NBER WORKING PAPER SERIES

THE ECONOMICS OF INFERTILITY: EVIDENCE FROM REPRODUCTIVE MEDICINE

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Working Paper 32445
http://www.nber.org/papers/w32445

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2024

We are grateful for helpful comments from seminar participants at the University of Michigan, Stanford University, University of Zurich, the Becker Friedman Health Economics Initiative Annual Conference, and the Whistler Junior Health Economics Summit. We thank Iliriana Shala at the Research Institute for Industrial Economics for excellent research assistance. We also gratefully acknowledge support from the National Science Foundation (CAREER SES-2144072, Persson), 2022 Stanford Discovery Innovation Fund (Polyakova), the National Institute on Aging (K01AG05984301, Polyakova), and the Sweden-America Foundation (Moshfegh). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Science Foundation or the National Institute on Aging. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

The Economics of Infertility: Evidence from Reproductive Medicine
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NBER Working Paper No. 32445
May 2024
JEL No. H0,I0,J0

ABSTRACT

WHO estimates that as many as 1 in 6 individuals of reproductive age worldwide are affected by infertility. This paper uses rich administrative population-wide data from Sweden to construct and characterize the universe of infertility treatments, and to then quantify the private costs of infertility, the willingness to pay for infertility treatments, as well as the role of insurance coverage in alleviating infertility. Persistent infertility causes a long-run deterioration of mental health and couple stability, with no long-run "protective" effects (of having no child) on earnings. Despite the high private non-pecuniary cost of infertility, we estimate a relatively low revealed private willingness to pay for infertility treatment. The rate of IVF initiations drops by half when treatment is not covered by health insurance. The response to insurance is substantially more pronounced at lower income levels. At the median of the disposable income distribution, our estimates imply a willingness to pay of at most 22% of annual income for initiating an IVF treatment (or about a 30% chance of having a child). At least 40% of the response to insurance coverage can be explained by a liquidity effect rather than traditional moral hazard, implying that insurance provides an important consumption smoothing benefit in this context. We show that insurance coverage of infertility treatments determines both the total number of additional children and their allocation across the socioeconomic spectrum.

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1 Introduction

WHO estimates that as many as 1 in 6 individuals of reproductive age worldwide are affected by infertility, which is defined as attempting but failing to conceive a child after 12 months (WHO, 2023). Since the 1980s, the technology of assisted reproduction (ART) has experienced dramatic advances.[1] Throughout its history, infertility treatments have been at the center of many ethical, demographic, and economic policy debates. Variation in policies that affect the availability and the price of infertility treatments around the world is striking, reflecting many differences in how societies think about infertility and assisted reproduction. At the most fundamental level, there is disagreement about the ethics of ART procedures altogether, as has recently sharply come to the public spotlight in the U.S. after the 2024 Alabama Supreme Court ruling that frozen embryos should be considered children, which in turn has lead to pauses in IVF treatments in the state.[2] Most commonly, however, reproductive assistance is available, but there is variation in whether infertility is considered a disease and its treatment a medical necessity that should be covered by (public) health insurance, or whether it is viewed as an elective procedure that shouldn't be subsidized by taxpayers.[3]

This remarkable variation in policy highlights the need for more evidence, yet systematic population-level evidence on the rate of infertility burden, its private and public non-pecuniary costs, and families' willingness to pay for treatment remains scant. We use administrative population-wide data from Sweden to fill some of these gaps, focusing on the economics of subsidizing medical treatments for families who would like to have a child but experience persistent involuntary medical infertility (henceforth "infertility").

We begin by documenting the prevalence of infertility and the utilization of infertility treatments in Sweden using over more than a decade of data, from 2006 to 2019. We develop a measure of infertility that is based on purchases of any prescription drug used for infertility treatments, capturing the universe of (treated) involuntary medical infertility.[4] Nearly 8% of women who are of

[1] The ability of ARTs to lead to a successful birth has improved over time after medication-assisted reproduction became available in the 1940s and in-vitro-fertilization in 1980s (Nordlund, 2008). The first IVF child was born in 1981 in the U.S.. As the success of ARTs has improved, its price has remained high.

[2] Supreme Court of Alabama (2023); Albert (2024)

[3] The WHO recognized infertility as a disease in 2009 and the American Medical Association followed in 2017 (Adashi, 2018).

[4] As we discuss in the data section, the least invasive infertility treatments are effectively free in the Swedish health insurance system, alleviating concerns that some women may not initiate treatment due to cost. Our definition does not capture involuntary "social" infertility that women may face if they would like to have a child, but do not have a suitable partner, or do not initiate infertility treatments due to individual ethical or religious considerations. We also do not capture cases of infertility in which the woman does not initiate treatments for other medical reasons.

childbearing age (16 to 45) but have no children in 2006 initiate an infertility treatment by the end of 2019. Conditional on being childless by age 31, 11% (in the first income decile) to 16% (in the top income decile) of women experience infertility and initiate a treatment until the end of their fertile years. We observe that the take-up of the more expensive and intensive treatment technologies is higher among higher-income women. Many infertility stories have a happy end, with nearly 75% of women bearing a child within eight years after starting their first infertility treatment of any kind. A quarter of women, however, remain infertile.

We next proceed to estimating the private monetary and non-monetary costs of infertility. We use the sample of women who initiate an infertility treatment (and hence have a revealed preference for a child), to estimate the consequences of remaining infertile on the woman's own and partner's mental health, labor market outcomes, and couple stability. We leverage the variation in the failure of medically assisted pregnancies conditional on conception. While many women who initiate an infertility treatment eventually carry a pregnancy to term, the failure of the first pregnancy results in a 33 percentage point lower long-run (over 5 years) probability of having a child. In other words, among women whose first assisted conception fails, only 67% eventually carry a pregnancy to term. Yet, this outcome is rarely predictable.

Our findings reveal large impacts on well-being of wanting to, but not being able, to have a child. We find that Women who are not able to have a child on their first assisted conception are more likely to suffer from mental health issues in the long-run—they are 4 percentage points (or 16% relative to the pre-treatment mean) more likely to have a mental health prescription. Scaling this by the first stage of 33% implies a 48% increase in the use of mental health medications for those who have no birth within 5 years after the first unsuccessful conception. We also estimate an increase in the history of mental health medication among male partners. We further find that women who remain infertile are 6 percentage points more likely to be divorced in the long-run, suggesting infertility has a toll on couple stability. At the same time, we find no protective long-run impact on labor-market incomes. This finding is at odds with a large literature that has documented a negative effect of child-bearing on female earnings, which hence may be expected to imply a large positive effect of infertility on earnings. The lack of a "child penalty" in our estimates likely reflects the fact that our analysis focuses on women who reveal a preference for having a child, and is consistent with a small body of evidence using IVF-births (Gallen et al., 2023; Lundborg et al., 2024). Among women who want a child, our results suggest that remaining childless does not have a long-run protective effect on income. Women who have a successful first assisted conception experience a short-run large drop in income, but catch up with women whose conception was unsuccessful within a year after childbirth. We find a small decline in the long-run income of partners.

Substantial deterioration in mental health and couple stability as a consequence of infertility would conceivably suggest a substantial private willingness to pay for infertility treatments. We examine the willingness to pay empirically by using a sharp discontinuity in subsidies for IVF treatments in Sweden. Swedish public insurance uses age cutoffs that vary over time and across regions ("län") to determine who is eligible to be on the waitlist for subsidized IVF cycles. Eligible (i.e., young enough) women are entitled to three cycles at effectively no out of pocket cost. On the day a woman crosses the age cutoff, however, she becomes ineligible for coverage and the out-of-pocket cost for IVF jumps to roughly 1.9 monthly disposable incomes for one treatment cycle.[5] As wait times and the course of treatment are both uncertain, women close to the age cutoff cannot perfectly control their ability to initiate their treatment before the cutoff birthday. We use this discontinuity to estimate the impact of the price of IVF on IVF utilization and the ultimate likelihood of having a child. Our estimates suggest that the rate of treatment initiations declines by 50%—nearly 12 out of 23 per 10,000 childless women refrain from initiating treatment when they become ineligible for free IVF cycles, which causes an analogous 50% reduction in the number of births. The implied maximum willingness to pay for women with median individual disposable income is 22% of annual income for one cycle of IVF (or a circa 30% probability of giving birth to a child).

Our estimates of revealed private willingness to pay are high in absolute terms, but may appear too low and indeed at odds with our estimates of the significant private non-pecuniary cost of infertility. What can reconcile this result? It is possible that couples substantially underestimate the private cost of infertility, although this explanation seems unlikely given the salience of the issue. Another possibility is that our traditional estimate of "moral hazard" in this context reflects liquidity constraints rather than a low willingness to pay. To investigate this hypothesis, we follow an approach similar to Chetty (2008) and estimate the elasticity of demand at different points in the income distribution. We find that the response to insurance coverage of IVF is larger at the bottom of the income distribution than it is at the top. Conceptually, this income gradient can either reflect an income gradient in the ability to pay the high lump-sum price for IVF treatments (a liquidity effect), or an income gradient in the underlying preferences and willingness to pay for children.

[5] At the median of the individual disposable income distribution in the relevant population. See a more detailed discussion of this computation in Section 2.

The limited income gradient in the prevalence of biological children, where liquidity constraints do not inhibit conception, suggests that differences in preferences for children across the income distribution are unlikely to account for the differential price sensitivity. Using the response of high income individuals as a measure of the liquidity unconstrained behavioral response, we estimate that at least 40% of the reduction in infertility treatment utilization is can be attributed to a liquidity effect rather than traditional moral hazard. These estimates suggest that if the availability of credit markets for financing IVF treatments is limited, then constraints on insurance coverage of IVF treatments may both be socially inefficient (as couples with sufficient willingness to pay do not receive treatment) and regressive (as lower-income households are more likely to face liquidity constraints and no access to credit). Further, because insurance coverage has a larger impact on IVF treatments—and hence childbirths—at lower income levels, the coverage policy design ultimately affects the allocation of children across the income distribution.

This paper contributes to several literatures. First, we contribute to a broader literature investigating the impact of health shocks on family behavior and well-being, and the implications of those responses for policy design (see, e.g., Fadlon and Nielsen, 2019, 2021; Persson and Rossin-Slater, 2018, forthcoming). Second, our specific focus on infertility as the health shock relates the paper to an extensive literature on the causal effects of having children on maternal health and labor market outcomes.

A large body of work has examined the consequences of having a child on labor market outcomes.[6] Most closely related to our paper is a literature that studies the causal effects of having *any* child using miscarriages and/or stillbirths (Bratti and Cavalli, 2014; Hotz et al., 1997; Hotz et al., 2005) or the success of infertility treatment (Cristia, 2008; Gallen et al., 2023; Lundborg et al., 2017, 2024) as an instrument for having a child.[7] We contribute to this literature by providing causal estimates of the impact of *not* having children, when children are desired (by revealed preference, individuals who undergo infertility treatment want to have children), on measures including but not limited to labor market outcomes. The extent to which the impacts of having a child are informative of the (reverse) impacts of not having a child holding preferences for a child constant is a priori ambiguous.

[6] An extensive literature has studied "child penalties" following the birth of the first child in general and not restricted to children conceived through infertility treatments. The existence of child penalties have been documented in labor markets in a range of contexts (Andresen and Nix, 2022; Kleven et al., 2019), including in Sweden (Angelov et al., 2016).

[7] Also closely related are the recent papers examining the consequences of miscarriage per se (i.e., not restricted to individuals seeking infertility treatment) (Bütikofer et al., 2024; Kalsi and Liu, 2022; Rellstab et al., 2022).

Evidence on the impact of fertility on outcomes other than those on the labor market is limited, in particular as pertains to overall well-being. There is conflicting evidence on the impact of having a child on maternal well-being, with some studies suggesting detrimental effects (e.g., Ahammer et al., 2023; Glass et al., 2016; Margolis and Myrskylä, 2015; Rizzo et al., 2013), in line with the notion of the "parenthood paradox" or the "parenthood happiness gap." However, as highlighted by Cetre et al. (2016), part of these associations may reflect selection into childbearing, something that we partially control for when we condition our sample on individuals who have a preference for childbearing.[8] Conceptually more closely related to our study is a notably smaller body of work examining the associations of infertility treatments with a variety of non-labor market outcomes. Prior evidence on the long-term effects of successful/unsuccessful infertility treatments finds mixed effects on the association with couple stability (e.g., Johansson et al., 2009; Kjaer et al., 2014; Martins et al., 2014; Peterson et al., 2011) and maternal well-being (e.g., Heazell et al., 2016; Rädestad et al., 1997; van den Berg et al., 2017; Verhaak et al., 2007; Vikström et al., 2017).

Third, this paper contributes to a literature analyzing the arrival of new fertility-related health technologies, and the implications of subsidies that influence access to and affordability of ART.[9] In the context of infertility treatments, insurance coverage for IVF has been shown to be associated with increased utilization and birth rates,[10] increased educational investments (Gershoni and Low, 2021b; Kroeger and La Mattina, 2017), and changes in marriage and divorce patterns (Abramowitz, 2014; Abramowitz, 2017; Cintina and Wu, 2019; Gershoni and Low, 2021a). Less is known about the uptake of other forms of ART.[11] We contribute to this literature by exploiting discontinuities in a nationwide subsidy schedule for IVF, which limits concerns of selection, to estimate the impact of subsidies on IVF take-up as well as the willingness to pay for IVF. Our evidence on the diffusion of ART across couples of different socioeconomic status also contributes new facts to the broader work on (health and non-health) technology diffusion and how it relates to socioeconomic status; see Cutler et al. (2006) for an overview.[12]

[8] A related literature documents that the postpartum period is a high-risk period for the onset of anxiety and depression in a woman's life, with estimates of the share of new mothers who experience postpartum depression and anxiety ranging from 6.5% to 20% (Mughal et al., 2018).

[9] Outside of the context of infertility treatments, see e.g. Junhong (2001) and Conner et al. (2022) for analyses of the arrival of fertility-related technologies that allow expecting individuals to learn about the characteristics of the fetus during pregnancy.

[10] See, e.g., Banks et al. (2010), Bitler and Schmidt (2006), Bitler and Schmidt (2012), Boulet et al. (2015), Buckles (2013), Bundorf et al. (2007), Crawford et al. (2016), Griffin and Panak (1998), Hamilton and McManus (2012), Hamilton et al. (2018), Henne and Bundorf (2008), Jain et al. (2002), Machado and Sanz-de Galdeano (2015), Provost et al. (2016), and Schmidt (2005).

[11] See, e.g., Kessler et al. (2013).

[12] Some examples include Glied and Lleras-Muney (2008), Jaravel (2019), Jayachandran et al. (2010), Lleras-Muney

Finally, our paper contributes to an emerging body of work documenting the importance of liquidity sensitivity in healthcare (e.g., Belchior and Gomes, 2022; Ericson and Sydnor, 2018; Gross et al., 2022; Lyngse, 2020). In contrast to a large literature that estimates moral hazard in the context of health insurance (Einav and Finkelstein (2018) provide an overview), evidence is scarce on the role of liquidity constraints (Nyman, 2003). The evidence we present suggests that insurance coverage serves a consumption smoothing role. Liquidity constraints, in turn, can be a quantitatively important determinant of the extensive margin take-up of expensive healthcare treatments. While existing work has shown that liquidity sensitivity may cause consumers to delay healthcare consumption that is associated with small lump-sum payments (co-pays) until the receipt of income (Gross et al., 2022), our evidence suggests that liquidity sensitivity can crowd out healthcare consumption entirely, as potential children are simply not born when insurance is removed.

The rest of the paper proceeds as follows. We describe our data sources and measurement in Section 2. We present facts about the prevalence of infertility and the success rates of infertility treatments in our data in Section 3. We quantify the consequences of infertility on monetary and non-monetary well-being in Section 4. We estimate the private willingness to pay, the role of liquidity, and the implications of insurance coverage on the number of children born in Section 5. Section 6 briefly concludes.

2 Institutional Background, Data, and Measurement

2.1 Infertility and Infertility Treatment

Involuntary infertility was classified by the World Health Organization as a disease in 2009 (Zegers-Hochschild et al., 2009), defined as a disease of the reproductive system.[13] Infertility treatment starts with an infertility evaluation, typically after at least one year of trying to conceive. The subsequent choice of treatment, if any, depends on the underlying cause of infertility. Often the first line of treatment is what we will refer to as low-intensity treatment (henceforth LIT). LIT can take two forms. Patients can take prescription medication that regulates ovulation, improving chances of conception. Another form of LIT is in-utero insemination, which may or may not be supported by the same medication. Thus, LIT is a non-invasive or minimally invasive method of assisted reproduction. It is generally cheap and considered well-established and safe.

and Lichtenberg (2005), and Moshfegh (2024).

[13]The American Medical Association followed suit in 2017. The designation of a condition as a disease has significant implications for insurance coverage, as it changes the designation of treatment as being "medically necessary."

If LIT is not successful or if the patient's case is not medically appropriate for LIT, a high-intensity treatment is available. High intensity treatments include various forms of in vitro fertilization (IVF). IVF involves strong ovulatory stimulation, an egg retrieval procedure, fertilization outside of the woman's body, and subsequent implantation of a fertilized embryo. IVF is a substantially more invasive and more expensive procedure. Women also often need multiple IVF cycles to arrive at one birth.

The market price of a single cycle of IVF in Sweden in 2010 (which is roughly in the middle of our main analytic sample) was about 26,813 SEK ($3,246 in 2022 USD).[14] As the solid blue line in Figure A1 illustrates, this market price corresponds to about 1.9 median monthly individual disposable incomes among childless women.[15] In other words, one IVF cycle costs 16% of median individual disposable annual income in the relevant population. As is clearly visible in Figure A1, there is substantial variation in how the price of IVF compares to disposable incomes of women of different socio-economic status. The unsubsidized cost of IVF amounts to more than six times the monthly individual disposable income in the first decile of the income distribution, and less than one month of disposable income for the top decile.

The effective out of pocket price for IVF varies dramatically depending on health insurance coverage. For primary infertility (i.e., for women who are childless and are struggling to conceive their first child), Swedish public health insurance provides coverage for three IVF cycles, but with some important restrictions. During our sample period, coverage eligibility was based on age cutoffs—a woman needed to be young enough to be eligible for insurance coverage. The age cutoffs varied across Swedish regions and over time. The lowest age cutoff was 36; see Table A1 for the cutoffs in all regions and years. When a woman is eligible for insurance coverage, the out of pocket cost of IVF is comparatively low, corresponding to at most 2,700 SEK in 2010 in co-pays for prescription drugs and office visits ($327 in 2022 USD) within the public insurance system. Figure A1 again illustrates this cost as a multiple of individual disposable monthly income—the out of pocket cost with insurance subsidy is 0.2 median disposable incomes in the relevant population. Even when a woman is covered by insurance financially, access to care can be challenging in practice, with significant wait times.[16]

[14] The average price of one IVF cycle is as reported by eight clinics in Sweden. Data on prices was collected for 2010 using the web.archive.org website snapshots.

[15] Figure A1 uses the sample of women from our regression discontinuity analysis in Section 5 to compute deciles of disposable income. We discuss the characteristics of this sample below. Full summary statistics for this sample are reported in Table 1, column (5).

[16] Typically the waiting period is between 3–12 months, but can be as long as 2 years depending on where in Sweden the patient lives (https://xn--fertilitetsrd-0fb.se/ivf-vantetid/; https://www.1177.se/Halland/

2.2 Data and Measurement

The backbone of our data is an extract from the Swedish Population Register of all individuals residing in Sweden from 2000 through 2016. We merge this data with the Statistics Sweden's longitudinal database of individuals (LISA) from 1990 through 2021, which contains demographic and socio-economic information drawn from various administrative records (Statistics Sweden, 2019). We further link individuals to their spouses using marital records and, from 2011, also to cohabiting partners using information about shared addresses. Hereafter, we refer to a person's spouse or cohabiting partner simply as the person's partner.

To construct measures of ART utilization and health outcomes, we merge in health records from the National Board of Health and Welfare (Socialstyrelsen, 2019). For each individual, we observe the universe of prescription drug purchases made in outpatient pharmacies from July 2005 through 2019. For each purchase, we observe the name of the drug and the drug's seven-digit Anatomical Therapeutic Chemical (ATC) classification code. We also observe the universe of inpatient hospital visits and specialist outpatient visits from 2002 through 2019. For each visit, we observe the date of the visit and the diagnosis codes (ICD-10) attached to the visit. We also observe birth records that contain all live births and stillbirths in Sweden from 1985 through 2019.[17] For each birth we observe whether it is a live birth or a still birth, gestational age at birth, and the due date. We also observe if the birth resulted from a medically assisted conception.

To capture all women who initiate an ART treatment, we create a list of all drugs (ATC codes) that are used in LIT and IVF treatments, respectively. We define a woman as initiating LIT (IVF) treatment on day d if she fills an LIT (IVF) prescription for the first time in 365 days during the period from July 2006 through November 2019.[18] Appendix A provides the details. Figure A2 validates our measure. In this figure we compare the rate of ART-births as recorded in the administrative birth register (dashed line) with the rate of assisted births computed based using our ART measure (solid line). For the overlapping years of data, the two measures are very close to each other.

`barn--gravid/barnloshet/ivf-provrorsbefruktning/`).

[17]For dates prior to July 1 2008, the birth record contains alive and stillborn infants from week 28+0. Starting with July 1, 2008, the register contains alive and stillborn deliveries from week 22+0.

[18]Some drugs are only used in IVF treatments, whereas some drugs are used both in LIT and IVF treatments. Thus, to define a woman as an LIT initiator, we require that she does not take an IVF drug. To ascertain that we capture only women who undergo treatment due to infertility, we exclude women for whom we observe a cancer diagnosis in either the inpatient or specialist outpatient records in the 6 months following d, as they may undergo infertility treatment in preparation for their cancer treatment. We additionally exclude women for whom we observe a breast cancer diagnosis in the 2 years before d to avoid misclassifying cancer treatment as ART since similar drugs are used for breast cancer hormone therapy and ART.

We identify the women who *conceive* following an ART treatment as those who either (i) appear in the birth records with a live birth or a birth of a stillborn child, or (ii) appear in the inpatient or specialist outpatient records with a primary diagnosis code indicating a miscarriage.[19] For each birth, we infer the date of conception by subtracting 280 days from the due date. For miscarriages, we observe the date of diagnosis, but not the date of conception. For individuals who initiated ART treatment within 22 weeks of the miscarriage, we take the ART initiation date to be the date of conception. For individuals who initiated ART treatment more than 22 weeks before the miscarriage, we infer the date of conception as 12 weeks earlier (thus, we assume that the miscarriage occurred on day 12+0 of pregnancy).

We use these data sources to define our key outcome variables for women of fertile age and their partners. First, we create indicator variables for any drug claims in the following three categories: anti-anxiety, anti-depressant, and antibiotic. Appendix A lists the exact ATC codes. To capture labor market outcomes, we use LISA variables to calculate total annual work-related income, which includes wages from employers as well as income from self-employment. Finally, we create an indicator variable for divorce among those who are married.

The merged dataset further allows us to define additional variables used in the analysis including a categorical variable indicating the individual's region ("län") of residence, a categorical variable indicating the individual's highest level of completed schooling (i.e., no college, some college, completed college), and place (usually country) of birth. We also compute three measures of income ranks (within gender, calendar year, and birth cohort) that we use throughout the paper. First, for all women initiating ART treatments we compute the deciles of annual individual total (AGI-like) income measured in the two years prior to treatment initiation. Second, for all women irrespective of their ART use, we compute the woman's parental total (AGI-like) income rank taken over the two years when the woman was age 20 and 21. Third, we compute deciles of women's individual disposable income at age 32. We use this latter measure of relative income in our analysis of the willingness to pay for infertility treatment, as it captures income well before any woman approaches the insurance coverage age cutoff. Appendix A provides more details of each measure.

[19] See Appendix A for diagnosis codes for a miscarriage. We do not capture conceptions ending in early miscarriages that occur at home, without any contact with the healthcare system. As ART pregnancies are usually closely monitored, this is rarer than for non-assisted pregnancies, but likely nonetheless a relevant limitation of our definition of conception.

2.3 Samples

Table 1 presents summary statistics for several analytic samples. We start by defining a sample of women who are "at-risk" for involuntary infertility. Intuitively, as we do not (a priori) know which women are childless because they struggle to conceive, we start by taking all women who are of fertile age and who do not (yet) have any child. Specifically, our at-risk sample (Column 1) includes all person-year observations over the time period from 2006 through 2019 when the woman is (i) childless and (ii) age 16–45. This at-risk sample consists of 13.4 million observations and includes 1.8 million unique women. Column (1) reports average characteristics across all person-year observations. The typical woman who has not yet had her first child is 25 years old. Further, 22% have completed college, 9% are married (2% had an experience of a divorce), and 17% were born outside of Sweden. These women earn on average 138,240 SEK (measured in 2012 SEK) in work income (ca. $20,000 USD).

Column (2) presents characteristics for the "initiator" sample. This includes all women who are in the at-risk sample of Column (1) and who initiate either IVF or LIT treatment at some point over the time period when we observe initiations (i.e., from July 2006 through 2019). Column (2) reports summary statistics for this sample of women measured in the year before the initiation of ART, for one observation per woman. Women who initiate ART are older on average (31.1 vs. 25.4), more likely to have completed college (47% vs. 22%), more likely to be married (35% vs. 9%), and have nearly twice as much income than the typical woman who hasn't yet had her first child.

The sample in Column (3) is identical to the one in Column (2), but restricted to individuals initiating ART treatment by December 2012; we use this sample in Section 3 to describe the success rates of ART over an eight-year time horizon after initiation. The characteristics of women in the two initiator samples (measured, in both cases, in the year before initiation) are similar.

Columns (4) through (6) show summary statistics for samples that we will return to in detail in the subsequent parts of the paper. Column (4) shows summary statistics for the event study sample used in Section 4, which is a sub-sample of Column (2), restricted to observations up to February 2016 (to allow for follow-up observation) and to women who conceive within three years of treatment initiation. Women in this sample are generally similar to women in the two other initiator samples. Columns (5) and (6) present summary statistics for the two samples that we use in our Regression Discontinuity (RD) analysis of Section 5. Both are sub-samples of the childless at-risk sample in (1), but restricted to observations within two years of the ART eligibility cutoff, and Column (6) is further restricted to women who initiate LIT. The characteristics are measured at age 32, i.e., well before any woman approaches the insurance eligibility cutoff. As compared to all at-risk women in Column (1), the women close to the insurance eligibility cutoff are (mechanically) older, are somewhat more likely to have completed college and to be married, have higher income, and are more likely to have been born outside of Sweden.

3 Prevalence of Infertility and Infertility Treatments

3.1 Aggregate Patterns

Measuring the prevalence of infertility in the general population has traditionally been challenging, as infertility is inherently defined as an absence of an event (pregnancy) over a certain time period, making measurement complex as it requires knowing intent (WHO, 2023). As infertility treatment is not easily available (or may not be utilized by all couples) in many countries, WHO measure of worldwide infertility relies on responses to surveys about a woman's reproductive experience. In the Swedish context, in which at least the LIT treatment is cheap and readily available, and so the take-up of some treatment is less of a concern, the measure based on administrative healthcare records has the advantage of being able to capture the full population without variation in individual recall or interpretation.

There are several ways to measure how common infertility is in our context. Panel (a) of Figure 1 illustrates the annual incidence of infertility, plotting initiations of infertility treatments in our sample of 16 to 45 year old women without children. In each year of the data (on the x-axis),[20] we ask what share of women who are still childless initiate an infertility treatment (y-axis). The incidence of infertility based on this measure has been stable over twelve years of our data, hovering around 0.7% of women initiating treatment every year (solid line). While the incidence of infertility has been relatively stable, two dashed lines illustrate the substantial technological change in treatment over the same time period. While LIT treatments were more common at the beginning of the period, LIT has seen a persistent decline, while the more intensive IVF treatment has grown. By 2018, nearly twice as many women were initiating IVF compared to LIT. This shift towards a more intensive technology is consistent with the steady rise of ART births (which capture only successful treatments) that we observed in Figure A2; less than two percent of births were from

[20] We restrict the axis to years in which we have data for all 12 months, i.e., 2007 to 2018.

assisted conceptions in 1995, and that share grew to almost ten percent by 2019.

Panel (b) of Figure 1 shows an estimate of infertility prevalence by plotting the cumulative share of women who were 16–45 and childless in the first year of the sample (as of June 2006) and who have initiated an ART treatment by a given year on the x-axis. Over the course of twelve years, 8% of women encounter infertility (as measured by treatment initiation). Notably, this underestimates the lifetime prevalence of infertility, as many women who are 16-45 in 2006 will not have aged out of their childbearing years by 2018 (and thus may still initiate ART in later years).

Figures 2 and 3 illustrate how often women who initiate infertility treatments give birth. Figure 2 shows the pathway through infertility treatments among all childless women who initiate either LIT or IVF during our sample period and whom we can observe over an eight-year time horizon. This is the sample of women in Column (3) of Table 1.[21] 60% of women who initiate a treatment start with LIT, while 40% directly initiate a more intensive treatment. Among those who start with the less intensive treatment, 42% eventually switch to IVF. All in all, within eight years of initiating any infertility treatment, 79% of women give birth. 15% go all the way through at least one cycle of an intensive IVF treatment and still do not have a child within eight years. About 6% of women start with LIT but then appear to "drop out"—they neither switch to IVF, nor have a child, within eight years.

Figure 3 provides another view of how infertility journeys resolve. The figure plots the rate of childbirth as a function of time since initiation of LIT (dashed line) and IVF (solid line), respectively. For both technologies, the eight-year follow-up birth rate is around 75%. The similar eventual success rates are not informative of the underlying effectiveness of each technology, however. IVF is generally considered to be more effective than LIT. Rather, this pattern likely reflects the correct sorting of women into treatment, with a selection of individuals with less complex infertility cases into LIT as the first line of treatment.[22] Taken together, these numbers suggest that, at the population-level, infertility is common and assisted reproductive technologies are highly effective, with the majority of women who use them ultimately ending up with a birth.

[21] Recall that since our drug data spans the time period from July 2005 through December 2019, and as we define initiation of ART as the first utilization within 12 months, this sample includes women who initiate ART from July 2006 through December 2012.

[22] Consistent with this, Figure A3 shows that women who undergo LIT tend to be younger than women who undergo IVF; age tends to be one of the main predictors of treatment success.

3.2 Variation by Income

The aggregate patterns mask substantial variation across different demographic groups. Figure 4 examines the socio-economic gradient in infertility treatments in our sample. In Panel (a) of Figure 4 we plot, by income decile (x-axis), the share of women born in 1970 to 1975 and childless as of June 2006 who initiate any ART treatment until the end of our observation in 2019 (y-axis).[23] Figure A4 shows similar panels for LIT and IVF separately. Dashed lines show the raw data; solid lines with 95% confidence intervals show estimates adjusted for differences in the place and year of birth across income deciles. This choice of cohorts allows us to focus on women who we observe until the end of their primary childbearing years. These women are 31 to 36 years old in 2006 and have no children. We follow them for thirteen years until they turn 44 to 49 years old in 2019, thus capturing close to their full fertile history.

Two facts are evident in Panel (a) of Figure 4. First, the overall prevalence of infertility as measured by ART use is substantially higher in this sample as compared to Figure 1. Around 1 in 7 women who are childless at age 31 initiate infertility treatments over the course of the next thirteen years of their lives. There is a substantial income gradient in the initiations—around 11% of women in the first decile of income ever use LIT or IVF, compared to more than 16% at the top decile. In Figure A4 we observe that the gradient is markedly steeper in IVF than in LIT.[24]

Panels (b) through (d) capture the variation in the intensity of ART use across the income distribution. Here we return to our baseline sample of all 16–45 year old childless women, focusing on the subset who initiate LIT. Panel (b) shows that the share of these women who transition to IVF within three years of their LIT initiation increases almost monotonically with income, from roughly 35% in the bottom decile to nearly 45% in the top decile (using the age-adjusted estimates; the raw data displays an even sharper gradient).[25] The switch to IVF occurs approximately three months faster in the top decile compared to the bottom decile (panel c). Moreover, panel (d) suggests women in the top decile are doing IVF for somewhat longer than women in the bottom decile. In sum, the utilization and mix of reproductive technologies exhibits a clear income gradient in the sample of women seeking, and in need of, assisted reproduction.

[23]Here we use women's parental income rank as a measure of income, as this measure is defined for all women in our sample irrespective of their ART initiation.

[24]Figure A5 illustrates that these patterns of technology use are not specific to the 1970–1975 cohorts. In that figure we add younger cohorts, up to birth year 1990, and observe similar gradients.

[25]In these panels we use the deciles of women's own total income in the year prior to their initiation of an ART treatment.

4 The Consequences of Persistent Infertility

4.1 Empirical Approach

Estimating the causal effects of infertility is challenging for (at least) two reasons. First, infertility is hard to observe in most data sources, as we usually do not know which childless women are involuntary medically infertile and which are childless for other reasons. Second, even when infertility status is observed, being infertile is not randomly assigned among couples. In addition to these empirical challenges, there is also a conceptual issue that has received little attention in the prior literature on the effects of children. Conditional on wanting children, the counterfactual of having a child is experiencing infertility, while the counterfactual of not being infertile implies having a child. The treatment effects of infertility (or of children) are thus only defined in relative terms, as conceptually there is no untreated group conditional on preferences.

Our data and setting allow us to make progress in addressing these challenges. We zoom in onto childless women of child-bearing age (16–45) who are initiating an infertility treatment of any kind (see Appendix A for the detailed definition of treatment initiation). These women are a set of women who have revealed their preferences for having a child in the data. For these women, treatment can result in conception. Conditional on conception, some pregnancies fail due to the biological risk of a miscarriage or stillbirth, rendering infertility persistent for some. The (sporadic) miscarriage risk for the first conception is considered to be largely a matter of chance in the medical literature, or at least to be a risk that is not easily predictable by the patient or their physician (e.g., Larsen et al., 2013; Melo et al., 2023).[26] As we shall see below, the failure to carry a pregnancy to term on the first conception is predictive of remaining infertile for eight years after the start of the first infertility treatment.

We use the variation across the two subsets of women—(i) women whose first technology-assisted conception resulted in a live birth and (ii) women whose first-technology-assisted conception resulted in a miscarriage or stillbirth ("failed")—to measure the consequences of persistent (medical) infertility on mental health, earnings, and couple stability, in the medium- and long-run. More formally, we estimate the following event-study model centered around the time of the first assisted conception:

$$Y_{it} = \alpha_i + \sum_{\tau} \kappa_\tau D_{\tau,it} + \sum_{\tau} \sigma_\tau D_{\tau,it} * \mathit{Failed}_i + \gamma_t + \beta * \mathbf{X}_{it} + \epsilon_{it} \tag{1}$$

[26] According to the American College of Obstetricians and Gynecologists (ACOG), chromosomal abnormalities are a common cause of early miscarriages, largely described as "random" events (https://www.acog.org/womens-health/faqs/early-pregnancy-loss).

where Y_{it} is an individual-level outcome (e.g., having picked up a mental health prescription drug), t is the absolute time (quarter or year depending on the outcome) and τ is time relative to the quarter (or year) of conception. $D_{\tau,it}$ are fixed effects for relative time, α_i denotes individual fixed effects, and γ_t denotes absolute time fixed effects. $Failed_i$ is a dummy equal to 1 if the woman had an unsuccessful pregnancy following the first conception. $\mathbf{X}_{it}$ include dummies for age at time t in two-year bins. The coefficients of interest are σ_τ that measure how the time path of the outcome relative to the time of conception differs between women whose first conception is successful and women whose first conception fails. The identifying assumption needed to interpret these coefficients as the causal effect of infertility relative to the desired outcome (and to the societal default) of having a child, is that women whose first conception succeeds provide an accurate counterfactual for how the outcomes of women whose first conception fails would have evolved over time in the counterfactual scenario (i.e., if these womens' pregnancies, too, had succeeded). While we cannot test this assumption directly, we can examine trends in outcomes prior to conception.

In addition to the reduced form specification in Equation (1), we also estimate a first stage. The specification is analogous to Equation (1), but the outcome variable is an indicator for having had any childbirth. By definition, there are no births in the sample during the period prior to the first conception. In the post-period, we do not restrict births to be directly related to any infertility treatments.

In our baseline event study, we compare women whose first conception fails to women whose first conception succeeds. In the language of potential outcomes (where infertility is the treatment and the outcome of the first conception is an instrument), women whose first conception succeeds are compliers who are not treated (by infertility). Women whose first conception fails are either never takers (women whose first conception fails, but they go on to have a child in a subsequent pregnancy) or treated compliers (women whose first conception fails and who subsequently remain childless). There are no always takers in our context, as women cannot remain infertile if their first conception succeeds. A unique feature of our environment is that if we restrict ourselves to a finite follow-up time horizon, we can empirically differentiate between treated compliers (whose first conception failed) and never takers. We define never takers as those women whose first conception fails, but they go on to have a birth within a five year follow up period. Taking these women out of the sample allows us to do a direct comparison of compliers whose first conception succeeds and compliers whose first conception fails and who remain infertile (at least during a five to ten year follow-up, depending on the outcome). Throughout, we also estimate the analogue of Equation 1 only on this compiler sample, which recovers the treatment effect of infertility among those women whose experience with the first assisted conception determines their long-term fertility.

Experiencing a miscarriage may itself be a traumatic event that affects outcomes above and beyond infertility (see e.g. Oster and Fox (2024) for a recent discussion). In Appendix C we present two sets of event studies that center on infertility treatment initiation, without conditioning on conception. The first set of event studies compares women who fail to conceive (and thus remain infertile) to women who conceive; this specification effectively puts women who experience a miscarriage in the comparison group (as they are included in the group of women who conceive). The second set of event studies compares women who fail to conceive to women who have a successful first conception; this specification thus excludes women who experience a miscarriage. The results of these specifications are generally similar to our baseline (and nearly identical between each other), suggesting that the long-run effects are indeed driven by infertility rather than the (observed) experience of a miscarriage several years earlier.

4.2 Results

Figure 5 illustrates the first stage. Panel (a) is a flow measure, which shows the share of women giving birth in each quarter relative to the time of the first conception. Mechanically, there are no births prior to conception. Among women whose first conception results in a live birth (gray dashed line, 80% of the sample), births are concentrated in quarter 3 (as we would expect given the modal length of pregnancy). Among women whose first conception fails (blue solid line, 20% of the sample), we observe live births only after quarter 4. There is a small mass of births in quarter 5 after the first conception, but births are generally spread across multiple quarters post the first unsuccessful conception. Panel (b) shows that some of the first conception failures are persistent. This panel plots a stock measure—the share of women who have had at least one live birth by a given quarter relative to the first conception. Mechanically, 100% of women whose first conception is successful have had a live birth by quarter 5. Among women whose first conception fails, about two thirds still experience a birth in the longer-run (Table A2). In Table 2 column (1) we estimate that on average two years after the first conception and beyond (up to 20 quarters), women whose first conception fails are 33 percentage points less likely to have a child. In other words, the failure of the first (assisted) conception predicts a substantial longer-term fertility difference.

We next estimate Equation (1) to quantify the impacts of remaining involuntarily infertile on women and their partners. For each outcome, in Figures 6 and 7, we show two types of panels.

The left column of panels plots the raw data for each outcome, re-normalized to the common mean in the quarter (or year) prior to conception. We split the sample into three groups: those who experience a birth at the first conception (the control group, or untreated compliers; gray dashed lines), those who have no viable birth at the first conception (the treatment group, which is a mix of treated compliers and never takers; solid blue line), and those who have no viable birth at the first conception and no birth within five years (treated compliers; blue dotted line). The right column of panels reports the point estimates from the event study in Equation (1). In light blue are our baseline estimates that use the full sample. The dark blue estimates are restricted to treated and untreated compliers only, effectively scaling our baseline estimates by the first stage.

We first consider the effect of infertility on health, focusing especially on mental health. The first row of panels in Figure 6 and Figure 7 show results for the probability of (ever) using antidepressant and anti-anxiety medications. We generally observe relatively high rates of mental health medications at baseline—about twenty five percent of women and seventeen percent of partners have ever taken these medications by the quarter prior to conception. Women (and partners) whose first conception fails and whose first conception succeeds have similar time trends in mental health drug use prior to the first assisted conception. The event study figures confirm the visual lack of pre-trends in the raw data and also reveal a substantial divergence in the use of mental health medication after the first conception fails. For both women and their partners, we observe a much faster growth in the probability of using mental health prescriptions after the conception failure. Our baseline estimates in column (2) of Table 2 suggest that two years after the first failed conception, women are 4 percentage points (16%) more likely to have taken a mental health medication. For women who remain infertile, this increase is substantially larger (48%). To shed light on whether this may simply capture a higher probability of taking any medication (or a deterioration in general health), in Appendix Figure A6 we present event study estimates for antibiotics claims.[27] Our estimates suggest that infertility causes a decline in antibiotics use around the age when couples whose first conception succeeded start sending their children to daycare (which happens around age one in Sweden);[28] however, in the longer run we observe no differences in antibiotics claims between women whose first conception succeeds and women whose first conception fails.

Next, we consider the impact of persistent involuntary infertility on economic outcomes. The

[27]As few chronic conditions are present in the relevant age group, we focus on infections that are common at any age.

[28]This is consistent with Daysal et al. (2022), who show that preschool children bring home germs that infect younger siblings with respiratory disease.

second row of panels in Figure 6 and Figure 7 show our estimate for women's and partners' work income. The trend in income is similar between the treatment and control groups prior to the first conception (income is growing slightly slower for both women and men in the treated complier sample). We see no changes in income trend among complier women and partners whose first and subsequent conceptions are unsuccessful. Consistent with the prior literature on the effect of children on earnings, however, we observe a sharp drop (by 56% among women and by 7% among partners) in income coinciding with the time of birth among those women and partners whose first conception is successful. We observe a muted and delayed drop in income the sample of women whose first conception is unsuccessful but two thirds of whom go on to have a child at a later point in time. The estimates in Table 2 indicate that remaining infertile "protects" income by 2.5% when we average over all years two to ten after the first conception. This protective effect, however, is driven by the years closer to conception and dissipates in the longer run (as is visible in Figure 6). At seven years after the first conception, women and men whose first assisted conception was successful not only catch up in income levels, but experience a steeper income growth trajectory as compared to the couples who remain infertile. Persistent infertility thus has no "protective" long-run effect on women's incomes, while for partners, persistent infertility leads to income declines in the long-run. In other words, for women who reveal their preference for having a child (and hence who experience infertility when they don't have a child), we estimate a zero long-run child penalty on income.

Finally, we turn to the impact of infertility on couple stability, and more specifically, the likelihood of a divorce. The last row of panels in Figure 6 shows the raw data and the event study for the share of couples who have divorced. This panel restricts our sample to the subset of couples who were married in the year before the first assisted conception. In both the raw data and the event studies, we observe that couples who had a failed first conception are divorcing at faster rates compared to couples who had a birth after the first conception. The difference is especially striking for couples who remain infertile. Ten years after the first failed conception, 30% of these couples have divorced, as compared to 20% among those whose first conception was successful. The event study estimate in Column (5) of Table 2 suggests that after two years, women whose first conception fails are 2 percentage points more likely to get divorced. The effect is 6 percentage points when scaled by the first stage (i.e., capturing the effect for those women who remain infertile in the long-run).

In sum, in contrast to the common notion that childbearing may lead to long-term unhappiness, drops in economic productivity, and couple instability, we find the opposite in the sample of couples who prefer to have children. Among couples who remain involuntarily infertile in the long run, mental health deteriorates, earnings remain the same (among women) or experience a slower growth (among men), and these couples experience substantially higher rates of separations.

5 Willingness to Pay for Infertility Treatments

The estimates in Section 4 reveal substantial private costs of infertility. We would thus expect a high willingness to pay for medical technologies that treat infertility. Our institutional setting allows us to estimate how responsive families are to the price of infertility treatments and what mechanisms may drive this response.

Swedish public insurance (nearly fully) covers three cycles of IVF treatment. The eligibility for coverage depends on age. Historically the age cutoff has varied across Swedish regions and over time. See Appendix Table A1 for the maximum age at which coverage was provided in each region-year. As patients age out of coverage, they can still access IVF services, but have to pay the full cost out of pocket. While the age-based eligibility change is deterministic and foreseeable, patients cannot perfectly control the timing of their treatment around the age cutoff. First, outcomes of each cycle are uncertain. Second, due to capacity constraints, most patients have to wait for their treatment, with wait times typically ranging from 3–12 months.[29] As a result, some women requesting to start a cycle when they are eligible for coverage may age out of insurance coverage by the time they receive their first appointment. This institutional context implies that right at the age cutoff, access to (highly) subsidized IVF becomes as good as randomly assigned. Taking advantage of this fact, we use a regression discontinuity design to estimate how much women respond to the sharp change in the price of IVF.

5.1 Graphical Evidence

Figure 8 shows the raw data. The x-axis in both panels shows the age of the woman (in months) relative to the (region-year specific) insurance eligibility cutoff. The y-axis in panel (a) shows the number of women who initiate IVF in a given (relative) month per 10,000 childless women who have not initiated IVF before. The sample includes all childless women whose age falls within five years of their (region-specific) age eligibility threshold. We observe a steady increase in the probability

[29]Source: https://xn--fertilitetsrd-0fb.se/ivf-vantetid/. See also Appendix Figure A7 for our estimates of wait times between an infertility diagnosis and treatment, which can be multiple years.

of initiating IVF as the woman ages, reaching over 25 per 10,000 initiations in the month just prior to the cutoff. There is no apparent anticipatory pattern. The initiation rate drops sharply at the eligibility cutoff, to circa 12 per 10,000 initiations. The initiation rate then stays flat for around two years, and gradually declines to nearly zero at five years after the cutoff, when all women are over the age of 40 and many are approaching age 45 (depending on their region's coverage cutoffs).[30]

Figure 8, panel (b), shows that the drop in the take-up of IVF is accompanied by a proportional drop in actual births within two years of treatment. This figure plots the number of IVF initiations in each month of age relative to the cutoff in dark blue—this is the same data as in the numerator of panel (a). In light gray, we show the number of (the same) women giving birth within two years of each relative month. At the insurance eligibility cutoff, we observe a sharp decline in the number of children born. Panel (b) of Figure A9 plots the ratio of the number of births to the number of IVF initiations. We observe no change in the success rate at the cutoff. Women who continue with IVF treatments at full price are not differentially more likely to have more successful treatments. In other words, we do not observe selection on the treatment effect of IVF when the price increases substantially at the cutoff. This suggests that the sharp drop in childbirths is a direct consequence of the reduction in the number of IVF attempts at the cutoff.

5.2 Formal Estimates

We next convert the graphical evidence in the preceding discussion into formal regression discontinuity (RD) estimates. Our running variable is the year-month of birth of an individual in the at-risk sample (either all childless women or those with a history of LIT treatment) relative to the region-year specific age cutoff for IVF coverage. Our primary specification is a parametric linear RD:

$$Y_{itc} = \beta_0 + \beta_1 1\left[a_{it} > A_{ct}\right] + \beta_2 \left(a_{it} - A_{ct}\right) + \beta_3 1\left[a_{it} > A_{ct}\right] \times \left(a_{it} - A_{ct}\right) + \mathbf{x}'_{itc}\kappa + \epsilon_{itc} \qquad (2)$$

Y_{itc} is the outcome of interest (e.g., an indicator for initiating IVF treatment) for individual i at time t residing in region c. A_{ct} denotes the age cutoff that region c has at time t, above which there is no health insurance coverage for IVF. The variable $1[a_{it} > A_{ct}]$ is an indicator for the individual's

[30] In Figure A9, panel (a), we plot IVF initiation in the the sub-population of childless women who have initiated an LIT treatment in the two years prior to a given relative age. These women are characterized in column (6) of Table 1. As we saw in Figure 2, 60% of childless women who initiate any treatment in our sample start with an LIT. Consistent with the idea that we are zooming in onto women who are actively treating infertility, we observe nearly a twenty-fold higher rate of IVF initiations. In this sample as well, the rate of initiations drops at the cutoff.

age a_{it} in time t being above the region-year specific cutoff, and hence the individual being ineligible for the subsidy. The coefficient on this indicator, β_1, is the main coefficient of interest; it measures how much the probability of initiating IVF treatment changes when the woman becomes ineligible for insurance coverage. $(a_{it} - A_{ct})$ is an individual's age in months centered around the cutoff. We estimate how the initiation of IVF treatment varies by age and allow for this relationship to have different slopes on the opposite sides of the cutoff. We show results with and without a vector of controls x_{itc}, which include indicators for the region of residence, calendar years, an individual's place of birth, and education categories (high school only, some college, college degree or more).

The regression model is estimated on a panel of woman-year-month observations for women within two years on either side of the cutoff and childless. For each woman residing in region c in year t, we calculate relative age by comparing the month-year of birth to the age cutoff A_{ct} in region c in year t. A woman of child-bearing age is in our panel in a given year-month as long as she is childless. A woman exits the panel upon childbirth or IVF initiation—whichever (if any) occurs first. In addition to our primary specification, we also estimate a "donut" RDD that omits 5 months on each side of the cutoff. Although we do not observe anticipatory behavior in the graphical evidence, the donut RD verifies that anticipatory behavior to the left of the threshold is not driving our baseline estimates. Throughout, we cluster standard errors at the individual-level.

To interpret β_1 as the effect of insurance (or equivalently of the out of pocket price) on demand for IVF, we need two ingredients. First, we need to assume that, close to the threshold, women do not have precise control over whether they get access to IVF at the subsidized price. Note that our design explicitly allows women, both before and after the threshold, to choose to "opt out" of the waiting list and get IVF at a private clinic, paying the full price out of pocket—and this is the only option that remains for women who (as good as randomly) do not get access to IVF at the subsidized price to the right of the cutoff. While age, by definition, is both perfectly predictable and cannot be manipulated, as we have discussed above waiting lines for treatment and the unpredictability of treatment success introduce an element of uncertainty. Thus, women can try to influence—but cannot perfectly control—when they will be able to start an IVF procedure. The second assumption that we need is that no other major transitions that could affect IVF take-up happen at exactly the cutoff age. Here, we are helped by the fact that cutoff age varies across regions and over time. Appendix Figure A8 provides the results of formal density tests around the cutoff, revealing no evidence of treatment re-timing in our baseline sample.

Table 3 shows the results of estimating Equation (2) on observations 24 months around the cutoff. In the full sample of childless women, 23 per 10,000 women initiate IVF on average in the twelve months before their insurance coverage eligibility lapses. As women age out of insurance coverage, their rate of initiations drops by 12 per 10,000 or by 52%. The estimate is similar (50% drop) when we include controls in column (2). The "donut" estimate in column (3) gets a somewhat smaller absolute drop relative to a smaller pre-period base, for a total of a similar relative decline. The three last columns of the table show the estimated effect at different points in the income distribution (woman's disposable income measured at age 32), at the first, fifth, and tenth income decile, respectively (using the specification including controls). The price response as a share of the pre-cutoff mean is progressively smaller as we move up in the income distribution—a fact that we consider in more detail in the next sub-section.[31]

5.3 Willingness to Pay and the Role of Liquidity

All estimates in the previous sub-section imply that the decision to initiate an IVF treatment is very sensitive to the availability of insurance coverage, and in turn to the out of pocket price of IVF. As women cross the insurance eligibility threshold, and insurance coverage lapses, the cost of one IVF cycle goes up from about 20% of monthly disposable income to 190% of monthly disposable income at the median of the disposable income distribution (Figure A1). This is a 850% increase in price. At the same median income, the rate of IVF initiations drops by 67% (Column 5 in Table 3). The implied arc elasticity amounts to -0.6 at median income (the point elasticity is -0.08, but note that since demand cannot drop below 100%, the point elasticity estimate for this large change in price is not well defined and is bounded at -0.12). Under linear demand, for women with median disposable income, the rate of IVF initiations would go to zero if prices went up to 270% of monthly disposable incomes. In other words, the maximum willingness to pay for one IVF cycle for a median income woman in our sample is 2.7 monthly disposable incomes or 22% of annual disposable income.

While the maximum willingness to pay of nearly a quarter of one's annual disposable income is a large number, it may still appear puzzling that families are not willing to pay more to avoid the many years of non-pecuniary costs of infertility that we documented in Section 4.[32] There are two

[31] As we would expect, IVF initiation rates are substantially higher in the sample of women with a history of LIT treatment. 410 per 10,000 women initiate IVF in that sample in the twelve months before the age cutoff (Table A3). This rate goes down by 167 per 10,000 (or 137 per 10,000 in the donut RD estimate), or by 41% (33% in the donut). In other words, women with an observed history of infertility treatment are somewhat less responsive to the change in insurance coverage.

[32] This is particularly true if we consider the fact that often a woman's disposable income will only constitute a portion of couple's disposable resources.

potential drivers of revealed willingness to pay in this context. The first—textbook—explanation would consider the full response to insurance coverage to be moral hazard, reflecting changes in consumption in response to distortions in relative prices. Within that framework, our estimates would imply that families have a relatively low true willingness to pay for IVF and do not consume when faced with the full price. Given our estimates of large long-term costs for mental well-being and couple stability of remaining infertile, this textbook explanation appears implausible.

An alternative explanation is that (at least part) of the response reflects liquidity constraints. For lower-income households an unsubsidized cycle of IVF can cost as much as 6 months of disposable income (Figure A1). As we already saw in Table 3, higher-income households are less sensitive to the change in the price of IVF than lower-income households. We examine this observation closer. Figure 9 plots our baseline regression discontinuity estimates for each decile of the disposable income distribution. Fitting a linear regression to the pattern of these RD coefficients, we estimate that price sensitivity as measured by percent change in demand at the insurance eligibility cutoff drops by three percentage points for each income decile. Appendix Figure A11 provides another way of seeing this difference in response to insurance by income. This figure plots how much observable covariates of women who initiate IVF change at the cutoff. We observed in the earlier discussion that there was no selection into IVF initiation at full price on IVF success rates at the threshold. In panels (b)–(d) of Figure A11 we also do not see evidence of selection into continuing to initiate IVF without insurance on the degree of education, on being foreign born, or being married. In panel (a), however, we see that women who continue initiating IVF cycles after the subsidy is no longer available tend to have higher income.

Conceptually, the income gradient in Figure 9 can either reflect an income gradient in the ability to pay a high lump-sum price for IVF treatments (a liquidity effect), or an income gradient in the underlying preferences and willingness to pay for children. While differences in the willingness to pay or preferences for children by income are plausible, Appendix Figure A10 suggests that it is unlikely to be driving the income gradient in price sensitivity. Figure A10 plots (for the full population) the share of women who have biologic, non-ART children, by the end of their fertile years by income rank. The figure includes cohorts born in 1970 to 1975, so that we can observe their completed fertility by 2019. While women in the top decile of the income distribution are more likely to have a child than women at the bottom decile, this difference is small—of only two percentage point relative to the overall level of more than 80% of women having a child. As liquidity constraints are not relevant for conceiving a child,[33] we interpret this figure as suggesting that there is no clear evidence of differences in preference for a child across the income distribution. Instead, the high effective price of IVF, especially for the lowest income households, suggests that the more plausible mechanism for the income difference in the price response likely operates through liquidity constraints.

In the presence of liquidity constraints, families (at the median income) may be willing to pay 22% of annual disposable income for one cycle of IVF—or even 66% for a course of three treatments that are often needed to have a live birth[34]—but they may have no way of coming up with the lump-sum payment needed. This is even more true at income levels at the lowest income deciles, for whom three cycles of IVF would amount to 150% of *annual* disposable income. These couples may be unable to smooth large expenditures needed for IVF treatments over a longer time horizon.

While the consumption smoothing value of insurance has been noted in the context of unemployment insurance (Chetty, 2008), it has only been rarely considered in healthcare settings, especially for expensive treatments. Following the approach in (Chetty, 2008), we use the response of high income individuals in Figure 9 as a measure of behavioral response among liquidity unconstrained households. We estimate that at least 40% of reduction in fertility treatment utilization among the lowest-income households can be attributed to the liquidity effect rather than traditional moral hazard.

5.4 Distribution of Children

The sharp drop in IVF use and the associated births in the absence of insurance highlight how public policy can shape the number of children born, and not born, at the population level. To further inform this discussion, we next consider several policy counterfactuals. Using our regression discontinuity sample, we predict the number of children that would have been born under two different policy regimes; one in which the subsidy is universal and not tied to age, the other in which there is no subsidy.

Figure 10, panel (a) shows the number of women giving birth within two years of having initiated IVF by age relative to the subsidy cutoff (this is simply replicating the gray bars from panel (b) of Figure 8). To estimate the number of births that would have occurred in a counterfactual

[33] And in the Swedish context are also less relevant for raising a child.

[34] In Panel (d) of Figure 4 we observe that women usually do IVF for 2 quarters or about 6 months—this is consistent with about 3 cycles with a cycle every other month, which is also the number of cycles covered by public insurance when women are eligible and the number of cycles sold in private clinic IVF packages.

regime of a universal subsidy, we use data points to the left and a linear regression to form a prediction (dashed gray line). To estimate the number of births that would have occurred in a counterfactual regime of no subsidy, we perform a similar exercise using only data points to the right of the cutoff (solid line). The difference between predicted births and actual births on each side of the cutoff constitutes an estimate of "incremental" or "missing" births, respectively, under the assumption that the observed fertility responses are causal effects of the subsidy design. In panel (a), we estimate approximately 2,120 "missing" births under the current policy regime relative to a regime with no age-based cutoffs, and 4,013 "incremental" births as a result of the current subsidy relative to a regime with no subsidy. In total, 13,450 children would have been born if the subsidy were available to everyone, while 7,317 (or 47% fewer) children would have been born in the absence of subsidies.

In addition to affecting the birth rate in the overall population, panels (b) and (c) illustrate how the magnitudes of the effects differ across two points of the income distribution; childless women with above and below median income. The figures reveal that the mass of missing births is more pronounced in the below-median income population, relative to the above-median income population (1,285 vs 187 missing births). In relative terms, the drop in subsidy results in 70% of births becoming "missing" in the below-median income population, as compared to 21% "missing" births in the above-median income population. Hence, subsidy design in this context affects not only the level, but also the distribution of births across the income spectrum.

6 Conclusion

Nearly every sixth woman of childbearing age experiences infertility (WHO, 2023). Medical innovation in infertility treatments over the past several decades has been remarkable. While the share of children born from assisted conceptions keeps growing, public policies in the space of infertility treatments remain ridden with controversy. This paper aims to inform this debate by providing evidence on the private monetary and non-monetary costs of infertility and the role of treatment prices (and policies that could affect them) in driving household decisions to initiate infertility treatments.

Our analysis reveals large negative impacts on well-being of wanting to, but being unable to, have a child. This contradicts a common notion that having a child makes couples unhappy. Instead, we find that women who want but fail to have a child are 48% more likely to suffer from mental health issues in the long-run, are 6 percentage points more likely to get divorced, and experience no "protective" effect on their income from not having a child in the long-run. The partners of these women are more likely to experience a deterioration of mental health and some loss of income in the long-run.

We estimate that despite the large negative effects of infertility on well-being, families exhibit a strong response to the price of infertility treatments. Our results suggest that up to 40% of this response can be attributed to liquidity constraints rather than traditional moral hazard, implying an important role for insurance in providing not only risk protection, but also a consumption smoothing value. Our estimates suggest that if the availability of credit markets for financing IVF treatments is limited and insurance coverage is unavailable or constrained, the resulting number of IVF treatments may be inefficiently low overall (as couples with sufficient willingness to pay do not receive treatment), and the incidence of inefficiency may be regressive (as lower-income households are more likely to face liquidity constraints and no access to credit). Insurance coverage policy thus constitutes a powerful tool that can affect the overall number of children and their allocation across the income distribution.

References

Abramowitz, Joelle, "Turning Back the Ticking Clock: The Effect of Increased Affordability of Assisted Reproductive Technology on Women's Marriage Timing," *Journal of Population Economics*, 2014, *27* (2), 603–633.

—, "Assisted Reproductive Technology and Women's Timing of Marriage and Childbearing," *Journal of Family and Economic Issues*, 2017, *38* (1), 100–117.

Adashi, Eli Y., "Infertility: A Disease by Any Other Name," *JAMA Forum Archive*, 02 2018, *A7* (1).

Ahammer, Alexander, Ulrich Glogowsky, Martin Halla, and Timo Hener, "The Parenthood Penalty in Mental Health: Evidence from Austria and Denmark," *IZA Discussion Paper No. 16459*, 2023.

Albert, Victoria, "Major Alabama Health System Pauses IVF Treatments After State Court Says Frozen Embryos Qualify as Children," *The Wall Street Journal*, February 21, 2024.

Andresen, Martin Eckhoff and Emily Nix, "What Causes the Child Penalty? Evidence From Adopting and Same-Sex Couples," *Journal of Labor Economics*, 2022, *40* (4), 971–1004.

Angelov, Nikolay, Per Johansson, and Erica Lindahl, "Parenthood and the Gender Gap in Pay," *Journal of Labor Economics*, 2016, *34* (3), 545–579.

Banks, Nicole K, John M Norian, M Kate Bundorf, and Melinda B Henne, "Insurance Mandates, Embryo Transfer, Outcomes—The Link is Tenuous," *Fertility and Sterility*, 2010, *94* (7), 2776–2779.

Belchior, Carlos Alberto and Yara Gomes, "Liquidity Constraints, Cash Transfers and the Demand for Health Care in the Covid-19 Pandemic," *Health Economics*, 2022, *31* (11), 2369–2380.

Bitler, Marianne and Lucie Schmidt, "Health Disparities and Infertility: Impacts of State-Level Insurance Mandates," *Fertility and Sterility*, 2006, *85* (4), 858–865.

Bitler, Marianne P and Lucie Schmidt, "Utilization of Infertility Treatments: The Effects of Insurance Mandates," *Demography*, 2012, *49* (1), 125–149.

Boulet, Sheree L, Sara Crawford, Yujia Zhang, Saswati Sunderam, Bruce Cohen, Dana Bernson, Patricia McKane, Marie A Bailey, Denise J Jamieson, and Dmitry M Kissin, "Embryo Transfer Practices and Perinatal Outcomes by Insurance Mandate Status," *Fertility and Sterility*, 2015, *104* (2), 403–409. e1.

Bratti, Massimiliano and Laura Cavalli, "Delayed First Birth and New Mothers' Labor Market Outcomes: Evidence from Biological Fertility Shocks," *European Journal of Population*, 2014, *30*, 35–63.

Buckles, Kasey S, "Infertility Insurance Mandates and Multiple Births," *Health Economics*, 2013, *22* (7), 775–789.

Bundorf, M Kate, Melinda Henne, and Laurence Baker, "Mandated Health Insurance Benefits and the Utilization and Outcomes of Infertility Treatments," Report, National Bureau of Economic Research 2007.

Bütikofer, Aline, Deirdre Coy, Orla Doyle, and Rita Ginja, "The Consequences of Miscarriage on Parental Investments," *IZA DP No. 16858*, 2024.

Cetre, Sophie, Andrew E Clark, and Claudia Senik, "Happy People Have Children: Choice and Self-Selection into Parenthood," *European Journal of Population*, 2016, *32* (3), 445–473.

Chetty, Raj, "Moral Hazard versus Liquidity and Optimal Unemployment Insurance," *Journal of Political Economy*, 2008, *116* (2), 173–234.

Cintina, Inna and Bingxiao Wu, "How Do State Infertility Insurance Mandates Affect Divorce?," *Contemporary Economic Policy*, 2019, *37* (3), 560–570.

Conner, Peter, Liran Einav, Amy Finkelstein, and Petra Persson, "Targeting Precision Medicine: Evidence from Prenatal Testing," *NBER Working Paper No. 30669*, 2022.

Crawford, Sara, Sheree L Boulet, Denise J Jamieson, Carol Stone, Jewel Mullen, and Dmitry M Kissin, "Assisted Reproductive Technology Use, Embryo Transfer Practices, and Birth Outcomes After Infertility Insurance Mandates: New Jersey and Connecticut," *Fertility and Sterility*, 2016, *105* (2), 347–355.

Cristia, Julian P, "The Effect of a First Child on Female Labor Supply. Evidence from Women Seeking Fertility Services," *Journal of Human Resources*, 2008, *43* (3), 487–510.

Cutler, David, Angus Deaton, and Adriana Lleras-Muney, "The Determinants of Mortality," *Journal of Economic Perspectives*, 2006, *20* (3), 97–120.

Daysal, N Meltem, Hui Ding, Maya Rossin-Slater, and Hannes Schwandt, "Germs in the Family: The Short-and Long-Term Consequences of Intra-Household Disease Spread," *URL: http://www. meltemdaysal. com/docs/ChildSickness. pdf*, 2022.

Einav, Liran and Amy Finkelstein, "Moral Hazard in Health Insurance: What We Know and How We Know It," *Journal of the European Economic Association*, 05 2018, *16* (4), 957–982.

Ericson, Keith Marzilli and Justin R Sydnor, "Liquidity Constraints and the Value of Insurance," Report, National Bureau of Economic Research 2018.

Fadlon, Itzik and Torben Heien Nielsen, "Family Health Behaviors," *American Economic Review*, September 2019, *109* (9), 3162–91.

_ and _ , "Family Labor Supply Responses to Severe Health Shocks: Evidence from Danish Administrative Records," *American Economic Journal: Applied Economics*, July 2021, *13* (3), 1–30.

Gallen, Yana, Juanna Schrøter Joensen, Eva Rye Johansen, and Gregory F Veramendi, "The Labor Market Returns to Delaying Pregnancy," *Available at SSRN 4554407*, 2023.

Gershoni, Naomi and Corinne Low, "Older Yet Fairer: How Extended Reproductive Time Horizons Reshaped Marriage Patterns in Israel," *American Economic Journal: Applied Economics*, 2021, *13* (1), 198–234.

_ and _ , "The Power of Time: The Impact of Free IVF on Women's Human Capital Investments," *European Economic Review*, 2021, *133*, 103645.

Glass, Jennifer, Robin W Simon, and Matthew A Andersson, "Parenthood and Happiness: Effects of Work-Family Reconciliation Policies in 22 OECD Countries," *American Journal of Sociology*, 2016, *122* (3), 886–929.

Glied, Sherry and Adriana Lleras-Muney, "Technological Innovation and Inequality in Health," *Demography*, 2008, *45*, 741–761.

Griffin, Martha and William F Panak, "The Economic Cost of Infertility-Related Services: An Examination of the Massachusetts infertility Insurance Mandate," *Fertility and Sterility*, 1998, *70* (1), 22–29.

Gross, Tal, Timothy Layton, and Daniel Prinz, "The Liquidity Sensitivity of Healthcare Consumption: Evidence from Social Security Payments," *American Economic Review: Insights*, 06 2022, *4*, 175–190.

Hamilton, Barton H and Brian McManus, "The Effects of Insurance Mandates on Choices and Outcomes in Infertility Treatment Markets," *Health Economics*, 2012, *21* (8), 994–1016.

_ , Emily Jungheim, Brian McManus, and Juan Pantano, "Health Care Access, Costs, and Treatment Dynamics: Evidence from In Vitro Fertilization," *American Economic Review*, 2018, *108* (12), 3725–77.

Heazell, Alexander EP, Dimitrios Siassakos, Hannah Blencowe, Christy Burden, Zulfiqar A Bhutta, Joanne Cacciatore, Nghia Dang, Jai Das, Vicki Flenady, and Katherine J Gold, "Stillbirths: Economic and Psychosocial Consequences," *The Lancet*, 2016, *387* (10018), 604–616.

Henne, Melinda B and M Kate Bundorf, "Insurance Mandates and Trends in Infertility Treatments," *Fertility and Sterility*, 2008, *89* (1), 66–73.

Hotz, V Joseph, Charles H Mullin, and Seth G Sanders, "Bounding Causal Effects Using Data from a Contaminated Natural Experiment: Analysing the Effects of Teenage Childbearing," *The Review of Economic Studies*, 1997, *64* (4), 575–603.

_ , Susan Williams McElroy, and Seth G Sanders, "Teenage Childbearing and its Life Cycle Consequences: Exploiting a Natural Experiment," *Journal of Human Resources*, 2005, *40* (3), 683–715.

Jain, Tarun, Bernard L Harlow, and Mark D Hornstein, "Insurance Coverage and Outcomes of In Vitro Fertilization," *New England Journal of Medicine*, 2002, *347* (9), 661–666.

Jaravel, Xavier, "The Unequal Gains from Product Innovations: Evidence From the US retail sector," *The Quarterly Journal of Economics*, 2019, *134* (2), 715–783.

Jayachandran, Seema, Adriana Lleras-Muney, and Kimberly V Smith, "Modern Medicine and the Twentieth Century Decline in Mortality: Evidence on the Impact of Sulfa Drugs," *American Economic Journal: Applied Economics*, 2010, *2* (2), 118–146.

Johansson, Marianne, Annsofie Adolfsson, Marie Berg, Jynfiaf Francis, Lars Hogström, Per Olof Janson, Jan Sogn, and Anna-Lena Hellström, "Quality of Life for Couples 4–5.5 Years After Unsuccessful IVF Treatment," *Acta Obstetricia Et Gynecologica Scandinavica*, 2009, *88* (3), 291–300.

Junhong, Chu, "Prenatal Sex Determination and Sex-Selective Abortion in Rural Central China," *Population and Development Review*, 2001, *27* (2), 259–281.

Kalsi, Priti and Maggie Y Liu, "Pregnancy Loss and Female Labor Market Outcomes," *Available at SSRN 3829769*, 2022.

Kessler, Lawrence M, Benjamin M Craig, Shayne M Plosker, Damon R Reed, and Gwendolyn P Quinn, "Infertility Evaluation and Treatment Among Women in the United States," *Fertility and Sterility*, 2013, *100* (4), 1025–1032. e2.

Kjaer, Trille, Vanna Albieri, Allan Jensen, Susanne K Kjaer, Christoffer Johansen, and Susanne O Dalton, "Divorce or End of Cohabitation Among Danish Women Evaluated for Fertility Problems," *Acta Obstetricia Et Gynecologica Scandinavica*, 2014, *93* (3), 269–276.

Kleven, Henrik, Camille Landais, and Jakob Egholt Søgaard, "Children and Gender Inequality: Evidence from Denmark," *American Economic Journal: Applied Economics*, October 2019, *11* (4), 181–209.

Kroeger, Sarah and Giulia La Mattina, "Assisted Reproductive Technology and Women's Choice to Pursue Professional Careers," *Journal of Population Economics*, 2017, *30* (3), 723–769.

Larsen, Elisabeth Clare, Ole Bjarne Christiansen, Astrid Marie Kolte, and Nick Macklon, "New Insights Into Mechanisms Behind Miscarriage," *BMC Medicine*, 2013, *11*, 1–10.

Lleras-Muney, Adriana and Frank R Lichtenberg, "Are the More Educated More Likely to Use New Drugs?," *Annales d'Économie et de Statistique*, 2005, pp. 671–696.

Lundborg, Petter, Erik Plug, and Astrid Würtz Rasmussen, "Can Women Have Children and a Career? IV Evidence from IVF Treatments," *American Economic Review*, 2017, *107* (6), 1611–37.

_ , _ , **and Astrid Wurtz Rasmussen**, "Is There Really a Child Penalty in the Long Run? New Evidence from IVF Treatments," April 2024. IZA working paper.

Lyngse, Frederik Plesner, "Liquidity Constraints and Demand for Healthcare: Evidence from Danish Welfare Recipients," *arXiv preprint arXiv:2010.14651*, 2020.

Machado, Matilde P and Anna Sanz de Galdeano, "Coverage of Infertility Treatment and Fertility Outcomes," *SERIEs*, 2015, *6* (4), 407–439.

Margolis, Rachel and Mikko Myrskylä, "Parental Well-Being Surrounding First Birth as a Determinant of Further Parity Progression," *Demography*, 2015, *52* (4), 1147–1166.

Martins, Mariana V, Patrício Costa, Brennan D Peterson, Maria E Costa, and Lone Schmidt, "Marital Stability and Repartnering: Infertility-Related Stress Trajectories of Unsuccessful Fertility Treatment," *Fertility and Sterility*, 2014, *102* (6), 1716–1722.

Melo, Pedro, Rima Dhillon-Smith, Md Asiful Islam, Adam Devall, and Arri Coomarasamy, "Genetic Causes of Sporadic and Recurrent Miscarriage," *Fertility and Sterility*, 2023.

Moshfegh, Jasmin, "Who Gains When Medicine Becomes More Precise? Evidence from Genomic Testing In Breast Cancer," 2024. Stanford University mimeo.

Mughal, Saba, Yusra Azhar, and Waquar Siddiqui, "Postpartum Depression," 2018. In: StatPearls. StatPearls Publishing, Treasure Island (FL); 2023. PMID: 30085612.

Nordlund, Christer, *Hormoner för Livet: Endokrinologin, Läkemedelsindustrin och Drömmen om ett Botemedel Mot Sterilitet 1930–1970*, Arkiv förlag, 2008.

Nyman, J.A., *The Theory of Demand for Health Insurance* Stanford Business Bks, Stanford University Press, 2003.

Oster, E. and N. Fox, *The Unexpected: Navigating Pregnancy During and After Complications* The ParentData Series, Penguin Publishing Group, 2024.

Persson, Petra and Maya Rossin-Slater, "Family Ruptures, Stress, and the Mental Health of the Next Generation," *American Economic Review*, April 2018, *108* (4-5), 1214–52.

_ **and** _ , "When Dad Can Stay Home: Fathers' Workplace Flexibility and Maternal Health," *American Economic Journal: Applied Economics*, forthcoming.

Peterson, Brennan D, Matthew Pirritano, Jessica M Block, and Lone Schmidt, "Marital Benefit and Coping Strategies in Men and Women Undergoing Unsuccessful Fertility Treatments Over a 5-Year Period," *Fertility and Sterility*, 2011, *95* (5), 1759–1763. e1.

Provost, Meredith P, Samantha M Thomas, Jason S Yeh, William W Hurd, and Jennifer L Eaton, "State Insurance Mandates and Multiple Birth Rates After In Vitro Fertilization," *Obstetrics & Gynecology*, 2016, *128* (6), 1205–1214.

Rellstab, Sara, Pieter Bakx, and Pilar Garcia-Gomez, "The Effect of a Miscarriage on Mental Health, Labour Market, and Family Outcomes," 2022. Tinbergen Institute Discussion Paper 2022-027/V, Available at SSRN: https://ssrn.com/abstract=4075881 or http://dx.doi.org/10.2139/ssrn.4075881.

Rizzo, Kathryn M, Holly H Schiffrin, and Miriam Liss, "Insight Into the Parenthood Paradox: Mental Health Outcomes of Intensive Mothering," *Journal of Child and Family Studies*, 2013, *22* (5), 614–620.

Rädestad, Ingela, Berit Sjögren, Conny Nordin, and Gunnar Steineck, "Stillbirth and Maternal Well-Being," *Acta Obstetricia Et Gynecologica Scandinavica*, 1997, *76* (9), 849–855.

Schmidt, Lucie, "Infertility Insurance Mandates and Fertility," *American Economic Review*, 2005, *95* (2), 204–208.

Socialstyrelsen, "Hälsodataregister - Räddar Liv och Ger Bättre Vård," 2019. Accessed August 2021. https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/dokument-webb/ovrigt/halsodataregister-information-om-nyttan-med-register.pdf.

Statistics Sweden, "Longitudinal Integrated Database for Health Insurance and Labour Market Studies (LISA)," 2019. Accessed May 2019. https://www.scb.se/en/services/ordering-data-and-statistics/ordering-microdata/vilka-mikrodata-finns/longitudinella-register/longitudinal-integrated-database-for-health-insurance-and-labour-market-studies-lisa/.

Supreme Court of Alabama, "October Term, 2023-2024, Case SC-2022-0515," 2023. Accessed May 2019. https://publicportal-api.alappeals.gov/courts/68f021c4-6a44-4735-9a76-5360b2e8af13/cms/case/343D203A-B13D-463A-8176-C46E3AE4F695/docketentrydocuments/E3D95592-3CBE-4384-AFA6-063D4595AA1D.

van den Berg, Gerard J, Petter Lundborg, and Johan Vikström, "The Economics of Grief," *The Economic Journal*, 2017, *127* (604), 1794–1832.

Verhaak, Chris M, Jesper MJ Smeenk, Andrea WM Evers, Jan AM Kremer, Floris W Kraaimaat, and Didi DM Braat, "Women's Emotional Adjustment to IVF: A Systematic Review of 25 Years of Research," *Human Reproduction Update*, 2007, *13* (1), 27–36.

Vikström, Josefin, Ann Josefsson, Mats Hammar, Marie Bladh, and Gunilla Sydsjö, "Risk of Postpartum Psychosis After IVF Treatment: A Nationwide Case-Control Study," *Human Reproduction*, 2017, *32* (1), 139–146.

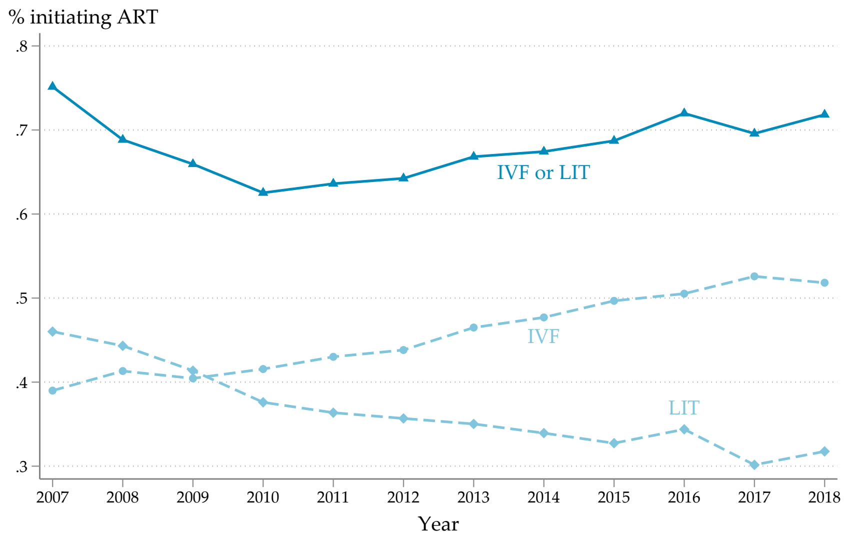
WHO, *Infertility Prevalence Estimates, 1990–2021*, Geneva: World Health Organization, 2023.

Zegers-Hochschild, Fernando, G David Adamson, Jacques De Mouzon, Osamu Ishihara, Ragaa Mansour, Karl Nygren, Elisabeth Sullivan, and Sheryl Van der Poel, "The International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) Revised Glossary on ART Terminology, 2009," *Human reproduction*, 2009, *24* (11), 2683–2687.

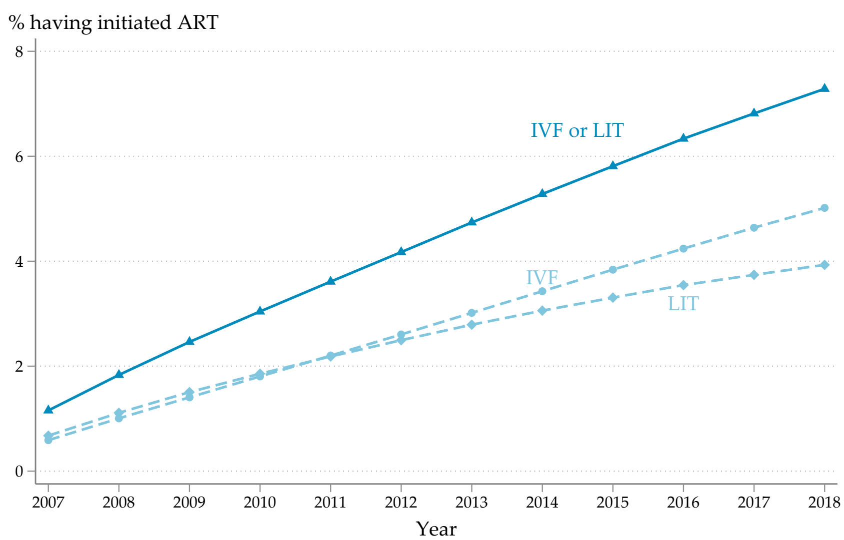
Figures and Tables

Figure 1: **Prevalence of Infertility as Measured by ART Use**

(a) Rate of ART initiations

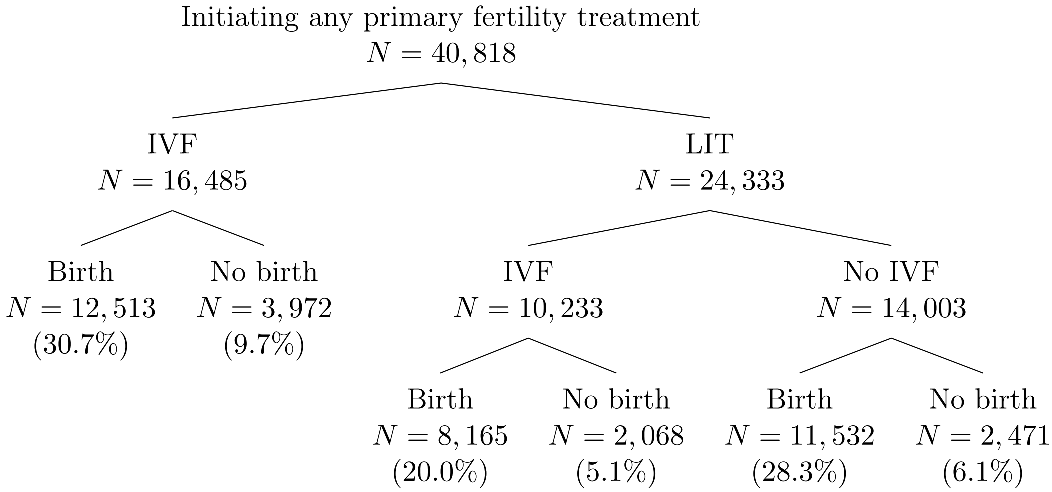


(b) Stock of ART initiations



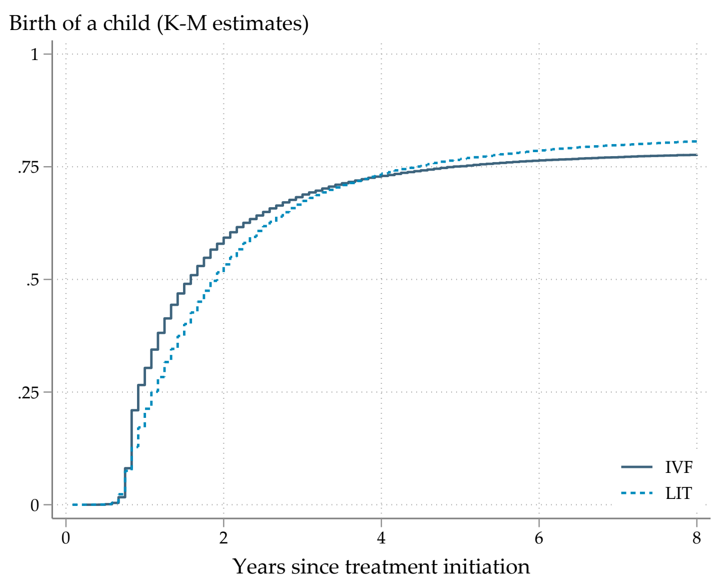
Notes: Panel (a) of the figure shows the share (in %) of women in Sweden age 16–45 with no children by a given calendar year (y-axis) who initiate an ART treatment in that calendar year. Initiation of an ART treatment is defined using prescription drug records as described in Section 2 and Appendix A. We exclude women from the sample once they have initiated treatment. The dashed lines show initiations of the low-intensity treatments (LIT, which include either medication for ovulatory regulation and/or in-utero insemination) or IVF, separately. The solid line shows the share initiating either LIT or IVF. For women who initiate both in different years, we keep the first initiation. Panel (b) plots the stock version of Panel (a), showing what share of women has initiated treatment in or before a given calendar year. We fix the sample to only include women who were age 16 to 45 with no children as of June 2006.

Figure 2: **Infertility Treatment Pathways**



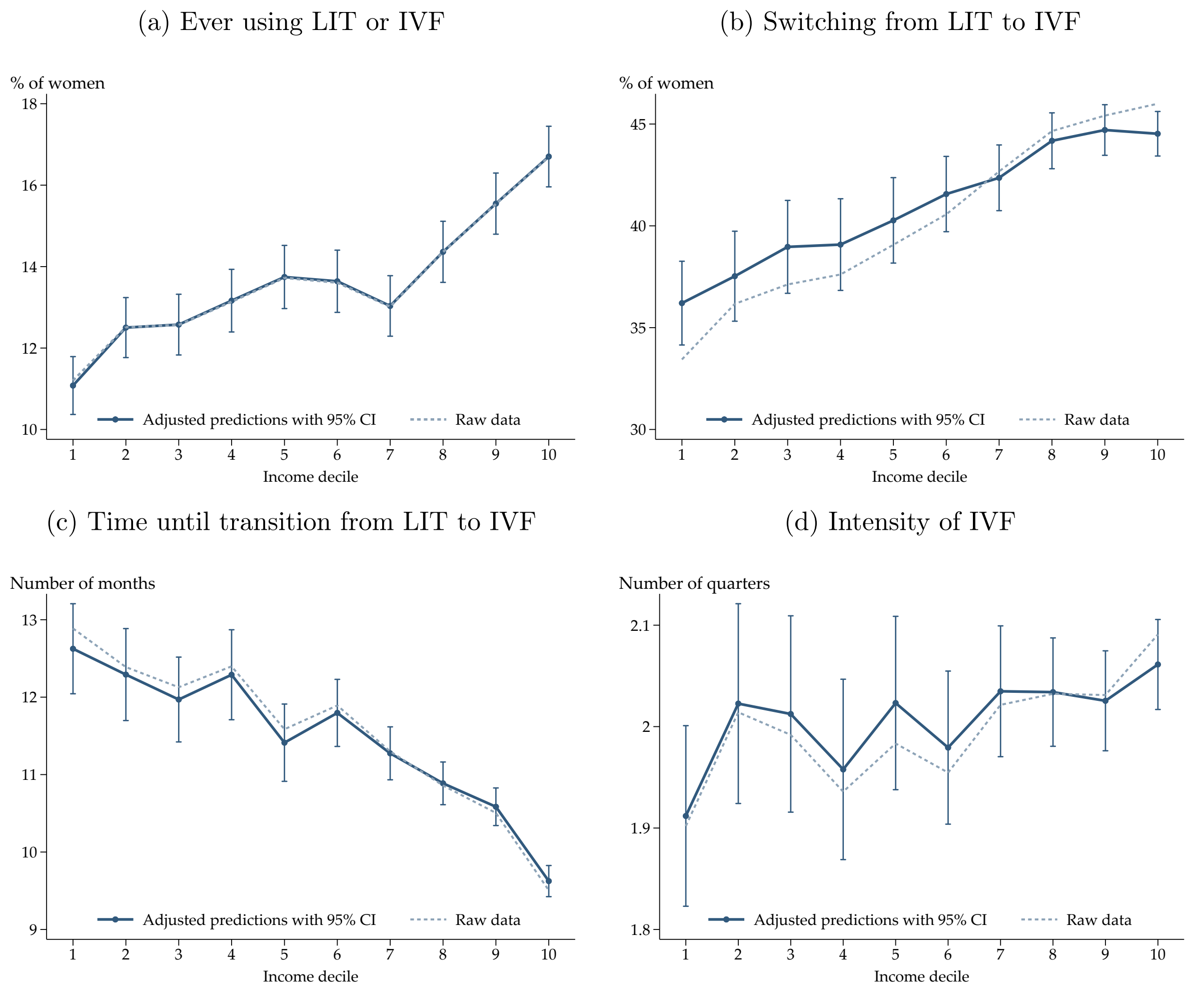
Notes: The figure tracks the progression of infertility treatments over an eight-year time horizon after the year of treatment initiation, for the universe of childless women in Sweden age 16–45 who initiate low-intensity treatment (LIT) or IVF between July 2006 and December 2012. The characteristics of this sample of women are reported in Column (3) of Table 1. Fertility outcome is evaluated at eight years after the initiation of infertility treatment without requiring a birth outcome to directly follow a treatment cycle. The total birth rate within eight years after treatment initiation is 78.9%. IVF initiation after LIT is evaluated at 6 years and 11 months after LIT initiation, allowing for one year follow-up after the IVF treatment.

Figure 3: **Long-Run Success Rate of ART**



Notes: The figure tracks the progression of fertility outcomes over an eight-year time horizon after the year of an ART initiation, for the universe of childless women in Sweden age 16–45 who initiate low-intensity treatment (LIT) or IVF between July 2006 and December 2012. The characteristics of this sample of women are reported in Column (3) of Table 1. The figure plots the hazard rate (estimated as the Kaplan-Meier function without covariates) for women to have given birth to a child as a function of time since the initiation of an LIT (dashed line) or IVF (solid line) treatment.

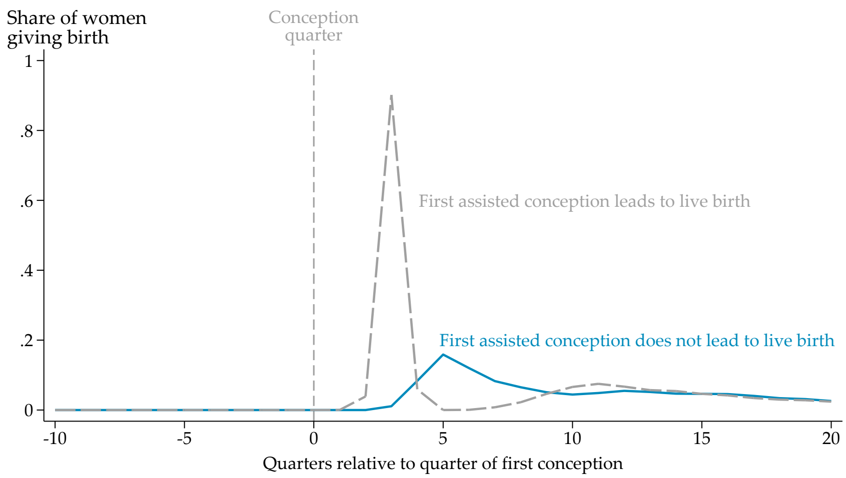
Figure 4: **Income Gradient in ART Use**



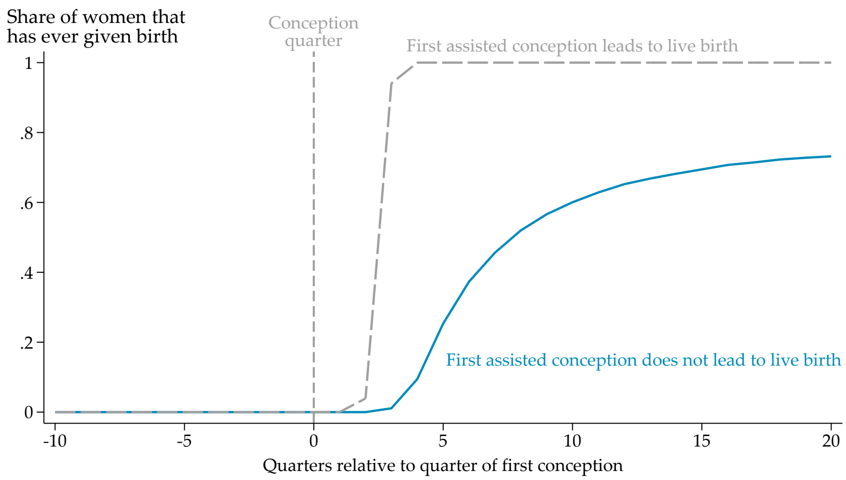
Notes: Panel (a) of the figure shows our proxy for the lifetime prevalence of infertility—we plot the share of women who ever initiate LIT or IVF between July 2006 and December 2019. The sample includes all women born from 1970 through 1975 (women whom we observe in our drug records over a large share of their fertile ages) who are childless in June 2006. Income deciles (x-axis) are based on parental income at women's age 20/21 as described in Appendix A. Panels (b) to (d) illustrate how the intensity of ART varies across the income distribution in our main analytic sample of all 16–45 year old childless women (Column (1) of Table 1), who initiate LIT. Panel (b) plots the share of these women who transition to IVF within 3 years of LIT initiation. Panel (c) plots the number of months it takes women to transition from LIT to IVF, conditional on transitioning. Panel (d) then shows the number of quarters that women who transition to IVF persist with IVF treatments. In all panels (b) to (d), the income deciles on the x-axis are based on women's total (AGI-like) income over two years prior to treatment initiation as described in Appendix A. Dashed lines in all panels show the raw data. Solid lines in panel (a) show adjusted predictions after controlling for place and year of birth fixed effects. Solid lines in panels (b)–(d) show adjusted predictions after controlling for place of birth, age at initiation, and common infertility-related diagnoses. Predicted values plotted with 95% CIs are adjusted means of the outcome for each income decile at the mean of all other covariates.

Figure 5: **First Assisted Conception and Subsequent Fertility**

(a) Rate of live births



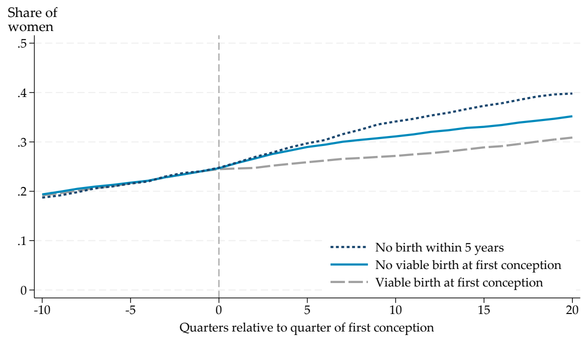
(b) Stock of live births



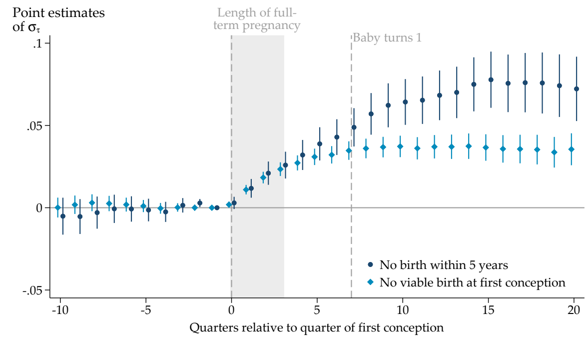
Notes: The figure shows the relationship between the success of the first assisted conception and subsequent fertility, measured as either the share of women giving birth in a given quarter relative to the first conception (y-axis in panel a), or as a share of women who have had a live birth by a given quarter (y-axis in panel b). The sample includes childless women who initiate either an LIT or an IVF treatment between July 2006 and February 2016. The characteristics of this sample of women are reported in Column (4) of Table 1. The sample is then split up by the success (dashed gray line) or failure (solid blue line) of the first assisted conception. The x-axis indexes time in quarters relative to the date of the first assisted conception, which is defined as the first conception after treatment initiation.

Figure 6: **First Assisted Conception and Subsequent Outcomes (Women)**

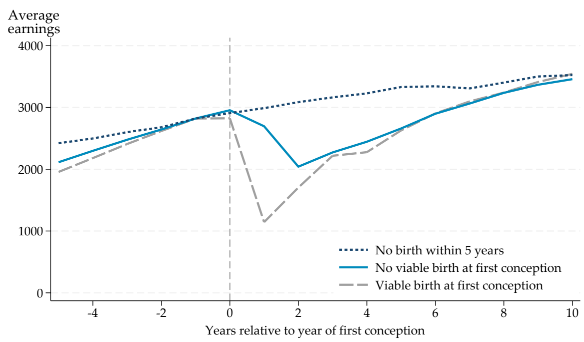
(a) Mental health R_x, raw data



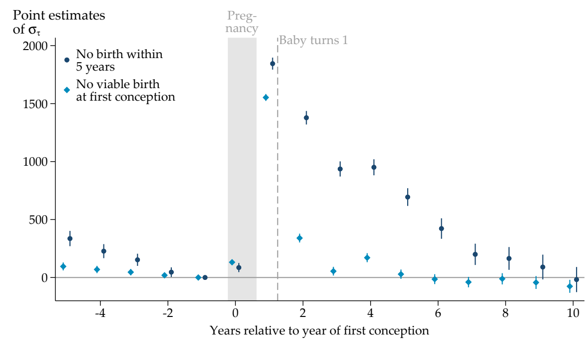
(b) Mental health R_x, event study



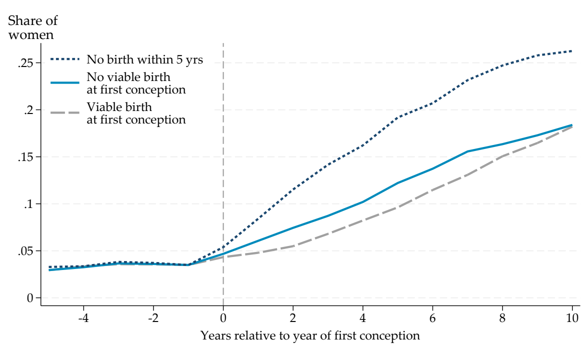
(c) Work income, raw data



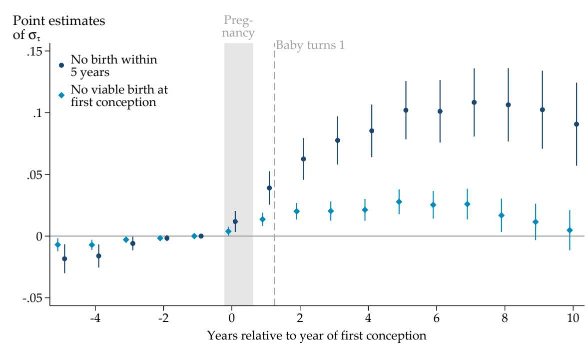
(d) Work income, event study



(e) Divorce, raw data



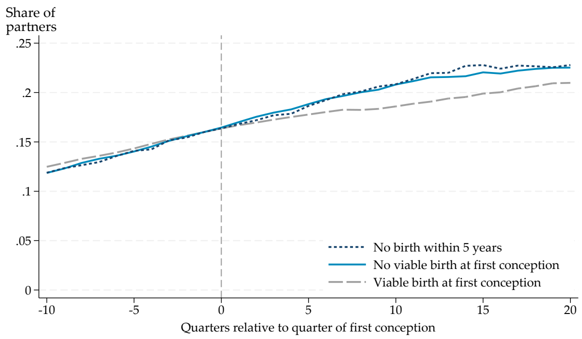
(f) Divorce, event study



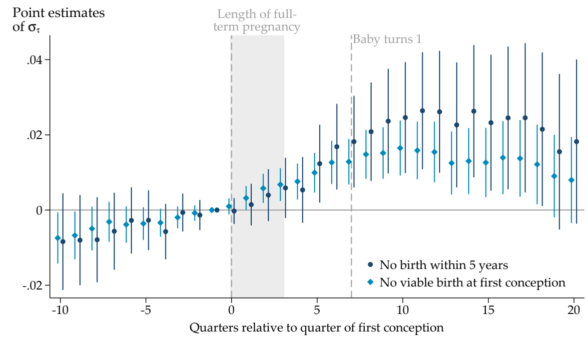
Notes: The figure shows raw data (panels on the left, normalized to the mean in time −1) and event study estimates as specified in Equation (1) (panels on the right) for the effect of having an unsuccessful first conception (which predicts persistent infertility, see Figure 5) on outcomes of women. The sample includes childless women who initiate LIT or IVF treatments between July 2006 and February 2016 and conceive within 3 years of treatment initiation. The characteristics of this sample of women are reported in Column (4) of Table 1. The x-axis indexes time relative to the first conception in either quarters (panels a–b) or years (panels c–f), which is defined as the first conception after treatment initiation. The outcome in panels (a) and (b) is a stock measure for having a history of drug claims with ATC codes N05 (psycholeptics, commonly used to treat anxiety) or N06 (analeptics, commonly used to treat depression). In panels (c) and (d) the outcome is annual individual work income in 100 SEK. In panels (e) and (f) the outcome is the history of a divorce. Event study panels show the results of two separate event studies. The control group in both are those women whose first assisted conception resulted in a live birth (long dashed gray line in the raw data). We provide estimates for two treatment groups: (i) for all women whose first conception was not successful (solid line in the raw data; light blue estimates) and (ii) for a subset of (i) where no birth happens within 5 years of that conception, i.e., those couples who remain infertile in the longer-run (short-dashed line in the raw data; dark blue estimates). Vertical lines in the event studies denote 95% confidence intervals. Standard errors are clustered at the individual level.

Figure 7: **First Assisted Conception and Subsequent Outcomes (Partners)**

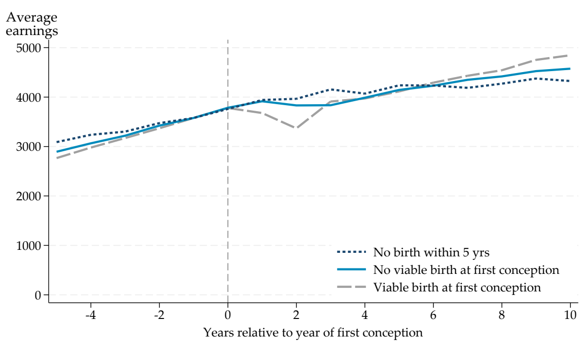
(a) Mental health R_x, raw data



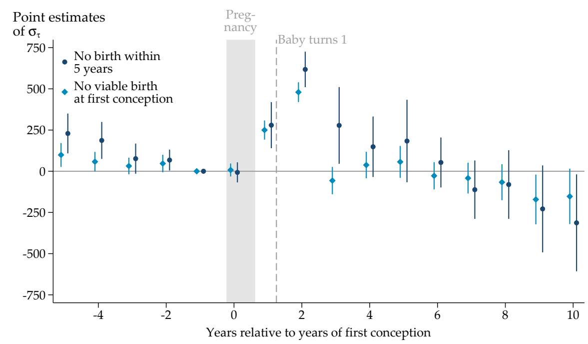
(b) Mental health R_x, event study



(c) Work income, raw data



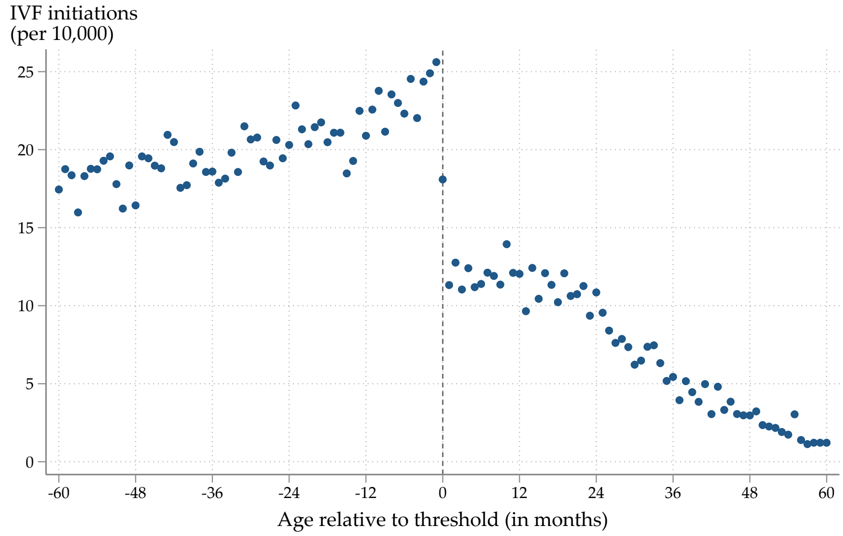
(d) Work income, event study



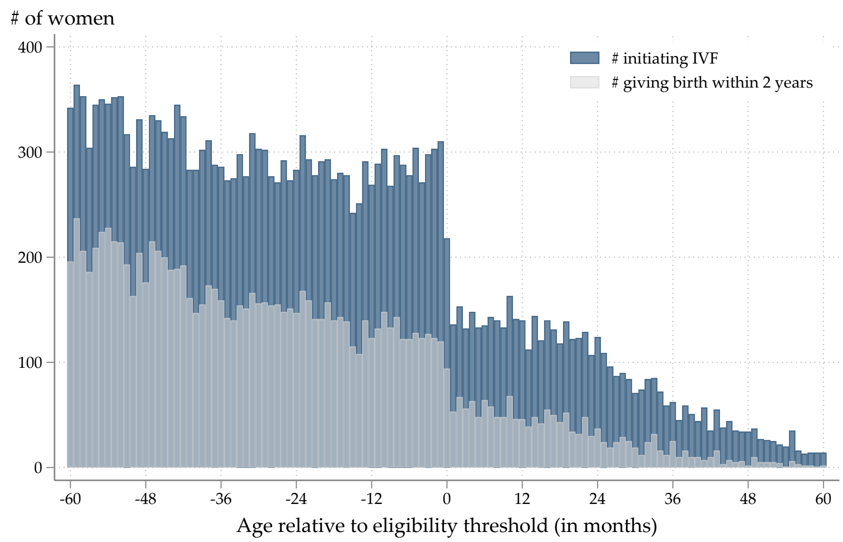
Notes: The figure shows raw data (panels on the left, normalized to the mean in time −1) and event study estimates as specified in Equation (1) (panels on the right) for the effect of having an unsuccessful first conception (which predicts persistent infertility, see Figure 5) on outcomes of partners. The sample includes married or co-habitating partners of childless women who initiate LIT or IVF treatments between July 2006 and February 2016 and conceive within 3 years of treatment initiation. The x-axis indexes time relative to the first conception in either quarters (panels a–b) or years (panels c–d), which is defined as the first conception after treatment initiation. The outcome in panels (a) and (b) is a stock measure for having a history of drug claims with ATC codes N05 (psycholeptics, commonly used to treat anxiety) or N06 (analeptics, commonly used to treat depression). In panels (c) and (d) the outcome is annual individual work income in 100 SEK. Event study panels show the results of two separate event studies. The control group in both are those male partners whose female partners' first assisted conception resulted in a live birth (long dashed gray line in the raw data). We provide estimates for two treatment groups: (i) for all partners of women whose first conception was not successful (solid line in the raw data; light blue estimates) and (ii) for a subset of (i) where no birth happens within 5 years of that conception, i.e., those couples who remain infertile in the longer-run (short-dashed line in the raw data; dark blue estimates). Vertical lines in event studies denote 95% confidence intervals. Standard errors are clustered at the individual level.

Figure 8: **Impact of IVF Insurance Coverage**

(a) IVF initiations

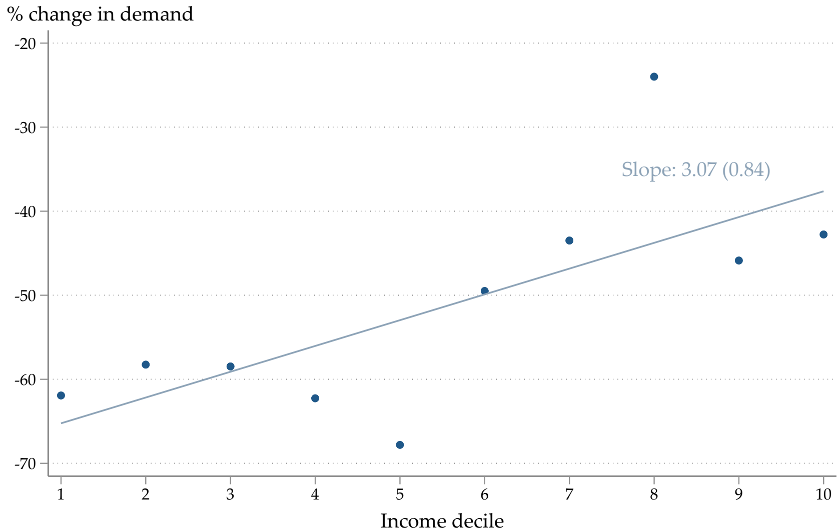


(b) IVF births



Notes: This figure illustrates the relationship between public health insurance coverage of IVF and the probability of IVF initiation (panel a) as well as the number of births (panel b). The x-axis in both panels indexes a woman's age in months relative to the insurance eligibility cutoff age, which is specific to the woman's region of residence and year. Panel (a) shows the number of women initiating IVF per 10,000 women in the sample of all childless women who are within five years of the insurance age eligibility cutoff, and who haven't initiated an IVF treatment yet by a given month. The characteristics of this sample of women are reported in Column (5) of Table 1; these women are the age-based subset of all age 16–45 childless women. In panel (b), the dark blue bars show the count of women who initiate IVF at every relative month—this is simply the numerator of the y-axis share in panel (a). The gray bars show the number of the same women who give birth within two years of the relative month on the x-axis. Individuals' dates of birth are at the year-month level, thus in relative month 0 they can be either eligible or not, depending on their exact day of birth.

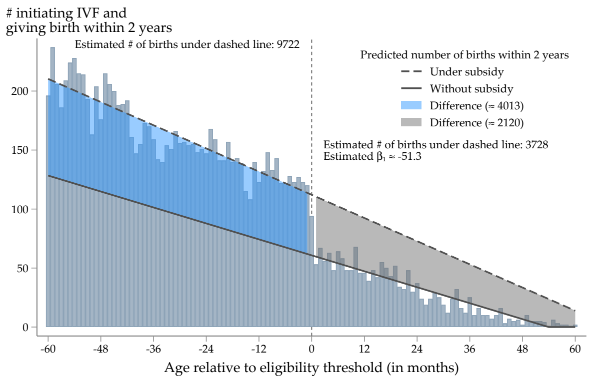
Figure 9: **Heterogeneity in the Impact of IVF Insurance Coverage**



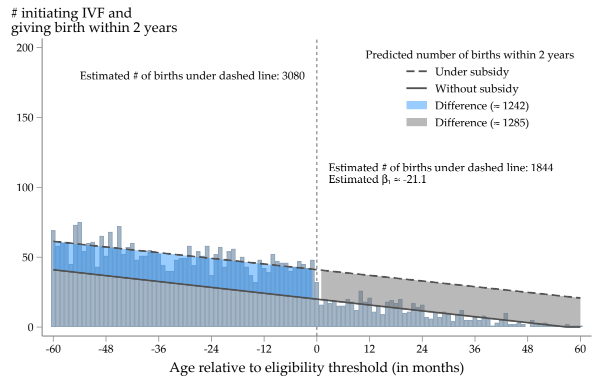
Notes: The figure shows our regression discontinuity estimates as reported in panel (a) of Figure 8 and in Table 3 estimated separately for each income decile. The x-axis uses deciles of women's own disposable income measured at age 32 (see Section 2 and Appendix A for detailed definitions of income). For each income decile, we estimate (2) and calculate the change in demand in % as $100 * \hat{\beta}_1$ divided by the sample mean in the 12 months before the cutoff. Solid line is a linear regression that captures the relationship between the estimated price response and income decile; the slope and the standard error (in parentheses) are reported close to the regression line. The intercept of the regression line is -68.3.

Figure 10: **IVF Insurance Coverage and (Missing) Births**

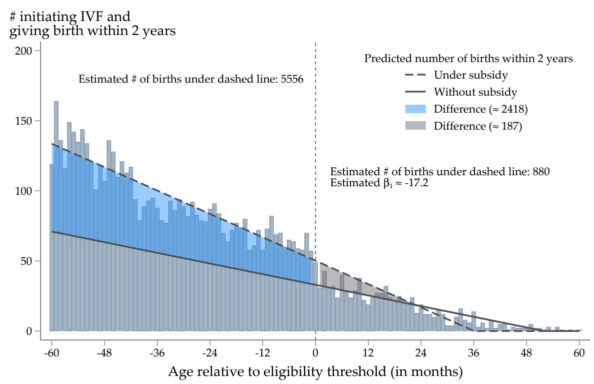
(a) All childless women



(b) Childless women with below-median income



(c) Childless women with above-median income



Notes: Panel (a) of the figure replicates a part of panel (b) in Figure 8. It plots the number of women giving birth within two years of IVF initiation in the sample of all childless women who are within five years of the insurance age eligibility cutoff and who haven't yet initiated an IVF treatment. The characteristics of this sample of women are reported in Column (5) of Table 1; these women are the age-based subset of all age 16–45 childless women. Panel (b) and (c) plot the same figure, but splitting the sample into women with below (panel b) and above (panel c) median disposable income at age 32. The x-axis in each panel indexes a woman's age a in months relative to the insurance eligibility cutoff age A. The bars show the actual number of women who initiate IVF at a relative age,$a - A$, and give birth within two years of that initiation. The dashed lines are predicted numbers of births from a regression of the numbers of births on the left side of the cutoff ($a < A$) on the relative age, $a - A$. The solid lines are predicted numbers of births from a regression of the numbers of births on the right side of the cutoff ($a > A$) on $a - A$. The shaded blue and gray areas show the difference between the two lines for $a < A$ and $a > A$, respectively. "Estimated β_1" refers to the coefficient on an indicator variable for $a > A$ from an RD-style regression (similar to (2)) where the number of births is the outcome.

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	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)	1382.4	2699.5	2515.8	2679.0	1882.6	2292.7
	(1499.7)	(1770.0)	(1681.3)	(1694.2)	(1475.0)	(1470.8)
Disposable income (in 100 SEK)	1417.4	2432.8	2218.3	2356.8	1722.0	1942.3
	(1597.5)	(2260.8)	(1558.3)	(1519.3)	(1344.8)	(1028.5)
Total (AGI-like) income (in 100 SEK)	1638.4	2884.7	2641.8	2799.0	2094.3	2500.6
	(2037.8)	(2536.7)	(1998.3)	(1896.6)	(1922.0)	(1481.7)
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

Notes: The table shows summary statistics for our analytic samples. The "at-risk" sample in column (1) includes all women in our data (see Section 2 for the description of data sources and Appendix A for the definition of key variables) who are age 16–45 and childless in years 2006–2019. The initiator sample in column (2) includes all women who are in the at-risk sample (column (1)) and also initiate ART (IVF or LIT) treatment between July 2006 and November 2019. The sample in column (3) is a subset of column (2) restricted to individuals initiating ART treatment by December 2012. The sample in column (4) includes individuals who initiate LIT or IVF treatment between July 2006 and February 2016 and conceive within 3 years of treatment initiation. The regression discontinuity (RD) sample in column (5) is identical to the at-risk sample in (1) but restricted to observations within 2 years of the ART insurance eligibility age cutoff. The RD sample in (6) is a version of (5) that selects women who have done LIT in the two years prior to the observation. Characteristics in columns (2), (3), and (4) are measured in the year before initiation, and in columns (5) and (6) at age 32. Income is measured in 2012 Swedish Krona.

Table 2: **Event Study Estimates**

	First stage	Women's outcomes				Partner outcomes		
Time period	(1) Having had a birth	(2) Having had a mental health Rx	(3) Antibiotics Rx	(4) Work income (in 100 SEK)	(5) Having divorced	(6) Having had a mental health Rx	(7) Antibiotics Rx	(8) Work income (in 100 SEK)
Q1–Q4	−0.24***	0.01***	−0.00	131.7***	0.00**	0.00***	0.00	7.8
(≈ Pregnancy)	(0.00)	(0.00)	(0.00)	(9.8)	(0.00)	(0.00)	(0.00)	(20.1)
Q5–Q8	−0.70***	0.03***	0.03***	1553.5***	0.01***	0.01***	−0.00	250.4***
(≈ First year of life)	(0.00)	(0.00)	(0.00)	(15.1)	(0.00)	(0.00)	(0.00)	(29.7)
Q9 and later	−0.33***	0.04***	−0.01***	69.1***	0.02***	0.01***	−0.01***	47.8
	(0.00)	(0.00)	(0.00)	(16.1)	(0.00)	(0.00)	(0.00)	(35.3)
Mean of dep. var. at $\tau = -1$ [a]	0.00	0.25	0.09	2772.0	0.04	0.17	0.05	3498.4
No. of observations[b]	1,301,451	1,183,258	1,183,258	612,995	251,944	697,294	697,294	361,602
No. of individuals	43,165	43,165	43,165	43,165	18,001	26,365	26,365	26,357

[a] Among women whose first conception does not result in a viable birth (treatment group).

[b] Observations are at the quarterly level for drug-based outcome and annual level for work income and divorce. For the "having divorced" outcome, we restrict the sample to women who are married in the year before conception ($\tau = -1$).

Notes: This table reports coefficients from estimating a version of the event study specified in Equation (1) with relative time (year or quarter) indicators replaced by indicators for three time periods: Q1–Q4 which capture the pregnancy quarters, Q5–Q8 which capture the first year of life if the conception was successful, and Q9 (two years) and beyond. The sample includes childless women who initiate LIT or IVF treatments between July 2006 and February 2016 (in columns 1–5) and their partners (in columns 6–8). Column (1) shows the first stage effect of an unsuccessful first assisted conception on subsequent fertility. The outcome in columns (2) and (6) is a stock measure for having a history of drug claims with ATC codes N05 (psycholeptics, commonly used to treat anxiety) or N06 (analeptics, commonly used to treat depression). The outcome in columns (3) and (7) is the rate of antibiotics claims. The outcome in columns (4) and (8) is annual individual work income in 100 SEK. Column (5) captures the effect on the history of a divorce. The control group includes women whose first assisted conception resulted in a live birth. The treatment group are all women whose first conception was not successful. Standard errors (in parentheses) are clustered at the individual level.

Table 3: **Regression Discontinuity Estimates**

	Full sample			By income decile 1st	5th	10th
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}_1$	-11.9^{***}	-12.3^{***}	-10.1^{***}	-11.6^{***}	-15.0^{***}	-17.9^{***}
	(0.7)	(0.7)	(1.1)	(1.9)	(2.4)	(3.8)
Mean dep. var						
overall	17.0	17.5	16.7	12.8	15.4	34.1
in $\tau = -12$ to $\tau = -1$	23.2	23.9	23.2	18.7	22.1	41.8
No. of observations	$5,911,461$	$5,700,662$	$4,701,653$	$625,501$	$464,006$	$397,150$
Controls	N	Y	N	Y	Y	Y
Omit -5 to 5	N	N	Y	N	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 columns (3) and (6) that report the "donut" results and exclude 5 months around the threshold, we otherwise include 24 months before and 24 months after the cutoff in all specifications. Columns (1) and (4) have no controls, while columns (2) 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) of panel (a), the sample includes all childless women (of age as specified on the x-axis) in July 2006 to November 2019 who have not yet initiated IVF. In columns (4)–(6), we split up the sample by deciles of women's disposable income rank at age 32. Standard errors reported in parentheses are clustered at the individual level.

Appendix

A Sample Construction

Low-intensity treatment (LIT). The following describes the construction of the sample of women who initiate low-intensity treatment (LIT) between July 2006 and November 2019 at ages 16–45 using the Swedish prescription drug claims data. For each month m of drug claims, $m = 2006/07, \ldots, 2019/11$, we carry out the following five steps:

1. We find all women with an LIT drug claim (ATC codes G03GB, L02BA, L02BG, G03GA) in month m.
2. We keep person-year observations for women who are between 16 and 45 years old in the year of month m.
3. We drop all observations for women with a claim for an LIT or an IVF drug (ATC code G03GB, L02BA, L02BG, G03GA, L02AE, H01CA, H01CC) within 1 year (365 days) before the claim in (1).
4. We drop all observations for women with a breast cancer diagnosis (as the main diagnosis, ICD-10 code C50) in inpatient or outpatient records within 2 years (730 days) before the claim in (1). We drop women with chemotherapy or radiation treatment within 6 months (183 days) after the claim in (1)
5. We drop observations for women with a GnRH agonist/antagonist claim (ATC code L02AE, H01CA, H01CC) within 30 days after the claim in (1), including the date of the claim.

For women with more than one record satisfying the algorithm above, we keep the first record and define it as the initiation date.

IVF treatment. The following describes the construction of the sample of women who initiate IVF between July 2006 and November 2019 at ages 16–45. For each month m of drug claims, $m = 2006/07, \ldots, 2019/11$, we carry out the following five steps:

1. We find all women with a GnRH agonist/antagonist claim (ATC code L02AE, H01CA, H01CC) in month m
2. We keep person-year observations for women who are between 16 and 45 years old in the year of month m.
3. We drop all observations for women with a claim for a GnRH agonist/antagonist (ATC code L02AE, H01CA, H01CC) within 1 year (365 days) before the claim in (1).

4. We drop all observations for women with a breast cancer diagnosis (as the main diagnosis, ICD-10 code C50) in inpatient or outpatient records within 2 years (730 days) before the claim in (1). We drop women with chemotherapy or radiation treatment within 6 months (183 days) after the before the claim in (1).
5. We only keep women who used an ovulation drug (ATC code G03GB, L02BA, L02BG, G03GA) within 30 days before/after the claim in (1).

For women with more than one record satisfying the algorithm above, we keep the first record and define it as the initiation date.

Fertility outcomes. To impute conceptions, we combine data from the inpatient and outpatient registers, as well as the birth register. Conceptions can end in a miscarriage, stillbirth, or birth.

To infer conceptions resulting in a miscarriage, we find all abortion diagnoses in the inpatient and outpatient registers (ICD-10 codes O00–O08). If an individual has not initiated IVF or LIT in the 22 weeks before the diagnosis date, we assume the diagnosis happens exactly 12 weeks after conception. If an individual has initiated IVF or LIT within the 22 weeks before the diagnosis, we assume the day of conception coincides with the day of the last LIT/IVF drug claim before the diagnosis.

To infer conceptions resulting in a live birth or stillbirth, we use birth entries from the birth register. Whenever available, we use the estimated date of delivery based on ultrasound examination during pregnancy and subtract 280 days (40 weeks). If the estimate based on ultrasound is not available, we use the estimated date of delivery based on the record of the first day of the last menstrual period and subtract 280 days. If this estimate is not available either, we use the year-month of delivery and subtract 280 days from the last day of that month. We use the birth register definition of stillbirths that includes births where the newborn dies within 27 days.

If the conception in the three years after initiation of fertility treatment does not end in a live birth, we define the conception to be failed and our "Failed" dummy as taking the value of 1, and 0 otherwise.

Drug-based health outcomes. We use the data on prescription drug purchases from July 2005 to December 2019 to define the drug-based outcomes in the event studies of Section 4. For each individual in the sample, we define two indicators at the calendar quarter level. The "mental health Rx" indicator is equal to one if an individual filled a prescription for a drug with an ATC-code starting with N05 (Psycholeptics) or N06 (Psychoanaleptics) *in or before* a calendar quarter and zero otherwise. I.e., the indicator is equal to one if an individual has filled a mental health prescription (which tend to be chronic) anytime since July 2005. The "antiobiotics Rx" indicator is equal to one if an individual filled a prescription (which tend to be acute) for a drug with an ATC-code starting with J01 in a calendar quarter and zero otherwise.

Income measures. Throughout the paper, we use four measures of income:

1. Annual individual work-related income, which is defined as the sum of gross wages from employment (*loneink*) as well as positive net income from active self-employment (*fink* and *inkfnetto*).

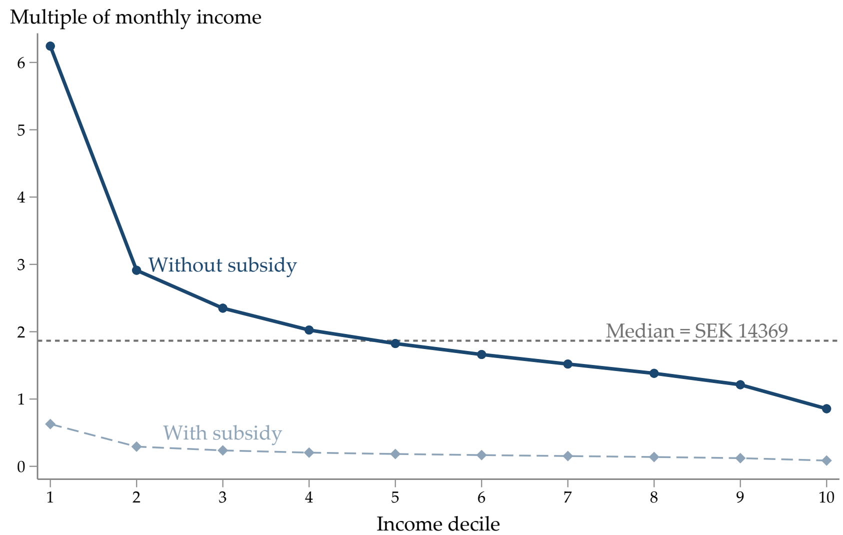
2. Annual individual total (AGI-like) income. This measure is defined similar in spirit to the US adjusted gross income and includes earned labor market income (*forvers*), income from passive business activities (*pasnar*), study-related transfers (*stud*), care allowances (*vardbidr* and *komvardbidr*) as well as parental leave (*forpeng*), transfers due to unemployment and other labor market policies (*arblos* and *ampol*), capital income, and allowances related to military service (*vplers* and *gmuers*). To determine individual total income deciles, we exclude negative and zero incomes and rank incomes within birth cohorts, gender, and calendar year groups.

3. Annual individual disposable income (*dispink*). Disposable income is defined by Statistics Sweden as salary net of social security contributions plus other incomes (such as business income, capital income, and rental incomes) and received taxable and tax-free transfers (e.g., student grants, care allowances, housing benefits, and sickness benefits) minus taxes and other paid transfers (such as student loan payments or pension savings).

4. Annual parental total (AGI-like) income. Total (AGI-like) income is defined as described above. To calculate parental income percentiles, we exclude negative and zero values and find an individual's father's and mother's income at ages 20 and 21 of the individual. We then pool the income over both parents and years and rank it within birth cohorts (of the child).

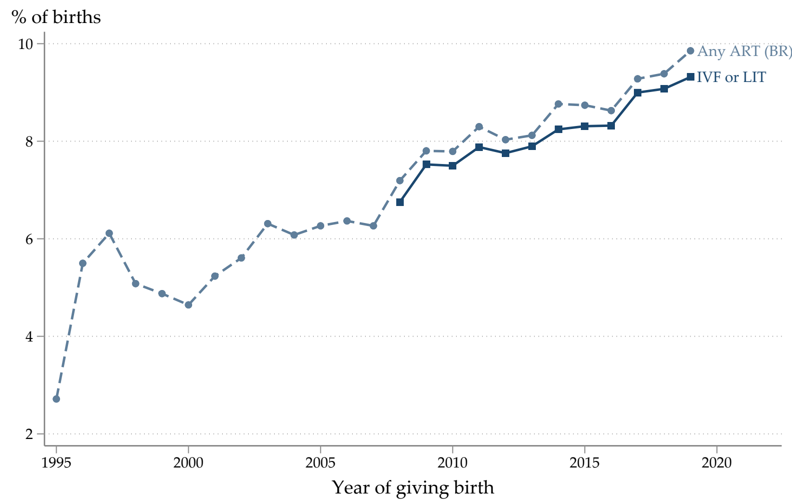
B Additional Tables and Figures

Figure A1: **Cost of One Cycle of IVF in Monthly Disposable Incomes**



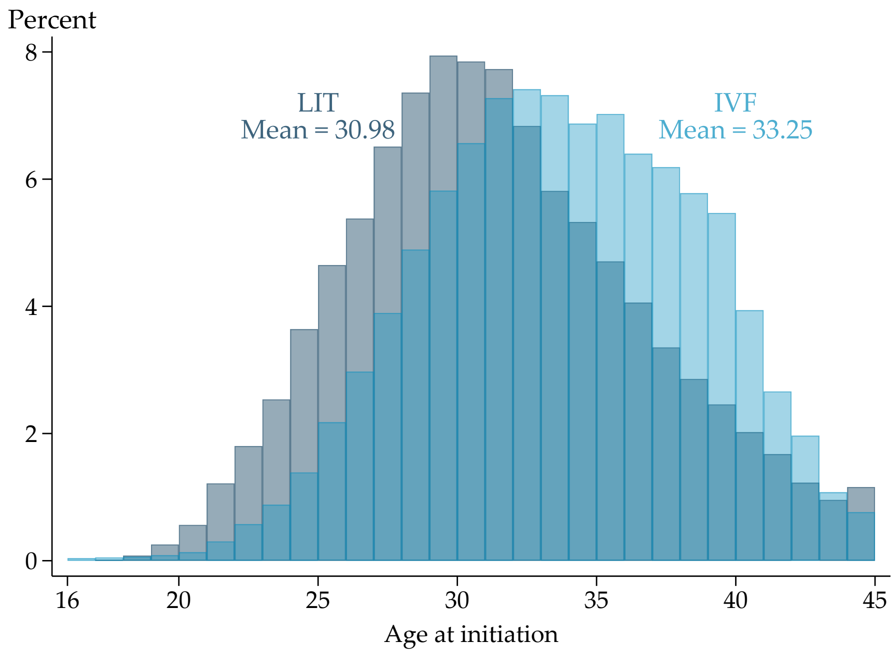
Notes: The figure shows the cost of an IVF cycle with and without health insurance coverage ("subsidy") in 2010 divided by monthly disposable income at age 32 (in 2010 SEK) at each income decile for women in the regression discontinuity sample. This is the sample of women characterized in column (5) of Table 1. The x-axis is equivalent to the x-axis in Figure 9. The market price of a single cycle of IVF in Sweden in 2010 (which is the numerator of the solid line) was about 26,813 SEK ($3,246 in 2022 USD). This is the average price of one IVF cycle is as reported by eight clinics in Sweden. Data on prices was collected for 2010 using the web.archive.org website snapshots. When a woman is eligible for insurance coverage, the out of pocket cost of IVF was at most 2,700 SEK in 2010 (which is the numerator of the dashed line). This is the sum of maximum co-pays for prescription drugs and office visits within the public insurance system.

Figure A2: **The Share of First Births with Assisted Conception**



Notes: The figure shows the share of first births (in %) from pregnancies that used Assisted Reproductive Technologies (ART) among women aged 16 through 45 at the time of birth. The dashed line uses data from the Medical Birth Records (BR), which includes flags for ART utilization starting in 1995. The solid line uses the prescription drug-based measures of high- and low-intensity infertility treatments (IVF and LIT) developed in this paper. See Appendix A for detailed definitions of LIT and IVF. The drug-based measure of LIT or IVF is available from July 2006 onwards. In the solid blue line the figure plots the share of births that happened within one year of doing either LIT or IVF.

Figure A3: **Age at ART Initiation**

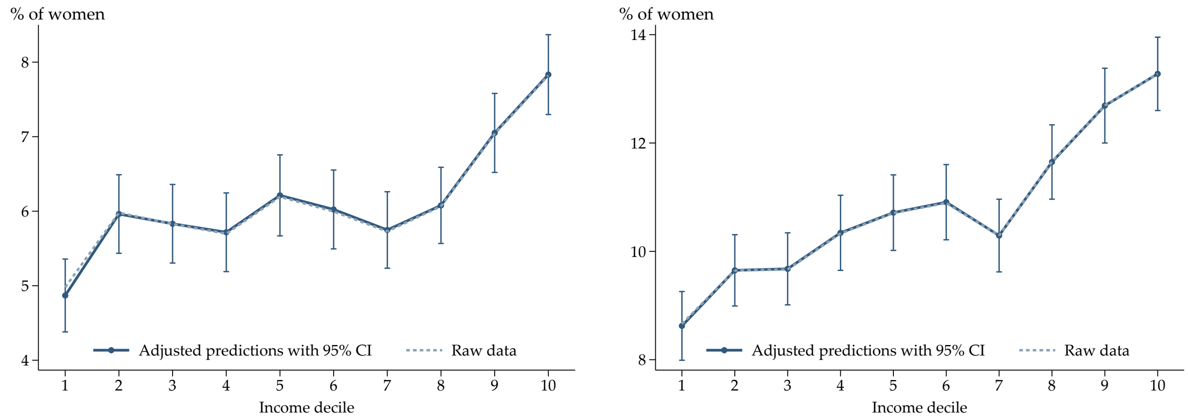


Notes: The figure shows the distribution of age at which women initiate either low-intensity (LIT) or high-intensity (IVF) infertility treatment. The sample includes the universe of childless women aged 16–45 who initiate low-intensity treatment (LIT, gray bars) or IVF (blue bars) in our primary analytic "initiators" sample. The sample of this women is characterized in column (2) of Table 1.

Figure A4: **Income Gradient in ART Use: LIT and IVF (Cohorts 1970–1975)**

(a) Ever using LIT

(b) Ever using IVF

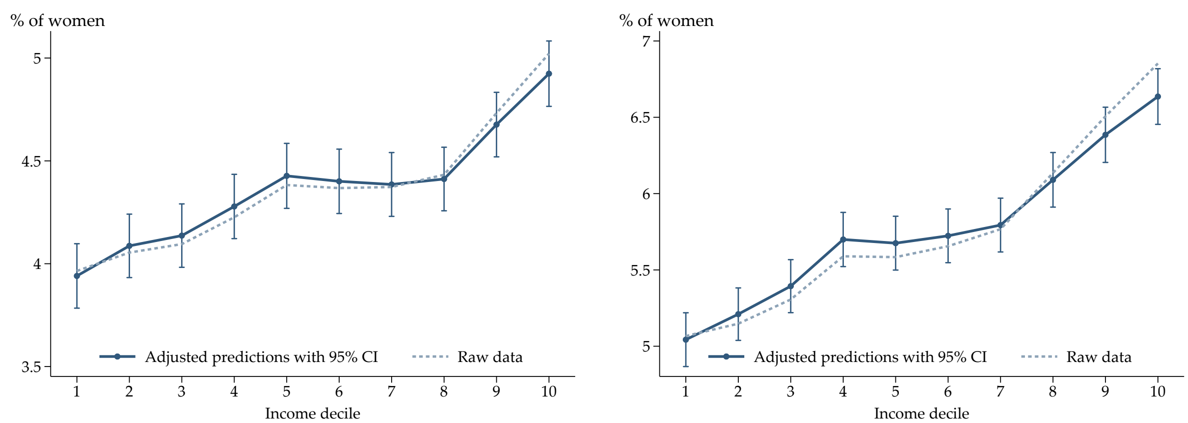


Notes: This figure replicates panel (a) of Figure 4, separately for low-intensity (LIT) and high-intensity (IVF) treatment. We plot the share of women who ever initiate LIT (panel a) or IVF (panel b) between July 2006 and December 2019. The sample includes all women born from 1970 through 1975 (women whom we observe in our drug records over a large share of their fertile ages) who are childless in June 2006. Income deciles (x-axis) are based on parental income at women's age 20/21 as described in Appendix A. Dashed lines in both panels show the raw data and solid lines show adjusted predictions after controlling for place and year of birth fixed effects. Predicted values plotted with 95% CIs are adjusted means of the outcome for each income decile at the mean of all other covariates.

Figure A5: **Income Gradient in ART Use: LIT and IVF (Cohorts 1970–1990)**

(a) Ever using LIT

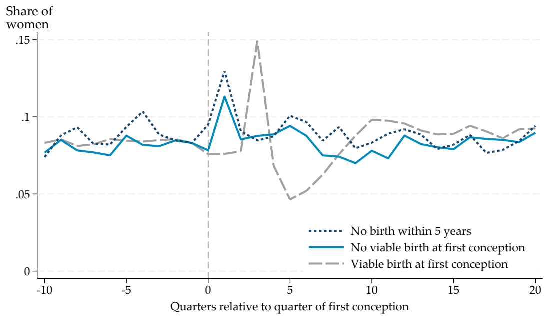
(b) Ever using IVF



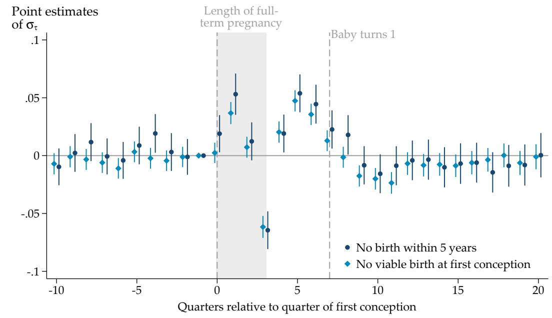
Notes: This figure replicates panel (a) of Figure 4, separately for low-intensity (LIT) and high-intensity (IVF) treatment, for a different set of cohorts. We plot the share of women who ever initiate LIT (panel a) or IVF (panel b) between July 2006 and December 2019. The sample includes all women born from 1970 through 1990 who are childless in June 2006. Income deciles (x-axis) are based on parental income at women's age 20/21 as described in Appendix A. Dashed lines in both panels show the raw data and solid lines show adjusted predictions after controlling for region and year of birth fixed effects. Predicted values plotted with 95% CIs are adjusted means of the outcome for each income decile at the mean of all other covariates.

Figure A6: **First Assisted Conception and Subsequent Consumption of Antibiotics**

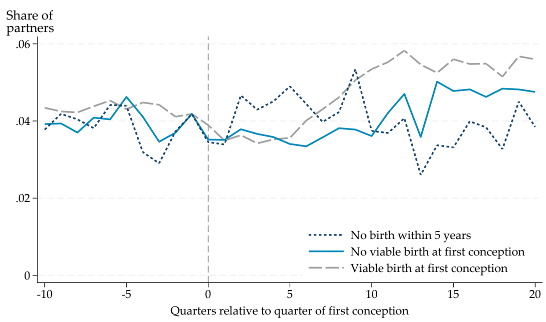
(a) Women, raw data



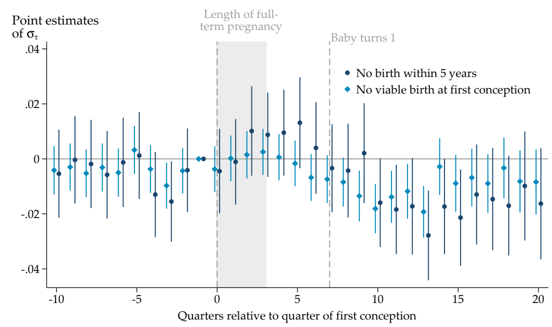
(b) Women, event study



(c) Partners, raw data



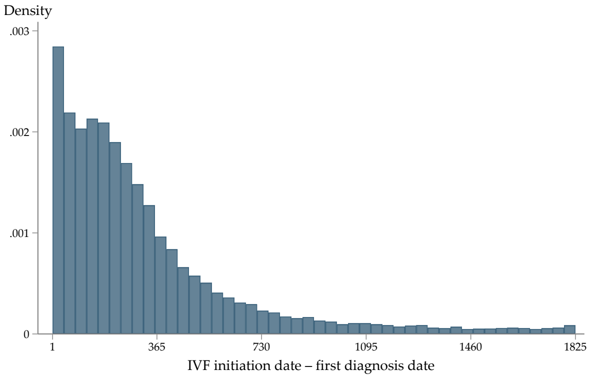
(d) Partners, event study



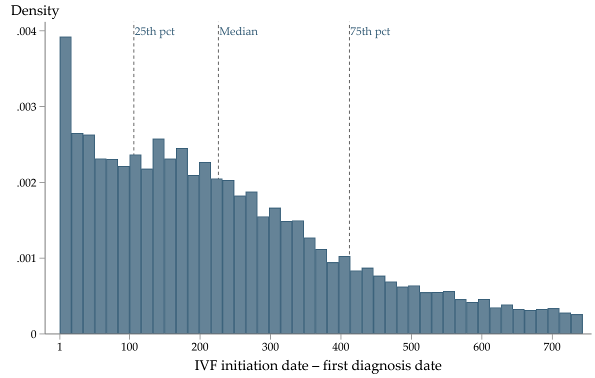
Notes: The figure shows raw data (panels on the left, normalized to the mean in time −1) and event study estimates as specified in Equation (1) (panels on the right) for the effect of having an unsuccessful first conception (which predicts persistent infertility, see Figure 5) on the consumption of antibiotics by women and their partners. The sample includes childless women who initiate LIT or IVF treatments between July 2006 and February 2016. The characteristics of this sample of women are reported in Column (4) of Table 1. The x-axis indexes time relative to the first conception in either quarters (panels a–b) or years (panels c–f), which is defined as the first conception after treatment initiation. The outcome in all panels is an indicator for filling an antibiotics prescription (ATC code: J01). Event study panels show the results of two separate event studies. The control group in both are those women whose first assisted conception resulted in a live birth (long dashed gray line in the raw data). We provide estimates for two treatment groups: (i) for all women whose first conception was not successful (solid line in the raw data; light blue estimates) and (ii) for a subset of (i) where no birth happens within 5 years of that conception, i.e., those couples who remain infertile in the longer-run (short-dashed line in the raw data; dark blue estimates). Vertical lines in the event studies denote 95% confidence intervals. Standard errors are clustered at the individual level.

Figure A7: **Time from an Infertility Diagnosis to IVF Initiation**

(a) Distribution of wait time

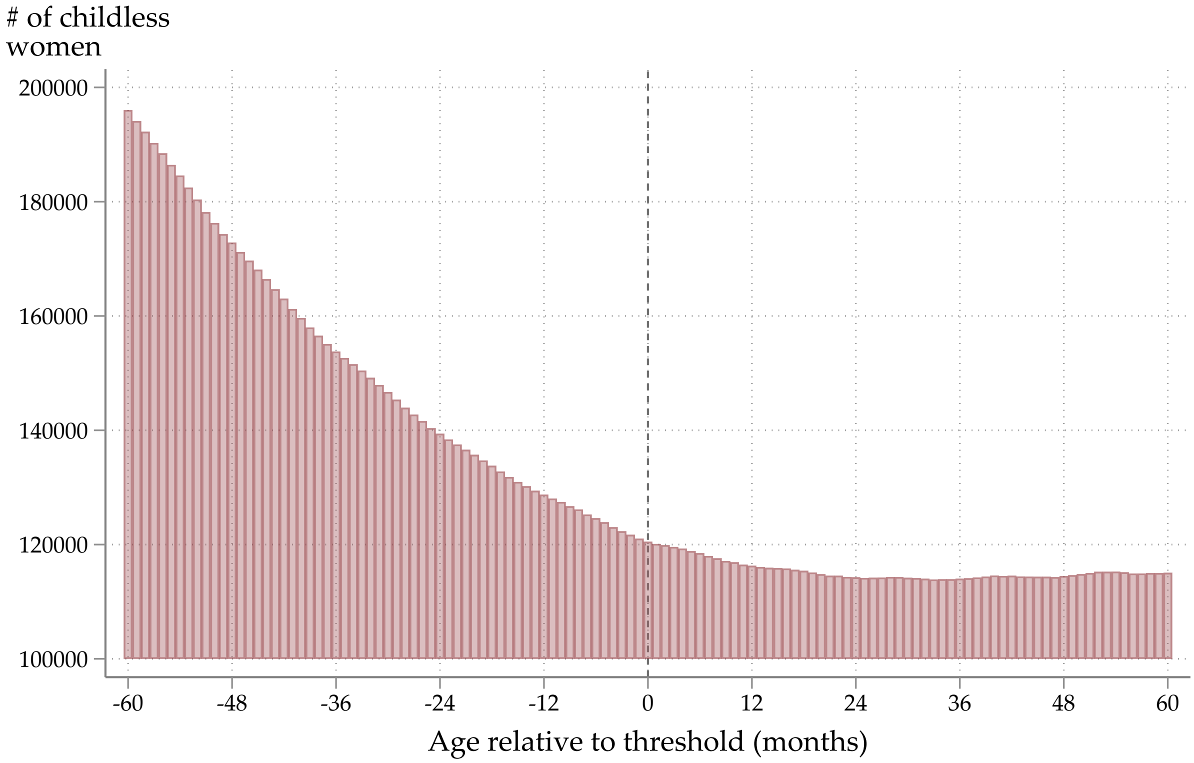


(b) Panel (a) cut at the 90th percentile



Notes: These figures illustrates the time between an individual's infertility (ICD-10 code N97) diagnosis and initiation of high-intensity treatment (IVF) in days. The sample includes a subset of the "initiator" sample (column 2 of Table 1) that is restricted to childless women age 16–45 who initiate IVF between 2006 and 2019 and who had an infertility diagnosis in the 5 years before IVF initiation. "First diagnosis date" refers to the earliest diagnosis within 5 years before IVF initiation excluding the day of IVF initiation. Panel (b) drops the top 10% of wait times and displays a zoomed in version of panel (a).

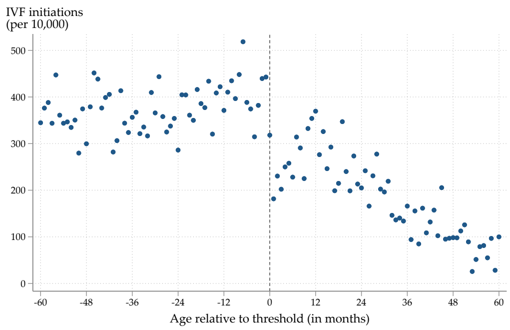
Figure A8: **Density of Observations in the Regression Discontinuity Sample**



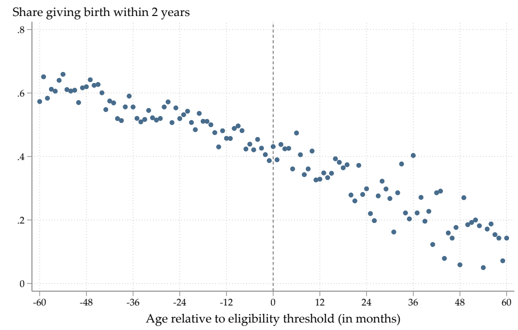
Notes: The figure shows the number of women in the regression discontinuity sample that underlies Figure 8, by a woman's age in months relative to the IVF insurance eligibility cutoff age. The characteristics of the sample are reported in Columns (5) of Table 1. These women are the age-based subset of all age 16–45 childless women in 2006–2019 who have not initiated IVF treatment by a given relative month. A formal test that uses the number of individuals as the dependent variable as the outcome in an RDD specification restricted to 24 months around the cutoff (as in Table 3), results in the following estimates (and standard errors): 196.08 (231.11) for a linear polynomial and 106.24 (152.69) for the quadratic polynomial.

Figure A9: **Impact of IVF Insurance Coverage: Additional Analyses**

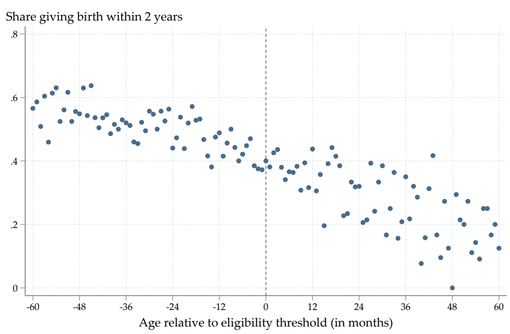
(a) IVF initiation conditional on LIT



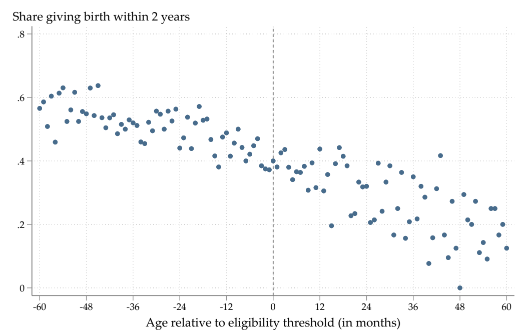
(b) Share of IVF initiators giving birth



(c) Panel (b), below-median income

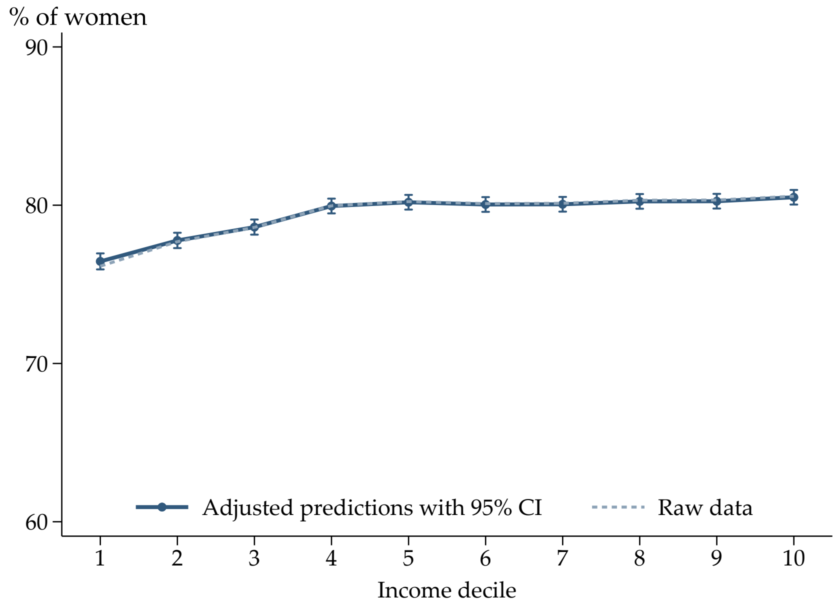


(d) Panel (b), above-median income



Notes: This figure presents additional analyses on the effects of public health insurance coverage of IVF. The x-axis in both panels indexes a woman's age in months relative to the insurance eligibility cutoff age, which is specific to the woman's region of residence and year. Panel (a) shows the number of women initiating IVF per 10,000 women in the sample of childless women who are within five years of the insurance age eligibility cutoff and have not initiated an IVF treatment yet by a given month, but in comparison to the similar panel (a) in Figure 8, this figure is restricted to women who have undergone LIT within two years prior to a given month. The characteristics of this sample of women are reported in Column (6) of Table 1; these women are the age-based subset of all age 16–45 childless women in years 2006–2019 who had undergone LIT within two years prior to a given relative month. Panel (b) shows the share of women giving birth within two years of IVF initiation in the sample of childless women who are within five years of the insurance age eligibility cutoff and who have initiated an IVF treatment in a given relative month - this corresponds to the ratio of the gray bar and the dark blue bar in Figure 8 panel (b). Panels (c) and (d) show this share for the sub-samples of women with below-median and above-median disposable income at age 32. Individuals' dates of birth are at the year-month level, thus in month 0 they can be either eligible or not, depending on their exact day of birth. Running an RD-style regression of the share shown in panel (b) on relative age ($a - A$), an indicator for age being above the cutoff ($a > A$), and an interaction between the two yields an estimate of -0.004 (p-value 0.74) on the indicator for being on right side of the cutoff. Analogous estimates for the samples in (c) and (d) are 0.008 (p-value 0.68) and -0.024 (p-value 0.22).

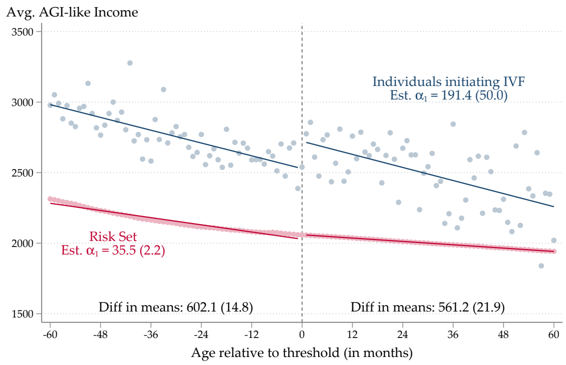
Figure A10: **Share of Women with a Non-ART Child**



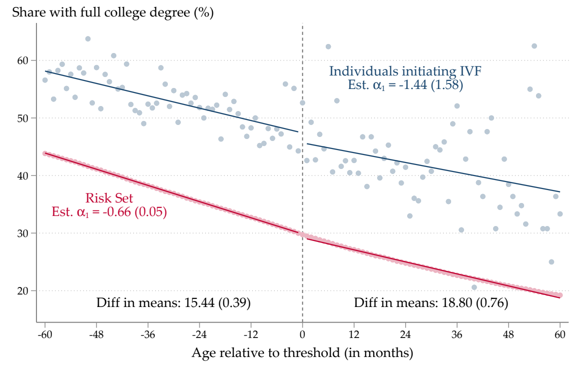
Notes: The figure shows the share of women who have given birth without the use of ARTs between 1995 and 2019. We use the Medical Birth Register to flag non-ART births. The sample includes all women born between 1970–1975 that are observed in our raw data (i.e., these estimates are not restricted to being childless in any year). Income deciles are based on total parental income measured as described in Appendix A.

Figure A11: **Observable Characteristics and IVF Insurance Coverage**

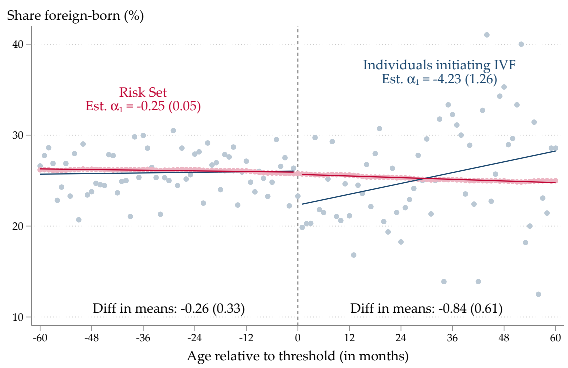
(a) AGI income



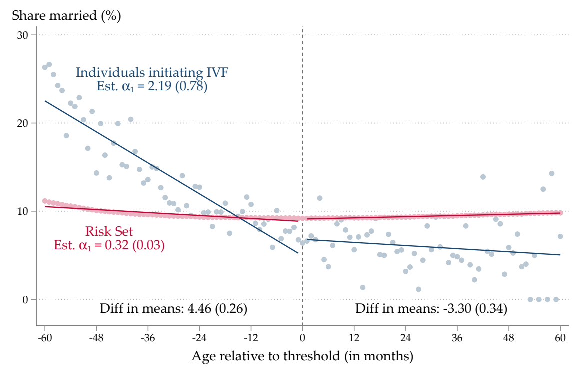
(b) College degree



(c) Foreign-born



(d) Being married



Notes: The figure shows the average of four observable charactersitics of women around the change in IVF insurance coverage eligibility. The x-axis indexes a woman's age in months relative to the insurance eligibility cutoff age, which is specific to the woman's region of residence and year. The y-axis measures average income (panel a), share of women with a college degree (panel b), share of foreign-born women (panel c), and the share of women who are married (panel d) for each relative month. All characteristics are measured at age 32. We report these covariate means for two samples of women. In red, we include all women in the regression discontinuity sample (age 16–45 childless women in years 2006–2019) who haven't yet initiated an IVF treatment or given birth and are thus "at risk" of initiating treatment. The blue dots and lines report the same means for women out of those "at risk" who initiate IVF in a given relative month. "Est α_1" reports the coefficient from estimating (2) with the covariate at age 32 as the outcome. "Diff in means" reports the difference in the level of the mean covariate between the red and the blue lines (i.e., between those at risk of initiating IVF and those who do initiate), separately for relative months -60 to -1 and 1 to 60.

Table A1: **Age Cutoffs for IVF Insurance Coverage**

Region	2008	2009	2010	2011	2012	2013	2014	2015-
Stockholm	39	39	39	39	39	39	39	39
Uppsala	39	39	39	39	39	39	39	39
Sörmland	37	37	37	37	37	37	37	39
Östergötland	37	37	37	37	37	37	37	39
Jönköping	37	37	37	37	37	37	37	39
Kronoberg	38	38	38	38	38	38	38	39
Kalmar	37	37	37	37	37	37	37	39
Gotland	39	39	39	39	39	39	39	39
Blekinge	38	38	38	38	38	38	38	39
Skåne	38	38	38	38	38	38	38	39
Halland	38	38	38	38	38	38	38	39
Västra Götaland	39	39	39	39	39	39	39	39
Värmland	39	39	39	39	39	39	39	39
Örebro	39	39	39	39	39	39	39	39
Västmanland	39	39	39	39	39	39	39	39
Dalarna	39	39	39	39	39	39	39	39
Gävleborg	38	38	38	38	38	38	38	39
Västernorrland	36	36	36	36	36	36	36	39
Jämtland	36	36	36	36	36	36	36	39
Västerbotten	36	36	36	36	36	36	39	39
Norrbotten	36	36	36	36	36	36	36	39

Notes: The table shows the maximum age at which women were eligible for public health insurance coverage of IVF treatments in Sweden from 2008 onwards for each of 21 Swedish regions. The data is based on government reports, media coverage, and email correspondences with region representatives.

Sources:

Riksförbundet för sexuell upplysning (RFSU). "Sverigebarometern 2011." Accessed March 21, 2024. rfsu.se/globalassets/pdf/sverigebarometer-2011.pdf

Sveriges Kommuner och Landsting (SKL). "Assisterad befruktning Kartläggning och Landstingens Erbjudanded November 2012 - Version 2".

Sveriges Kommuner och Landsting (SKL). "Assisterad befruktning uppföljningsrapport med definitioner, rekommendationer och utvevcklingsområden - Maj 2014 Version 2." Accessed March 21, 2024. skr.se/download/18.1f376ad3177c89481f73e1af/1615204927279/SKL$_$assisterad$_$befruktning$_$uppfoljningsrapport$_$052014.pdf

Sveriges Kommuner och Regioner. "Rekommendation om enhetlighet i regionernas erbjudande av offentlig finansierad assisterad befruktning". Accessed March 21, 2024. skr.se/download/18.32563d7d1784aa279ecac6bb/1618304676440/Rekommendation-assisterad%20befruktning-ver2-nov2020.pdf

Sveriges Television (SVT). "Generösare regler för IVF-behandling på gång." Accessed March 21, 2024. svt.se/nyheter/lokalt/ost/hojda-aldersgranser-for-ivf-behandling-i-sormland-och-ostergotland

Sveriges Television (SVT). ""För gammal för barn" – lille Bore bevisar motsatsen". Accessed March 21, 2024. svt.se/nyheter/lokalt/ost/ansags-for-gammal-for-att-kunna-bli-gravid-lilla-bore-bevisar-motsatsen

Sveriges Television (SVT). "Vill se samma regler för assisterad befruktning". Accessed March 21, 2024. svt.se/nyheter/lokalt/vastmanland/enhetliga-regler-for-assisterad-befruktning

Sveriges Television (SVT). "Åldergränserna för IVF är orättvisa" Accessed March 21, 2024. svt.se/nyheter/lokalt/ost/aldergranserna-for-ivf-ar-orattvisa

Sundsvalls Tidning. "Hårda regler i länet för provrörsbefruktning". Accessed March 21, 2024. st.nu/artikel/harda-regler-i-lanet-for-provrorsbefruktning

Gefle Dagblad. "Åldersgränsen höjs för IVF".

Kvinnoklinikerna i Sydöstra sjukvårdsregionen. "Assisterad befruktning. Gemensamma regler och grundkrav för IVF i Sydöstra sjukvårdsregionen".

Södra regionsvårdsnämnden. "Rekommendation om enlighet i landstingens och regionernas erbjudande av offentligt finansierad assisterad befruktning."

Region Skåne. "Regionala riktlinjer för assisterad befruktning."

Table A2: **Event Study Sample Composition**

Initiating ART between 07/2006 and 02/2016 $N = 56,822$			
Conception within 3 years $N = 43,165$			No conception within 3 years $N = 13,657$
1st conception $\not\Rightarrow$ viable birth $N = 8,710$		1st conception $\Rightarrow$ viable birth $N = 34,455$	
Birth within 5 years $N = 6,443$	No birth within 5 years $N = 2,267$		

Table A3: **Regression Discontinuity Estimates: LIT Sample**

	(1)	(2)	(3)
$\hat{\beta}_1$	-167.1^{***}	-168.0^{***}	-136.8^{***}
	(26.5)	(26.7)	(43.0)
Mean dep. var			
overall	336.6	339.5	343.2
in $\tau = -12$ to $\tau = -1$	410.0	414.2	410
No. of observations	72,733	71,900	58,425
Controls	N	Y	N
Omit -5 to 5	N	N	Y

Notes: This table is similar to Table 3 and shows the results of estimating a linear parametric regression discontinuity specification in Equation (2), with IVF initiation as the outcome variable. Unlike in Table 3, the sample is restricted to all childless women (of age as specified on the x-axis) in July 2006 to November 2019 who have not yet initiated IVF, and who also have a history of an LIT treatment in two years prior. 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) and that reports the "donut" results and exclude 5 months around the threshold, we otherwise include 24 months before and 24 months after the cutoff. Column (1) has no controls, while column (2) includes the full set of controls (fixed effects for the region of residence, calendar years, whether the individual is foreign-born, and education categories (high school only, some college, college degree or more). Standard errors reported in parentheses are clustered at the individual level.

C Alternative Event Study Specifications

In this section, we estimate a version of our event study specification on the sample of all women who initiate LIT or IVF between July 2006 and February 2016 irrespective of whether they conceive or not. Specifically, we estimate

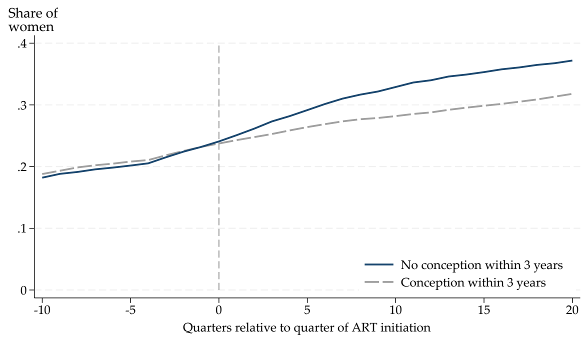
$$Y_{it} = \alpha_i + \sum_{\tau} \kappa_\tau D_{\tau,it} + \sum_{\tau} \sigma_\tau D_{\tau,it} * \text{No conception}_i + \gamma_t + \beta * \mathbf{X}_{it} + \epsilon_{it} \tag{3}$$

where No conception$_i$ is equal to 1 if individual i does not conceive within 3 years of treatment initiation and 0 otherwise.

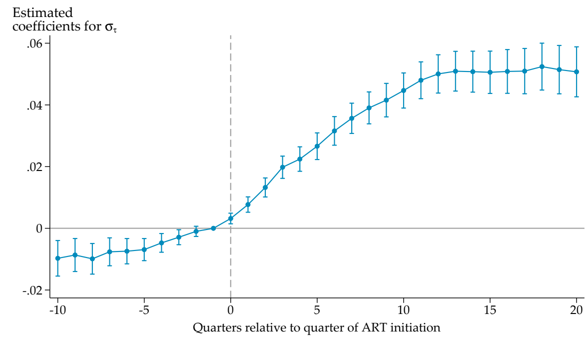
In Figure A12, we include all individuals who conceive and those who do not conceive. In Figure A13, we restrict our analysis to the subset of women who conceive and whose first conception leads to a viable birth and those who do not conceive. The latter specification thus excludes women who experience a miscarriage. Table A2 shows the observation counts in these different groups.

Figure A12: **Event Study Estimates (No Conception vs Conception)**

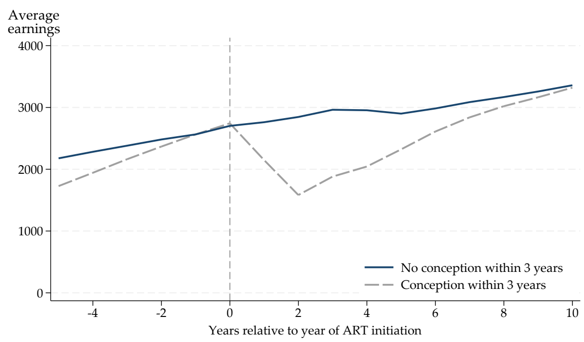
(a) Mental health R_x, raw data



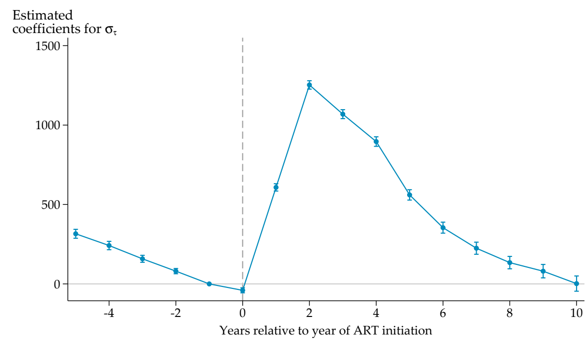
(b) Mental health R_x, event study



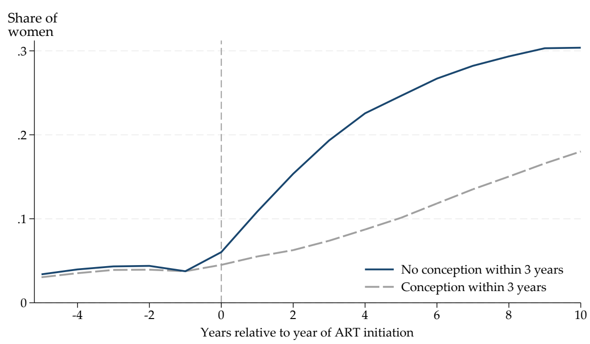
(c) Work income, raw data



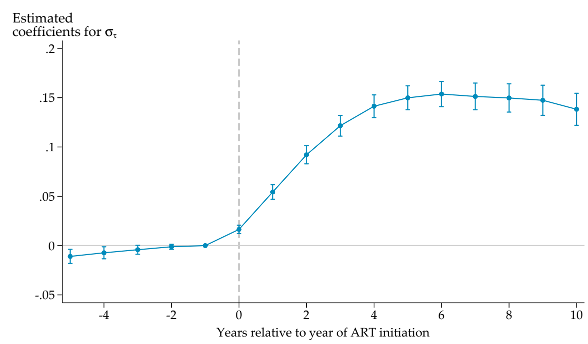
(d) Work income, event study



(e) Divorce, raw data



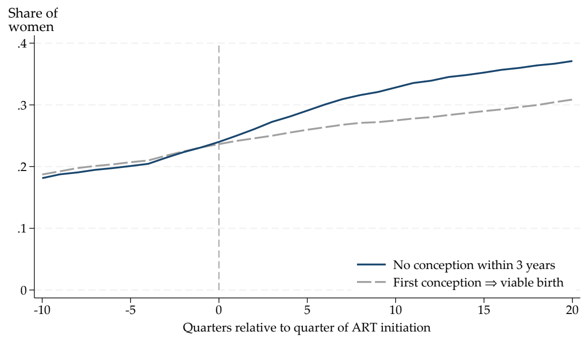
(f) Divorce, event study



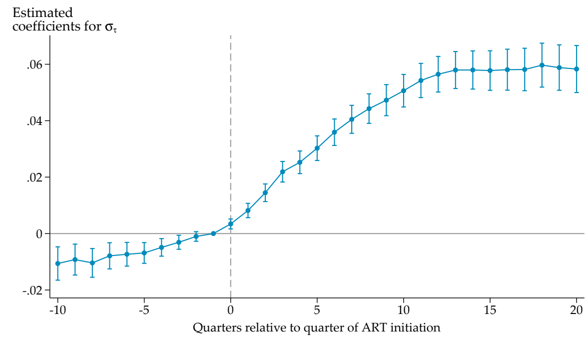
Notes: The figure shows raw data (panels on the left, normalized to the mean in time −1) and event study estimates as specified in Equation (1) (panels on the right) for the effect of having no conception within 3 years of an ART treatment initiation on outcomes of women. The sample includes childless women who initiate LIT or IVF treatments between July 2006 and February 2016. The x-axis indexes time relative to treatment initiation in either quarters (panels a–b) or years (panels c–f). The outcome in panels (a) and (b) is a stock measure for having a history of drug claims with ATC codes N05 (psycholeptics, commonly used to treat anxiety) or N06 (analeptics, commonly used to treat depression). In panels (c) and (d) the outcome is annual individual work income in 100 SEK. In panels (e) and (f) the outcome is the history of a divorce. Vertical lines in the event studies denote 95% confidence intervals. Standard errors are clustered at the individual level.

Figure A13: **Event Study Estimates (No Conception vs. "Successful" Conception)**

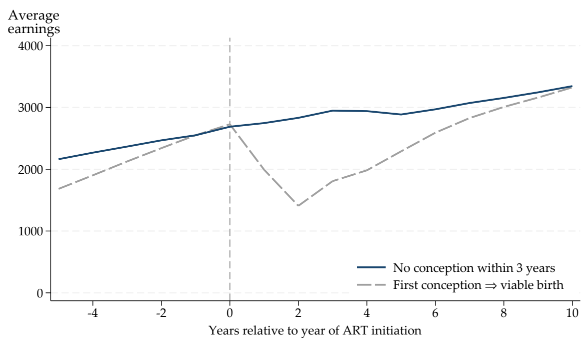
(a) Mental health R_x, raw data



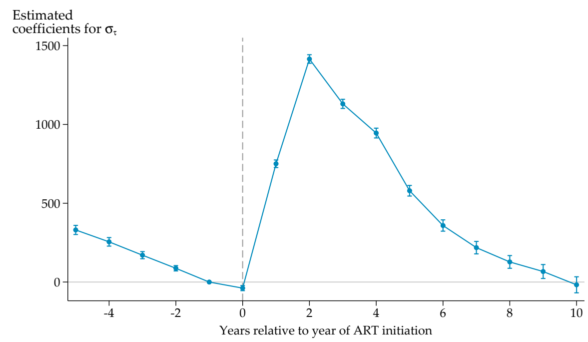
(b) Mental health R_x, event study



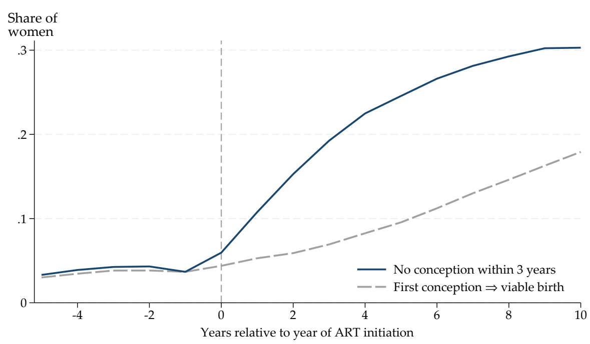
(c) Work income, raw data



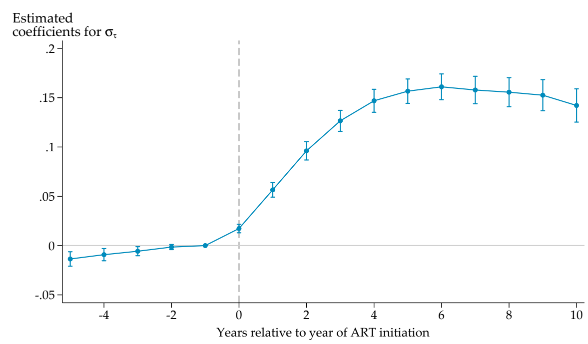
(d) Work income, event study



(e) Divorce, raw data



(f) Divorce, event study



Notes: The figure shows raw data (panels on the left, normalized to the mean in time -1) and event study estimates as specified in Equation (1) (panels on the right) for the effect of having no conception within 3 years of an ART treatment initiation on outcomes of women. The sample includes childless women who initiate LIT or IVF treatments between July 2006 and February 2016 and who do not experience a miscarriage (i.e., the control group only includes women whose conceptions are successful). The x-axis indexes time relative to treatment initiation in either quarters (panels a–b) or years (panels c–f). The outcome in panels (a) and (b) is a stock measure for having a history of drug claims with ATC codes N05 (psycholeptics, commonly used to treat anxiety) or N06 (analeptics, commonly used to treat depression). In panels (c) and (d) the outcome is annual individual work income in 100 SEK. In panels (e) and (f) the outcome is the history of a divorce. Vertical lines in the event studies denote 95% confidence intervals. Standard errors are clustered at the individual level.