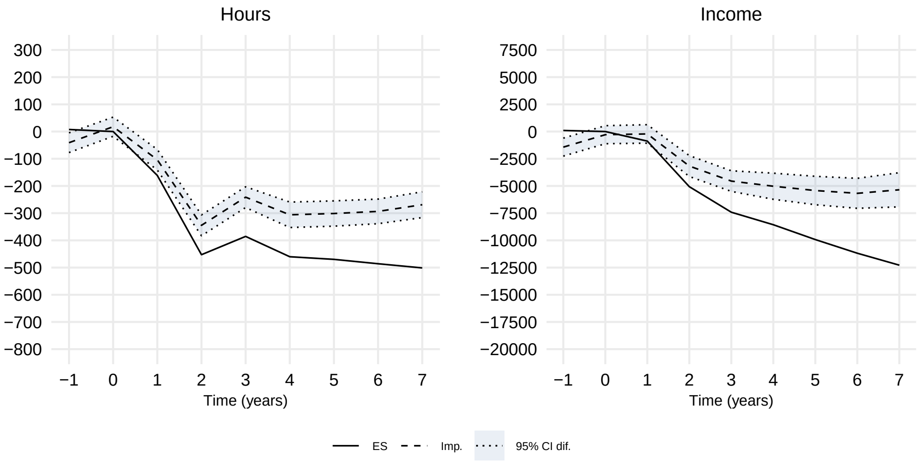


Figure 25: Event study vs IUI-imputation for population (age & education)

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