The economics of infertility:
Evidence from reproductive medicine

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Motivation

- One in six individuals worldwide are affected by infertility (WHO).

- Since 1980s, the technology of assisted reproduction (ART) has experience dramatic advances.

- There are many ethical, demographic, and economic policy debates around infertility treatment worldwide.

- In Economics perspective: Necessity for subsidization, Private and public costs of infertility burden, infertility burden's impact on households.

$\Rightarrow$ Remarkable variation in policy and the intense public debate highlight the need for more evidence on this matter.

Research question

1. Empirically analyze the infertility burden on women (mental health, etc).
2. Impact of public policies (insurance) on affordability of infertility treatment.
3. Private and public costs of infertility burden (We will not talk too much about this due to time constraint).
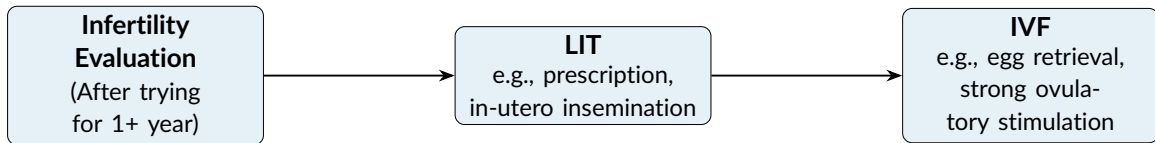
Brief terminology and backgrounds

- ART: Assisted Reproductive Technologies.

- LIT: Low-Intensity Treatment (prescriptive medication, in-utero insemination).

- IVF: In Vitro Fertilization (high intensity treatments), that includes strong ovulatory stimulation, egg retrieval procedure, etc.

- MKT price of a single cycle of IVF in Sweden in 2010: $3,250 in 2022 USD.

- Out-of-pocket price for IVF with health insurance coverage: $327 in 2022 USD.

Summary of results I will not have time to talk about

- **Willingness to pay**
  - Maximum willingness to pay for a 40% change of having a child: $16,741 (four monthly incomes).

- **Potential role of liquidity**: Understanding the degree to which IVF insurance coverage provides consumption smoothing benefits for liquidity-constrained households.

- **Normative analysis**: Calculating some Marginal value of public funds (MVPF) for distributional concerns.

Infertility Treatment Timeline

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┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│  Infertility        │      │       LIT           │      │       IVF           │
│  Evaluation         │─────▶│  e.g., prescription,│─────▶│  e.g., egg retrieval,│
│  (After trying      │      │  in-utero insemination│    │  strong ovula-      │
│  for 1+ year)       │      │                     │      │  tory stimulation   │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
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Data

- **Swedish Population Register & Statistics Sweden's longitudinal database**
    - Individual level data with demographic and socioeconomic information, linked to their spouses (+ cohabiting partners).

- **National Board of Health and Welfare**
    - Link individual's all purchases of prescription drugs (name, classification code).
    - University of inpatient hospital visits and specialist outpatient visits (date of visit, diagnosis codes).
    - Universe of birth records (live, still, due date, gestational age at birth, resulted from a medically assisted conception).

Sum stat: Final sample

Table 1: **Summary Statistics**

	Sample					
	(1) At-risk	(2) All initiators	(3) Initiators until 12/2012	(4) Event study	(5) RD sample	(6) LIT RD sample
Year of measurement	2012.6	2011.7	2008.1	2009.8	2005.1	2004.7
	(4.0)	(4.0)	(1.9)	(2.9)	(4.8)	(4.1)
Demographics						
Age	25.4	31.1	31.1	30.6	32.0	32.0
	(7.1)	(5.2)	(5.2)	(4.9)	(0.0)	(0.0)
No college	0.59	0.35	0.38	0.35	0.43	0.31
	(0.49)	(0.48)	(0.48)	(0.48)	(0.49)	(0.46)
Some college	0.15	0.15	0.14	0.14	0.15	0.16
	(0.36)	(0.35)	(0.35)	(0.35)	(0.35)	(0.37)
Full college (or more)	0.22	0.47	0.45	0.49	0.26	0.35
	(0.41)	(0.50)	(0.50)	(0.50)	(0.44)	(0.48)
Married	0.09	0.35	0.37	0.36	0.11	0.12
	(0.29)	(0.48)	(0.48)	(0.48)	(0.31)	(0.32)
Having ever divorced	0.02	0.05	0.05	0.04	0.05	0.06
	(0.15)	(0.22)	(0.22)	(0.20)	(0.21)	(0.24)
Work income (in 100 SEK)	1335.4	2607.7	2430.3	2587.9	1818.6	2214.8
	(1448.7)	(1709.8)	(1624.1)	(1636.6)	(1424.9)	(1420.7)
Disposable income (in 100 SEK)	1369.2	2350.1	2142.9	2276.7	1663.4	1876.3
	(1543.2)	(2183.9)	(1505.3)	(1467.6)	(1299.0)	(993.6)
Born outside of Sweden	0.17	0.25	0.23	0.21	0.28	0.30
	(0.38)	(0.43)	(0.42)	(0.41)	(0.45)	(0.46)
Health characteristics						
LIT (at any point)	0.04	0.68	0.75	0.71	0.06	1.00
	(0.19)	(0.47)	(0.43)	(0.46)	(0.24)	(0.00)
IVF (at any point)	0.04	0.69	0.67	0.69	0.07	0.51
	(0.20)	(0.46)	(0.47)	(0.46)	(0.25)	(0.50)
LIT or IVF (at any point)	0.06	1.00	1.00	1.00	0.09	1.00
	(0.23)	(0.04)	(0.03)	(0.02)	(0.29)	(0.00)
Having had a mental health Rx	0.23	0.26	0.19	0.21	0.17	0.16
	(0.42)	(0.44)	(0.39)	(0.41)	(0.37)	(0.37)
Number of individuals	1,807,328	85,110	40,818	43,165	182,746	6,300
Number of observations	13,370,388	85,110	40,818	43,165	5,911,461	72,733

The consequences of persistent infertility

Empirical specification: Impact of persistent infertility

The paper first employs DiD-ish specification to estimate the impact of persistent infertility.

Setup

1. **Sample**: Women who initiate any ART and conceive within 3 years of initiation.
2. **Variation**: **(i)** women whose first conception after ART initiation resulted in a live birth and **(ii)** women whose first conception resulted in a miscarriage or stillbirth ("failed").
3. **Identification assumption**: Women whose first conception succeeds vs women whose first conception fails would have evolved over time in the counterfactual scenario.

Individual-level outcome

$$\overbrace{Y_{it}} = \alpha_i + \sum_{\tau} \kappa_{\tau} \underbrace{D_{\tau,it}}_{\text{FE: relative time}} + \sum_{\tau} \sigma_{\tau} D_{\tau,it} * \textit{Failed}_i + \gamma_t + \beta * X_{it} + \varepsilon_{it}.$$

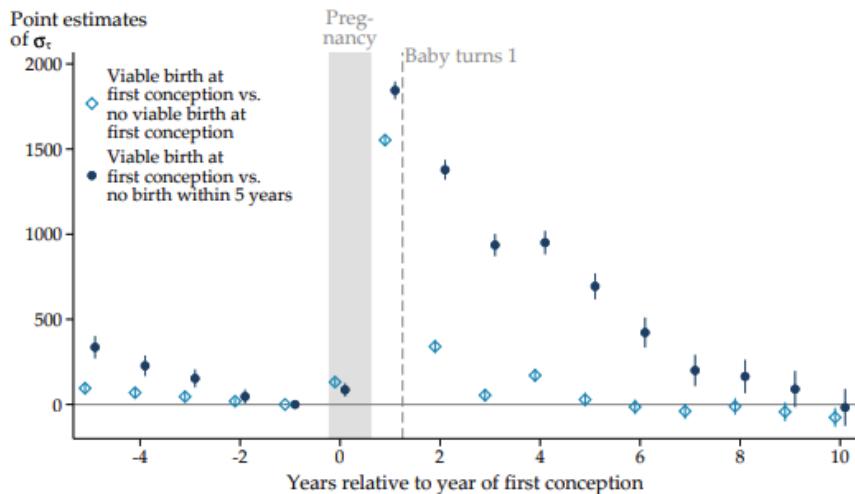- γ: Time relative to the quarter (or year) of conception.

Results: Mental health
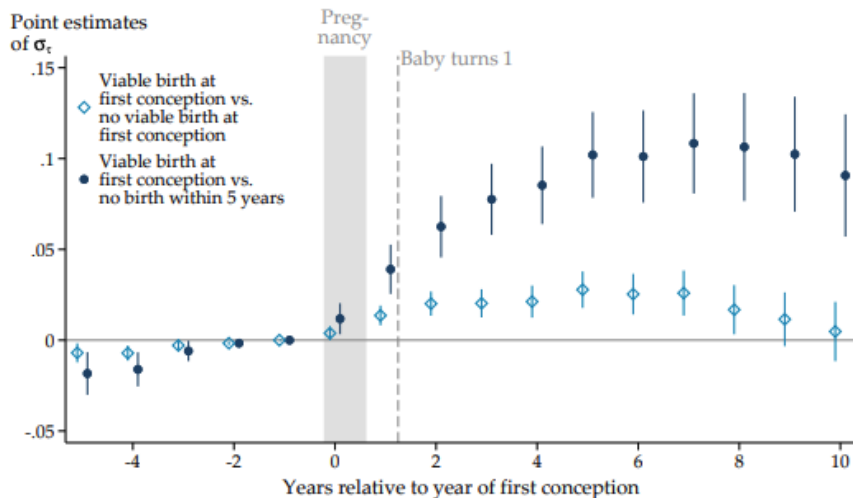

(b) Mental health R_x, event study

Point estimates of σ_τ

Length of full-term pregnancy

Baby turns 1

◇ Viable birth at first conception vs. no viable birth at first conception

● Viable birth at first conception vs. no birth within 5 years

Quarters relative to quarter of first conception
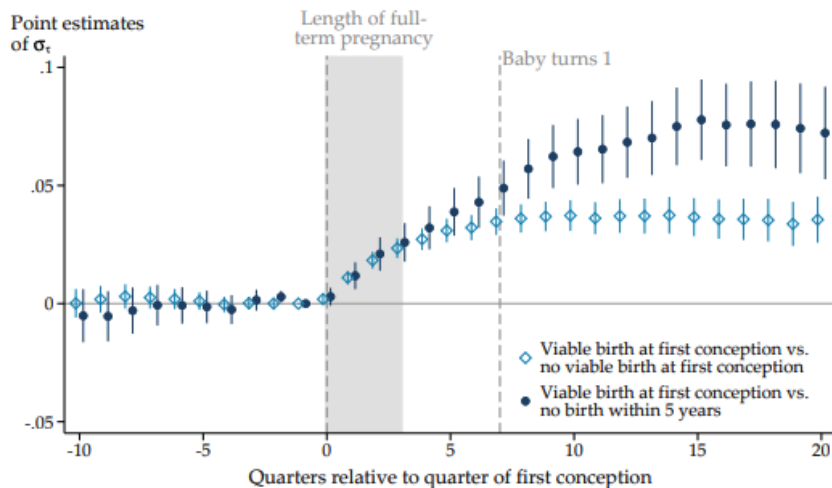
(d) Work income, event study

Results: Divorce rate

(f) Divorce, event study

Results: Summary

- Persistent infertility is bad for women's mental health.

- Persistent infertility has no "protective" long-run effect on women's income.

- This is relative comparison between women who revealed their preference for having a child. We are saying nothing about women who does not want to have a child having infertility.

- Persistent infertility leads to higher rates of divorce ("child"-oriented family?).

- "Wanting to have a child" might be the key here.

Demand for infertility treatment

Empirical specification: Impact of insurance coverage

The paper employ RDD to estimate the impact of insurance coverage on IVF initiation.

Setup

1. **Sample**: Women-year-month panel around the age cut-off (2 yrs) for insurance coverage (as-if-random treatment).
2. **Running variable**: Regional age cut-off for insurance coverage.
3. **Identifying assumption**: Age-based eligibility change is forseeable, but patients cannot perfectly control the timing of their treatment around the age cutoff (Really?).

$$\underbrace{Y_{itc}}_{\text{Initiating IVF treatment}} = \beta_0 + \beta_1 \mathbb{1}[a_{it} > \overbrace{A_{ct}}^{\text{Age cutoff}}] + \beta_2(a_{it} - A_{ct}) + \beta_3 \mathbb{1}[a_{it} > A_{ct}] \times (a_{it} - A_{ct}) + x'_{itc}\kappa + \varepsilon_{itc}$$
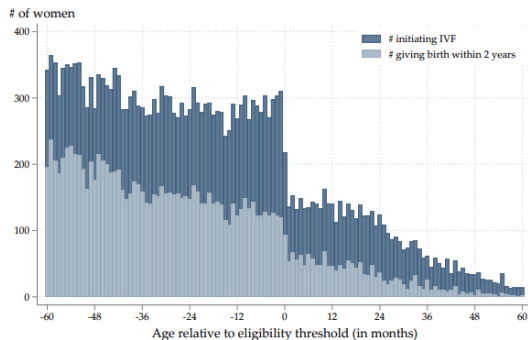
Graphical evidence

(a) IVF initiations
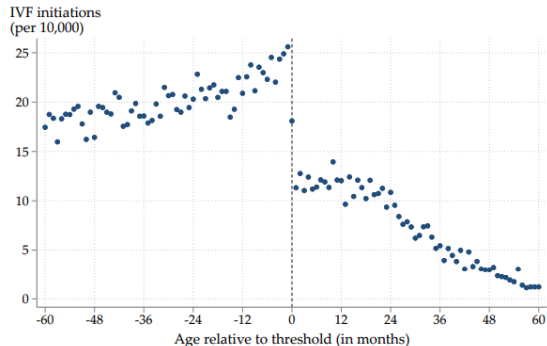
(b) Births after IVF initiation

- Huge drop happening at the age cutoff.

Formal RDD estimates

Table 3: **Regression Discontinuity Estimates**

| | Full sample | | | By income | |
| | | | | Below median | Above median |
	(1)	(2)	(3)	(4)	(5)
$\hat{\beta}_1$	−11.9***	−12.3***	−10.1***	−10.9***	−12.8***
	(0.7)	(0.7)	(1.1)	(0.9)	(1.4)
Mean dep. var					
overall	17.0	17.5	16.7	12.5	23.8
in $\tau = -12$ to $\tau = -1$	23.2	23.9	22.5	17.6	30.9
No. of observations	5,911,461	5,700,662	4,701,653	2,821,191	2,059,064
Controls	N	Y	N	Y	Y
Omit −5 to 5	N	N	Y	N	N

Notes: This table shows the results of estimating a linear parametric regression discontinuity specification in Equation (2), with IVF initiation as the outcome variable. In all regressions, we exclude the month when eligibility changes as we do not observe age at the daily level. Except as specified in Column (3) that reports the "donut" results and excludes 5 months around the threshold, we otherwise include 24 months before and 24 months after the cutoff in all specifications. Column (1) has no controls, while Columns (2), (4), and (5) include the full set of controls (fixed effects for the region of residence, calendar years, place of birth, and education categories (high school only, some college, college degree or more)). In Columns (1)–(3), the sample includes all childless women (of age −24 to 24 as specified on the x-axis of Figure 6) in July 2006 to November 2019 who have not yet initiated IVF. In Columns (4)–(5), we split up the sample by above and below median of women's disposable income rank at age 32. Standard errors reported in parentheses are clustered at the individual level.

Results: Summary

- As women age out of insurance coverage, their rate of IVF initiation drops by 51%.